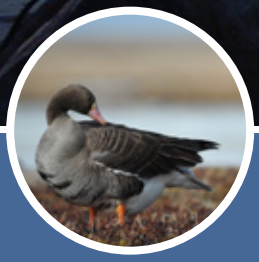

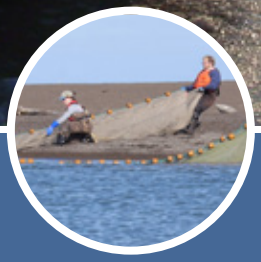

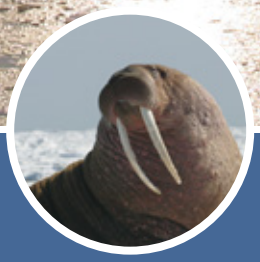

2015

North Slope Science Initiative

Report to Congress

North Slope Science Initiative
ALASKA

http://northslope.org

Scope, Mission and Vision

The North Slope Science Initiative (NSSI) was developed by local, state and federal governments with trust responsibilities for land and ocean management, to facilitate and improve collection and dissemination of Arctic ecosystem information pertaining to Alaska's North Slope region, including coastal and offshore regions. The ***mission*** of the NSSI is to improve scientific and regulatory understanding of terrestrial, aquatic and marine ecosystems for consideration in the context of resource development activities and climate change. The ***vision*** of the NSSI is to identify the data and information management agencies and governments will need in the future to develop management scenarios using the best information and mitigation to conserve the environments of the North Slope. The NSSI adopts a strategic framework to provide resource managers with the data and analyses they need to help evaluate multiple simultaneous goals and objectives related to each agency's mission on the North Slope and its adjacent seas. The NSSI uses and complements the information produced under other science programs, both internal and external. The NSSI also facilitates information sharing among agencies, non-governmental organizations, industry, academia, international programs and members of the public to increase communication and reduce redundancy among science programs.

2005 Legal Mandate

Under the provisions of the Energy Policy Act of 2005 (PL 109-58), an annual report is due from the Secretary of the Interior. This report describes NSSI's background, scope, mission, vision, objectives, administrative structure, and accomplishments, and outlines future directions based on identified issues on the North Slope and adjacent seas.

Credits

Dennis R. Lassuy, Ph.D., NSSI Deputy Director, John F. Payne, Ph.D., NSSI Executive Director, and the NSSI Oversight Group are the principal authors of this report, with input from the NSSI Science Technical Advisory Panel and Senior Staff Committee.

2015 Report to Congress

North Slope Science Initiative

Executive Summary

With U.S. assumption of the Chair of the Arctic Council the level of involvement by the North Slope Science Initiative (NSSI) and its member agencies in Arctic forums and cooperative Arctic activities has increased sharply. As the President's recent visit to Arctic Alaska highlighted, the nation is finally realizing that important events are happening in the Arctic that matter to them, and that it is Alaska that makes us an Arctic nation.

Senator Lisa Murkowski (R-AK) recently convened a unique event called, "Arctic Transformation: Understanding Arctic Research and the Vital Role of Science." At that event, Senator Angus King (I-ME), Senator Murkowski's Co-Chair for the Senate Arctic Caucus, noted that "This is all about science … if we don't have good science, we can't make good policy." The North Slope Science Initiative, as the only statutorily established science coordination forum whose structure is fully consistent with an Integrated Arctic Management approach in the U.S. Arctic (Clement et al. 2013), is uniquely positioned to facilitate the collaborative identification of science priorities.

USGS scientists Gene Ellis and Gary Clow measure permafrost temperature on North Slope. (USGS)

Executive Summary (Continued)

In very real economic and ecological ways, the state, the nation and the globe benefit from both the ecological and energy riches of the North Slope. For example, the life cycles of migratory species from distant lands and seas are inextricably connected to the ecosystems of the North Slope and its adjacent seas. After a period of feeding and growth and raising their young, these species return to those distant lands and seas having benefited from the relative health of our northern landscapes. Yet these same North Slope landscapes support oil and gas production that contributes heavily to the state's general fund revenue and Prudhoe Bay remains America's largest oil field. North Slope ecosystems also receive inputs from distant sources, both in the form of benefits such as harvestable migratory species and in the form of threats such as chemical and biological pollutants. The condition and continuity of all of these systems, on land, sea and ice are essential to Iñupiat culture and food security.

To better prepare themselves to meet unparalleled challenges and opportunities for partnered science and service, a group of federal, state, local and Alaska Native resource managers collectively formed the NSSI in 2001 and it was formally authorized under the Energy Policy Act of 2005 (Section 348). Since its formation, the NSSI has helped increase collaboration and coordination among its members and with industry, academia, non-governmental organizations, the public, and the whole of the Arctic community in a manner intended to better inform management decisions. This report to Congress briefly outlines the formation and organization of the NSSI and highlights its 2015 accomplishments. In fiscal year 2015, the NSSI with the help of our Science Technical Advisory Panel made significant progress in several areas:

- **Progress on Emerging Issue Summary Recommendations:** The 2010 NSSI Report to Congress highlighted the recommendations of a series of "Emerging Issue Summaries" prepared by our Science Technical Advisory Panel (STAP). Covered topics ranged from ecosystem level aspects such as fire regime and vegetation change, to physical factors like weather and climate, permafrost, hydrology, erosion, and coastal salinization to focal species such as marine mammals, caribou, and fish, and mitigative measures like tundra rehabilitation. In this year's Report to Congress we review what progress has been made in addressing those recommendations.
- **Energy and Resource Development Scenarios:** In 2014, the NSSI initiated a Scenarios Project to help identify plausible energy and resource development futures for the North Slope and adjacent seas to help inform future investment in appropriately targeted research and monitoring. The project is designed around a series of three workshops, the first to help identify plausible energy and resource development scenarios; the second to identify the plausible implications of those scenarios; and the third to translate those implications into the research and monitoring that may be needed to understand and manage the implications of the identified scenarios. The first two workshops are reviewed in this Report to Congress and the third will occur in FY16.

Executive Summary (Continued)

- **Data Management:** The NSSI, in partnership with the University of Alaska – Geophysical Institute, continued the development and updating of its North Slope Science Catalog (http://catalog.northslope.org). This NSSI-based tool is used extensively by the STAP (for example, in reviewing long-term monitoring needs); helps implement the guidance of the Alaska Data Integration Working Group; and is increasingly being leveraged to enhance other large data-intensive efforts like the National Science Foundation's Experimental Program to Stimulate Competitive Research and NASA's Arctic-Boreal Vulnerability Experiment.
- **Outreach and Communication:** With increased focus on the Arctic related to the U.S. Chairmanship of the Arctic Council, NSSI is playing an important role as a conduit for communicating the latest science to inform policy discussions. With that role in mind, the NSSI website http://www.northslope.org was revamped in 2015 to improve its user interface; NSSI visibility was significantly increased through social media activities; and we produced an especially popular NSSI calendar that featured photos of North Slope subsistence activities and species.
- **NSSI Influence on Arctic Monitoring:** The North Slope Science Initiative continues to represent the U.S. as co-lead for the Circumpolar Biodiversity Monitoring Program (CBMP) along with the Kingdom of Denmark. The CBMP seeks to harmonize and enhance Arctic monitoring efforts is to facilitate more rapid detection, communication, and response to significant trends and pressures. At the request of DOI, the NSSI and BLM accepted the challenge of building this Arctic partnership and have now successfully coordinated the marine, freshwater and terrestrial monitoring programs. In the past year, the NSSI, BLM, USGS and Canada began working with the other Arctic Council nations to develop a coastal strategy, the final international monitoring plan under the CBMP.

It is essential for all of the NSSI member organizations, as well as the greater Arctic community, to move forward with well-informed and coordinated inventory, monitoring and research efforts that can serve as a basis for more integrated Arctic management and provide a credible U.S. voice in a whole-of the-Arctic approach. NSSI's effectiveness at fostering this approach was recently noted by the Alaska Natural Heritage Program (http://aknhp.uaa.alaska.edu) when commenting on the relative ease with which they were able to identify a tightly focused set of management questions for their North Slope Rapid Ecoregional Assessment. Dr. Jamie Trammel of AKNHP said it was "absolutely made easier by the solid and long-established relationships that NSSI has created;" that this "speaks to the strength of the existing networks and spirit of cooperation that exists between stakeholders because of the NSSI;" and that this "led to a more robust assessment." To paraphrase Senator King, robust science makes for robust policy.

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Legislative Purpose and Objectives of the North Slope Science Initiative

The NSSI was formally authorized in Section 348, Energy Policy Act of 2005 (Public Law 109-58). The legislative purpose and objectives are stated below:

§(a)(2) The **purpose** of the Initiative shall be to implement efforts to coordinate collection of scientific data that will provide a better understanding of the terrestrial, aquatic, and marine ecosystems of the North Slope of Alaska.

§(b) **Objectives:** To ensure that the Initiative is conducted through a comprehensive science strategy and implementation plan, the Initiative shall, at a minimum—

1. identify and prioritize information needs for inventory, monitoring, and research activities to address the individual and cumulative effects of past, ongoing, and anticipated development activities and environmental change on the North Slope;
2. develop an understanding of information needs for regulatory and land management agencies, local governments, and the public;
3. focus on prioritization of pressing natural resource management and ecosystem information needs, coordination, and cooperation among agencies and organizations;
4. coordinate ongoing and future inventory, monitoring, and research activities to minimize duplication of effort, share financial resources and expertise, and assure the collection of quality information;
5. identify priority needs not addressed by agency science programs in effect on the date of enactment of this Act and develop a funding strategy to meet those needs;
6. provide a consistent approach to high caliber science, including inventory, monitoring, and research;
7. maintain and improve public and agency access to— a. accumulated and ongoing research; and b. contemporary and traditional local knowledge; and
8. ensure through appropriate peer review that the science conducted by participating agencies and organizations is of the highest technical quality.

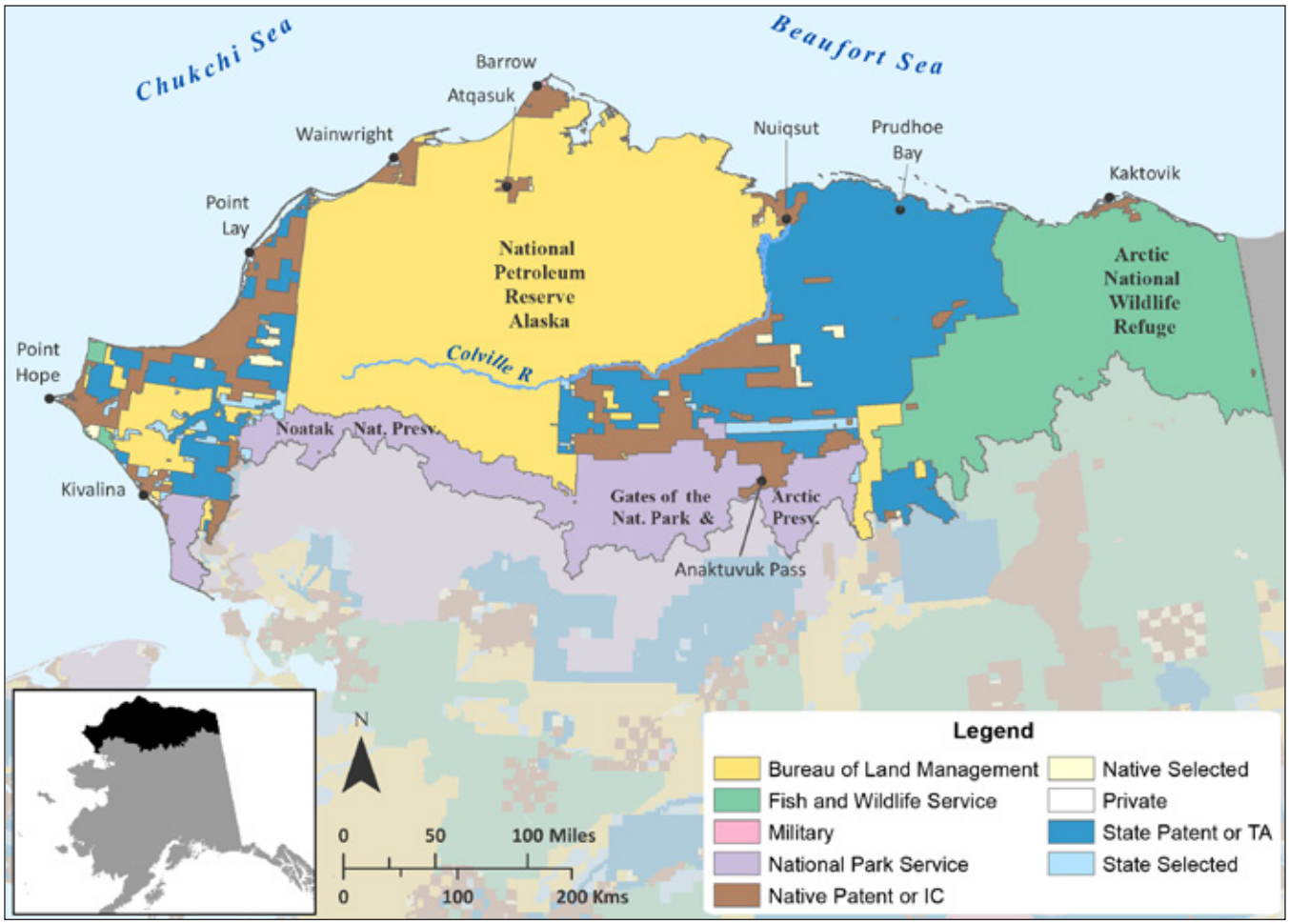
Note: Objectives will be referenced hereafter by (Obj. #).

Background and Need for the North Slope Science Initiative

The North Slope of Alaska is a vast area of the polar Arctic encompassing 231,000 km^2 (89,000 mi^2) on land; with an additional 295,000 km^2 (114,000 mi^2) in the offshore areas of the Chukchi and Beaufort Seas – in total, an area roughly the combined size of all of America's eastern seaboard states from Maine through Virginia. The natural resources of the North Slope are considerable. The area is believed to have some of the largest oil, gas, and coal potential remaining in the United States. The North Slope is also home to an abundant and diverse array of native fish, wildlife, and plant resources that support the vibrant subsistence culture of the Iñupiat people who reside in the area. Balanced and scientifically informed management of fish, wildlife, subsistence, and energy resources continues to be the goal of agencies, Alaska residents, and industry.

The wetland, coastal, and off-shore habitats of the North Slope support a wide variety of important fish and wildlife populations. Over 200 species of birds migrate to the North Slope each summer to nest and raise their young, including hundreds of thousands of waterfowl (e.g., the threatened spectacled and Steller's eiders), shorebirds and many others. These summer visitors migrate to the North Slope from nearly every U.S. state and as far

Spectacled Eider. (USFWS)



North Slope Land Status (information on this map should be used for graphic display only). (AKNHP)

away as South America, Africa, Asia, and Antarctica. Four caribou herds make their home on the North Slope and provide a significant portion of the wild native foods harvested by North Slope residents. Offshore areas provide habitat for a variety of marine mammals, including the polar bear, four species of ice seals, walrus, and several species of whale. Marine mammals comprise over 60 percent of the annual subsistence harvest. Freshwater fishes, particularly several whitefish species (e.g., Aanaakliq, Pikuktuuq, and Qaaktaq) and dolly varden (Iqalukpik), are also an important food source. The North Slope is the largest contiguous region of wetlands within the Arctic (CAVM Team 2003), in large part due to the continuous presence of permafrost beneath the surface.

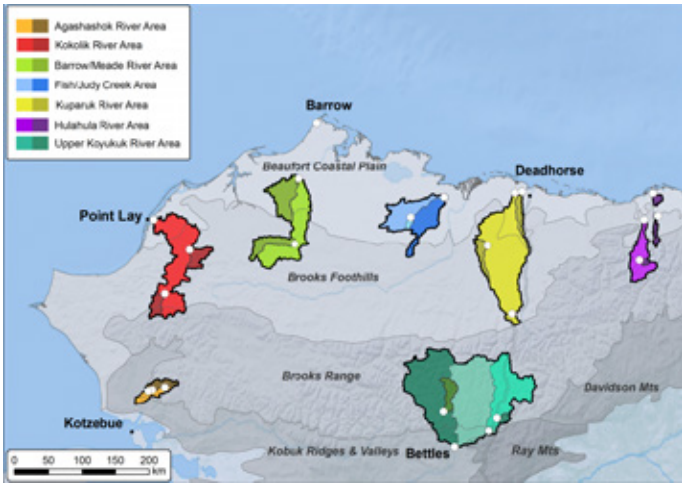
The North Slope, all of which is above the Arctic Circle, is a place where global forces have long been converging. In years past, it was a pathway for the spread of the Inuit culture eastward across Arctic North America. In modern times, whalers followed the bowhead whales into the pack ice; military contractors constructed the network of Distant Early Warning radar stations bringing the first large scale-development to the region; and oil companies developed a large industrial complex. Today the North Slope is a pan-arctic focal point of growing global awareness and is used for observation and assessment of the near- and long-term term impacts of climate change.

All of these resources and their patterns of development are of vital importance, both nationally and internationally and to the residents of the North Slope who depend on them for subsistence and economic well-being. The resources are managed by federal, state, and local governmental agencies to maintain healthy fish and wildlife populations and their habitats in a productive environment. The laws and regulations that govern oil and gas development and protect the environment are among the most stringent in the United States, and Alaska is proud of its track record. Through continued technological improvements, industry has succeeded in reducing the footprint of development while expanding into new areas with directional drilling, targeting oil reservoirs miles from the main drill site. Reserve pits for holding drilling wastes have been replaced by grind and inject facilities which return these materials to the formation underground. Alaska has an impressive record of incorporating new technologies for exploration and development activities to reduce environmental impacts.

Resource managers are seeking ways to adapt to a rapidly changing Arctic environment. Climate change impacts to the Arctic have both regional and global implications and will likely have increasing significant arctic and worldwide environmental and societal consequences (IPCC 2007). These Arctic-wide changes are of such magnitude and rate that there is broad consensus that enhanced, coordinated, and sustained observation, research, and monitoring is vital. The Study of Environmental Arctic Change (SEARCH), along with the International Study of Arctic Change (ISAC), both International Polar Year legacies, have identified three components to adapting to change: observing change, understanding change, and responding to change. The NSSI, with its statutory purpose and management-driven structure, is one of few entities within the larger Arctic science and resource management community that addresses each of these components. As such, the NSSI works within the greater community to move forward to help identify well-planned and coordinated inventory, monitoring, and research strategies.

The NSSI and Other National Initiatives: Putting the Power of Collaboration to Work

Since its authorization by Congress in 2005, the North Slope Science Initiative has continued to engage and collaborate with ongoing or new initiatives that help meet its mission. For example, from 2009 through 2011, the Departments of the Interior (DOI) and Commerce announced separate new national initiatives. On September 14, 2009, the Secretary of the Interior signed Secretarial Order Number 3289, “Addressing the Impacts of Climate Change on America’s Water, Land, and Other Natural and Cultural Resources.” This order established the Climate Change Response Council, chaired by the Secretary, to coordinate activities within and across the bureaus to develop and implement an integrated Departmental strategy for climate change response. Working at the landscape, regional, and national scales through the establishment of DOI Climate Science Centers (CSCs) and Landscape Conservation Cooperatives (LCCs), the Department is defining and implementing a vision that integrates DOI science and management expertise with that of NSSI’s partners, providing available information and best management practices to support strategic adaptation and mitigation efforts on U.S. and international public and private lands. This vision is consistent with and advanced by the 2013 Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*. In combination, these Secretarial and Executive Orders support and leverage individual bureau missions while creating synergies with



The Terrestrial Environmental Observation Network (TEON), designed under the auspices of the Arctic Landscape Conservation Cooperative, is organized around representative focal watersheds. For more information, visit: http://arcticlcc.org/projects/teon. (ALCC)

Arctic Countries. (Canadian Cryospheric Information Network)

other DOI agencies and partners to implement integrated climate change science, adaptation, and mitigation strategies across broad landscapes. DOI bureaus will pool their resources to support and leverage the joint work of work of the CSCs, LCCs and NSSI. Project-level funding and the implementation of regulatory, management, or policy decisions will continue to be the responsibility of each bureau and partner.

Relationship of the U.S. Arctic Policy Directives to the North Slope Science Initiative

The U.S. has had over 40-years of articulating U.S. Arctic interests and developing consistent policies. Beginning in 1971 with the issuance of the National Security Decision Memorandum, which created the Interagency Arctic Policy Group, the U.S. had its first national guidance that made agencies responsible for overseeing the implementation of the U.S. Arctic Policy. The guidance served as a starting point for continuing refinements in 1983, 1984, 1994, 2009, 2010, 2013 and 2014.

The most recent iteration of the U.S. policy was issued in 2013 with the release of the *National Strategy for the Arctic Region*. This document was based in part on the findings of a report to the President in 2013, *Managing for the Future in a Rapidly Changing Arctic*. The strategy is built on three lines of effort:

- Advance U.S. Security Interests – evolve Arctic infrastructure and capabilities
- Pursue Responsible Arctic Region Stewardship – protect Arctic environments and conserve its resources; employ scientific research to increase our understanding of the region
- Strengthen International Cooperation – advance collective interests; promote shared Arctic state property; work toward U.S. accession to the "Law of the Seas Treaty."

In 2014, the President released the *Implementation Plan for the National Strategy for the Arctic Region*. The implementation plan provides the objective for each Federal activity, lists the next steps and time period to accomplish the objective, specifies the way to measure programs, and designates the lead Cabinet entity and supporting Cabinet entities to accomplish the objective.

As the U.S. Arctic strategy has evolved, the NSSI has worked to facilitate access to scientific information for decision makers; promote international cooperation; and identify plausible scenarios to help decision makers better plan for future Arctic activity.

In addition, the National Oceanic and Atmospheric Administration (NOAA) created a Regional Climate Service in Alaska in 2010, finalized an Arctic vision and strategy in 2011 (http://www.arctic.noaa.gov/docs/NOAAArctic_V_S_2011.pdf), and released an Arctic Action Plan in 2014 (http://www.arctic.noaa.gov/features/action-plan.html). NOAA envisions an Arctic where conservation management is based on sound science that supports healthy, productive, and resilient communities and ecosystems. The agency seeks a future that better understands and predicts the global implications of changes in the Arctic.

The NSSI has developed a solid intergovernmental and societally and academically informed partnership structure for identifying science needs and sharing information in the Arctic. The NSSI Emerging Issues Summaries (http://northslope.org/issues), combined with the pilot WildREACH report from the Arctic LCC, form an excellent foundational inventory of research and management issues facing the Arctic today. The NSSI scenarios effort, initiated in 2014 and ongoing through 2015, (see Scenarios for Energy and Resource Development section of this Report) will extend that look into plausible future issues facing Arctic managers. This framework will continue to help prioritize science needs for the North Slope and put the power of collaboration to work. The DOI Climate Science Center is working with the University of Alaska system to meet climate science needs for conservation decisions in Alaska. The ability to meet these priorities and leverage multi-agency and partner resources will determine the success of these initiatives. All of the combined and integrated resources of the NSSI, Arctic LCC, Alaska CSC, and NOAA's Climate Service represent a good beginning for understanding and confronting the complexity of Arctic issues.

Icebreaker corridor. (NOAA)

National Research Council Reports and the NSSI

The National Academies, in response to a request from Congress, prepared the Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (NRC 2003). The purpose of the report was to review information on oil and gas activities and assess the known and possible cumulative impacts of those activities. The report considered impacts on the physical, biotic, human and marine environments from past and present development activities. Several findings and recommendations were developed, including:

- **Climate Change:** Additional research and modeling is required to understand its impacts on the Arctic and more specifically the North Slope region.
- **Need for Comprehensive Planning:** Currently, multiple agencies make decisions on industrial activities on a case-by-case basis, without a comprehensive plan to guide the process. A comprehensive plan is needed to ensure that future decisions match the overall goals for the region, in all phases of development.
- **Ecosystem Research:** Currently, the North Slope lacks ecosystem-level research. There is a need to increase research activities and focus on ecological processes.
- **Offshore Oil Spills:** The potential for a large Arctic offshore oil spill requires additional research to address the effects of such a spill, how marine life could be protected, and the effectiveness of various cleanup activities, especially in broken sea ice.

In 2009, the National Research Council released a second report (NRC 2009): Informing decisions in a changing climate: panel on strategies and methods for climate-related decision support. This report reaffirmed the organizational structure and benefits of the NSSI by outlining a cooperative, stakeholder-based, deliberative approach that decision makers can use. The NSSI was originally established to follow the six principles of the report, long before the report was released. These guiding principles are:

- Begin with the users' needs.
- Give priority to products over process.
- Link to information producers and users.
- Build connections across disciplines and organizations.
- Seek institutional stability.
- Design processes for learning.

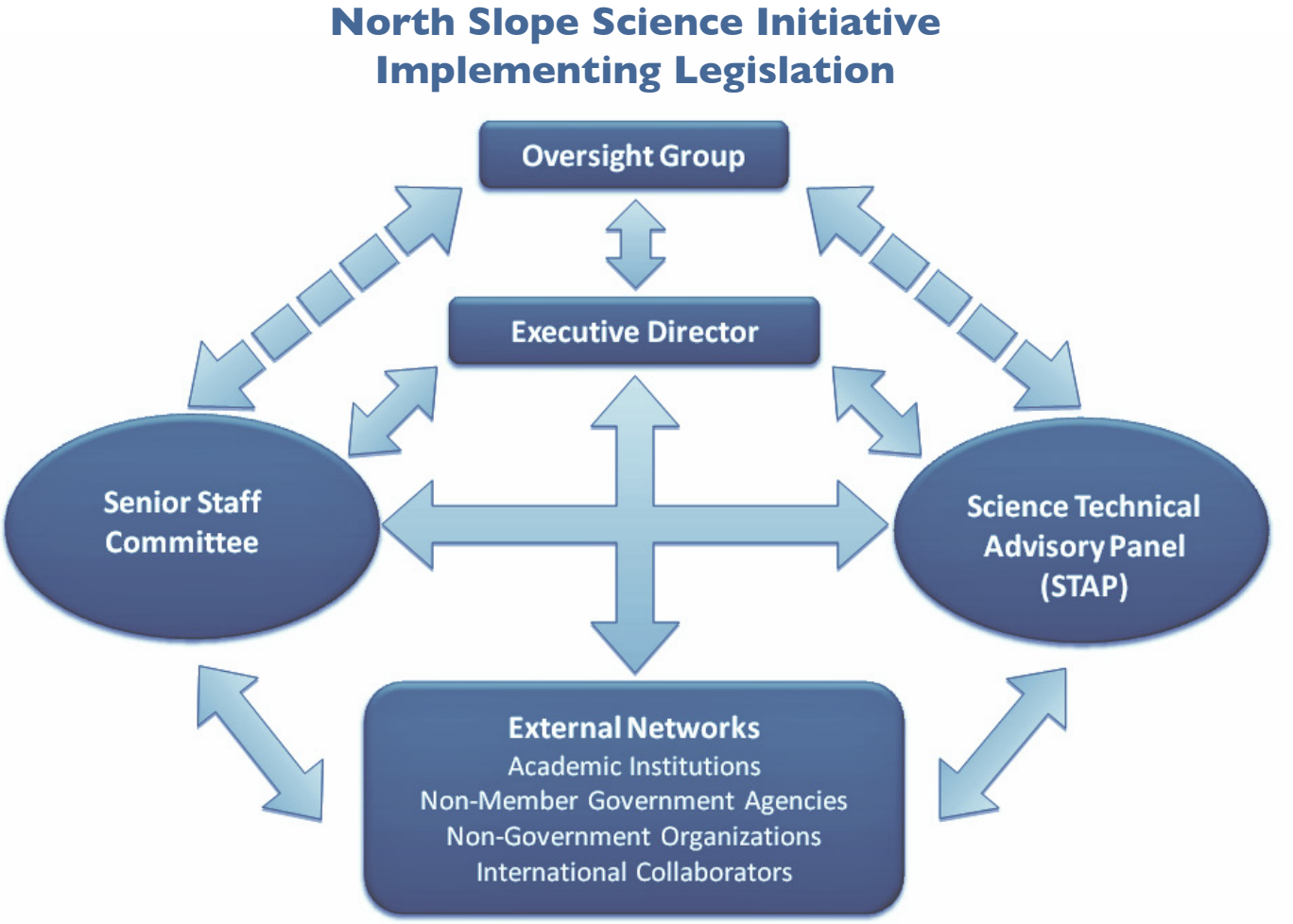
As the unparalleled challenges and opportunities of a changing climate, resource exploration, and development activities become more important to the nation, so does the need for information and more effective ways to support resource decisions. The NSSI, with its broad legislative mandate, is integrated across federal, state, and local governments with partnered research and service. The NSSI believes it can increase collaboration and coordination with industry, the public, academia, non-governmental organizations, and the greater pan-arctic community in a manner that will lead to better informed management decisions.

Organizational Structure and Administration of the North Slope Science Initiative

Why is the North Slope Science Initiative Unique in its Organization?

The NSSI's uniqueness begins with its senior leadership on the Oversight Group (See charter, Appendix 1). The group's membership comes from lead agency, government, and organization managers with responsibilities for resources on the North Slope and its off-shore environments. The NSSI also has a unique Science Technical Advisory Panel, operated under the Federal Advisory Committee Act, whose 15 members represent more than 300 collective years of expertise in the Arctic. NSSI's members include:

Department of the Interior	
Bureau of Land Management (administrative agency)	State Director
Bureau of Ocean Energy Management	Regional Director
Bureau of Safety and Environmental Enforcement	Regional Director
National Park Service	Regional Director
U.S. Fish and Wildlife Service	Regional Director
Department of Commerce	
National Marine Fisheries Service	Regional Administrator
State of Alaska	
Department of Fish and Game	Commissioner
Department of Natural Resources	Commissioner
Local Government/ Resource Manager	
Arctic Slope Regional Corporation	President
North Slope Borough	Mayor
Advisory to the NSSI	
National Weather Service	Regional Director
U.S. Arctic Research Commission	Chair
U.S. Department of Energy	Arctic Energy Office
U.S. Geological Survey	Regional Director
U.S. Coast Guard	Commander, 17th District



The NSSI is an organization that provides for highly effective interaction between government leadership, the senior staff specialists of member entities, its multidisciplinary Science Technical Advisory Panel, and outside networks to identify management needs and provide recommendations to address those needs to leadership. The NSSI organization is not intended to supplant individual agency science or management programs, but to facilitate many of the science directions already being addressed by some individual NSSI member agencies and help in the sharing of human and monetary capital to address needs beyond an individual agency capability. The NSSI is bounded by the collective needs of its membership while still providing individual agency science programs the opportunity to share in addressing those collective needs, or by offering an expanded network of expertise.

Consistent with its mission and vision, the NSSI is a highly interactive organization. It draws advice from a variety of disciplines, expertise, and knowledge. This functional structure is designed to assist federal, state, and local governments; academia; industry; and the public in making strategic, science-informed decisions based on short- and long-term ecosystem management needs. This structure, assisted by a small core of NSSI staff and a science advisory panel, provides independent expert review and advice; facilitates coordination and communication among member programs; and develops a common infrastructure for data management, publications, and information processing.

Oversight Group

The Oversight Group (OG) is the senior-level management from the NSSI member and advisory entities. The OG:

- Sets direction for the NSSI and cascades that direction through member agencies;
- Lays out a clear vision and sets goals and expectations;
- Serves as the decision maker for NSSI priorities and activities;
- Provides executive-level leadership;
- Provides a forum for looking forward; and,
- Approves NSSI's annual budget and Report to Congress

Musk oxen. (USFWS)

Executive Director and Deputy Director

The Executive Director's office provides the managerial guidance and executive oversight on day-to-day activities of the NSSI. In addition, it provides advice and consultation to governmental agencies, scientific and academic institutions, and other interested parties to further the Congressional objectives of the NSSI. It also coordinates and integrates science-based activities among NSSI member entities and their partners for the North Slope. The Executive Director:

- Identifies decision points for the Oversight Group;
- Implements the Oversight Group's decisions;
- Carries out direction from the Oversight Group through coordination with the Senior Staff Committee, Science Technical Advisory Panel, and others;
- Is the Designated Federal Officer for the Science Technical Advisory Panel;
- Manages the NSSI budget;
- Promotes the NSSI;
- Consults with the Oversight Group Chair when a subject matter may be outside the normal operations of the initiative. For example, a request to the NSSI for a response to a task may conflict with a member agency(ies) policy or operations. The Executive Director and Chair may consult with other members as necessary to draft the appropriate response;
- Speaks on behalf of the NSSI, but not on behalf of member agencies; and,
- Develops the annual Report to Congress.

The Deputy Director assists the Executive Director on all of the above-listed functions, and serves as the Chair of the Senior Staff Committee.

Testing sample from soil pit for pH or conductivity. (BLM)

Senior Staff Committee

The Senior Staff Committee (SSC) members are representatives from member entities with experience in North Slope management and science. The respective OG members are expected to clearly communicate their role within the NSSI to their SSC member and their immediate supervisor. These roles may include:

- Identifying environmental issues or needs as assigned by their respective OG member;
- Advising their respective OG member on assignments and direction of the NSSI;
- Compiling input and information from across their respective entities;
- Serving as the liaison between their respective OG member and their entity; and,
- Reviewing Science Technical Advisory Panel work and provides feedback to the OG.

Science Technical Advisory Panel

The Science Technical Advisory Panel (STAP) is a legislatively mandated Federal Advisory Committee Act (FACA) group consisting of not more than 15 scientists and technical experts from diverse professions and interests. This may include the oil and gas industry, subsistence users, Alaska Native entities, conservation organizations, wildlife management organizations, academia, and other areas as determined by the Secretary of the Interior. The panel's duties are listed in the STAP Charter (Appendix 2). Current panel members come from diverse disciplines such as:

- Marine Ecology/Marine Mammals
- Local & Traditional Knowledge
- Fisheries Biology
- Ornithology
- Social Science
- Civil Engineering
- Remote Sensing
- Public Health
- Oceanography
- Biochemistry
- Geography
- Modeling & Risk Analysis
- Wildlife Biology
- Landscape ecology
- Biometrics

2015 Progress and Accomplishments

Progress on Emerging Issue Summary Recommendations

The 2010 NSSI Report to Congress (http://northslope.org/reports) highlighted many of the findings and recommendations of a series of "Emerging Issue Summaries" prepared by the Science Technical Advisory Panel (STAP) with the assistance of the Senior Staff Committee (SSC). The covered topics ranged from ecosystem level aspects such as fire regime and vegetation change, to physical factors such as weather and climate, permafrost, hydrology, erosion, and coastal salinization to focal species such as marine mammals, caribou, and fish, and on mitigative measures like tundra rehabilitation. Each summary reviewed the state of the science at that time, addressed its relevance to management concerns of the day, and provided recommendations for how to move forward to address the identified needs. The full texts of these summaries are posted at: http://northslope.org/issues.

Five years later it's time to take a look back at what kind of progress has been made in addressing the recommendations made in those summaries. Members of the STAP and SSC recently reviewed such progress and the results of their reviews formed the basis for this section. While there are certainly many remaining needs, the Emerging Issue Summaries seem to have worked well to inform or broadly capture others' shared interests in North Slope research and monitoring priorities. We anticipate that when the ongoing NSSI Scenarios Project is complete (see next section of this report), the STAP and SSC will refocus their attention on how the identified scenarios and related science needs can be used to update their assessment and recommendations for future research and monitoring priorities.

Fire Regime

The Emerging Issue Summary on "Fire Regime" was initiated not long after the 2007 Anaktuvuk River Fire. That very large tundra fire was a unique event in the known fire regime of the North Slope and it occurred concurrently with a record late summer drought and record low sea ice extent. The significance of this fire as a portent of change in fire regime was unclear, but it was clear that it provided a unique opportunity to study the event and its impacts on Arctic tundra.

Fire rolls across North Slope tundra in the summer of 2012. (USGS)

At that time, the STAP and SSC recommended that "monitoring of the pattern of vegetation recovery in the 2007 Anaktuvuk River Fire and its relationship to burn severity should continue, and similar monitoring should be undertaken

for future wildland fires." This recommendation was picked up by the Bureau of Land Management which developed an Anaktuvuk Fire monitoring project that ran through the summer of 2011. An interdisciplinary team assessed fire effects including burn severity, potential plant community shifts, and effects on permafrost and active layers.

Results of the project suggested that regrowth of vegetation was rapid for some species (e.g., cottongrass, Eriophorum vaginatum) but others such as shrubs were recovering more slowly and that some species (e.g., Sphagnum mosses and lichens) were declining or virtually absent. Since lichens are absent for some years post-fire, the project concluded that "fire has reduced forage availability for caribou" and also suggested that "shifts in community species composition seem likely for many years to come in the burn area." A report summarizing the early results of BLM's work and references to the other associated studies (soils, permafrost, CO2 flux, etc.) can be found at the IARPC collaborations site: https://www.frames.gov/partner-sites/afsc/partner-groups/iarpc_fire_team.

The STAP also recommended completion of the NSSI-led land cover (vegetation mapping & classification) effort as "a necessary foundation for further work to describe plant communities, which will in turn support improvements to North Slope tundra and other fuel models necessary for fire modeling software used by managers." This NSSI project has been completed and marks the end of an extensively partnered effort to produce what is now the first consistent, accurate land cover map for the entire North Slope region. In addition to its value to fire modeling, this map provides reliable baseline reference for NSSI members and cooperators, or anyone else with applied interests in the North Slope, when conducting future initiatives on a range of potential subjects such as terrestrial habitat, hydrology, development, monitoring, and research. Completion of this project was extensively covered in the 2013-2014 NSSI Report to Congress (http://www.northslope.org/media/doc/reports/2013-2014_NSSI_RtoC_2-10-2015_WEB.pdf) and the linked data and images can be accessed through the North Slope Science Catalog at: http://arc-sctc.gina.alaska.edu/NSEcoLandscape.

Studies such as the Anaktuvuk River study cited above and the NSSI land cover mapping effort helped lay the groundwork for a core focus of the NASA-funded Arctic Boreal Vulnerability Experiment (ABoVE, http://above.nasa.gov). NASA has begun this multi-year field campaign to take advantage of its remote sensing capabilities and investigate ecological impacts of the rapidly changing climate in Alaska and northwestern Canada. The ABoVE program has just recently announced its first round of funding decisions and among the funded studies is one that will be investigating and quantifying fire-induced changes in Alaskan tundra with a specific aim to assess the region's vulnerability to on-going and future environmental change.

Because many of the factors that influence annual fire regime include both vegetation type and weather-linked measures, additional recommendations were presented in the Emerging Issue Summaries on "Vegetation Change" and "Weather and Climate" (see later sections in this report).

Vegetation Change

The lead recommendation of the Vegetation Change summary was to complete the slope-wide land cover mapping effort led by NSSI. After years of collaborative effort, the land cover mapping effort has been completed. This is a landmark accomplishment for the NSSI and its partners, as this map

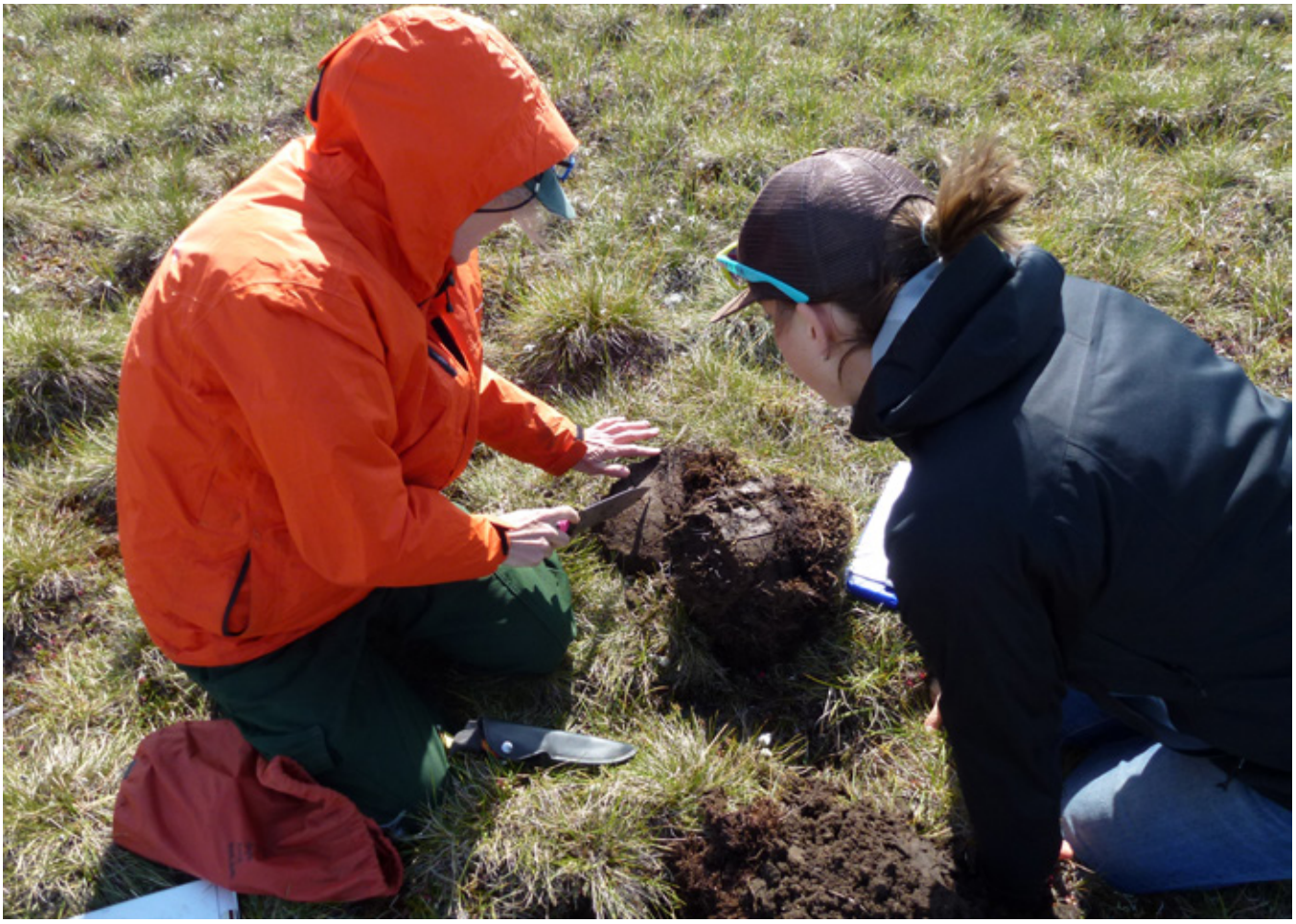
now provides a reliable baseline reference for all parties, public or private, with applied interests in the North Slope. This accomplishment was extensively covered in the 2013-2014 NSSI Report to Congress (http://northslope.org/reports) and the final report, data and images are available through the North Slope Science Catalog (http://catalog.northslope.org/catalogs/6979-north-slope-landcover-map).

One of the uses of a baseline map is to serve as a basis for vegetation change detection efforts. That was the nature of the second STAP recommendation on this issue and an effort towards that end is now underway. Through the Circumpolar Biodiversity Monitoring Program of the Arctic Council (currently co-led for the U.S. by NSSI and BLM), the land cover classifications developed for the NSSI land cover project will serve as the basis to create a land cover change index for the circumpolar Arctic. The index will first be developed and validated using data from the North Slope, Russian Federation and Greenland. Once the index is validated, Google Earth will use the algorithms to create the index for all of the Arctic.

At a more intermediate scale, the NASA-funded ABoVE program described in the previous section has also recently funded a study of changes in shrub abundance in Arctic tundra. The study take advantage of NASA's remote sensing capabilities by using semi-automated interpretation of high resolution imagery to assess the direction and magnitude of changes in shrub cover in Alaskan and Canadian Arctic tundra. Because NSSI worked with NASA since the early days of ABoVE planning process to shape its goals and objectives, we can expect to see this pay off in future studies of similar relevance to NSSI-identified science priorities.

Other more site specific vegetation change efforts are also underway on the North Slope, many of which are accessible through the North Slope Science Catalog (http://catalog.northslope.org). For example, Dr. Donald (Skip) Walker of the University of Alaska Fairbanks is assessing change in vegetation and geomorphology in areas affected by climate change and industrial infrastructure (http://catalog.northslope.org/catalogs/3090); BP is assessing change in vegetation plots scattered around the BP-operated oil fields (http://catalog.northslope.org/catalogs/513); BOEM in partnership with NOAA and the Arctic LCC recently completed coastal vegetation and geomorphic mapping along the entire North Slope with the ShoreZone program (see http://alaskafisheries.noaa.gov/mapping/szflex); and the USFWS has established an observation site for the international GLobal Observation Research Initiative in Alpine environments (GLORIA) program (http://catalog.northslope.org/catalogs/505). A compilation of vegetation studies on the North Slope can be found at: http://catalog.northslope.org/search?search[q]=ltmei:vegetation%20change.

Another STAP recommendation on vegetation change was to begin to assess the utility of baseline map products that existed at that time and to move towards standardization of methods. The now completed NSSI land cover map has already proven useful in helping to shape and provide critical information to support a landscape scale design for the BLM's Assessment, Inventory, and Monitoring (AIM) Strategy on the North Slope. The NSSI land cover map enabled AIM scientists to use consistent, scientifically vetted land cover information in combination with landscape physiography to develop an ecologically derived sampling strategy from which to select long-term monitoring locations in an efficient and scientifically unbiased manner. In turn, components of the basic structure of AIM have also been incorporated into the Arctic Council's Terrestrial Biodiversity Monitoring Plan, with the stated objective of identifying "a common suite of biological focal ecosystem components (FECs), attributes, parameters



Examining vegetation and soil content from soil pit near Atqasuk. (BLM)

and comparable methods to coordinate the monitoring of change across Arctic terrestrial ecosystems." Consistent with the STAP recommendation, the NSSI land cover mapping project has thus not only served the immediate on-the-ground needs of an NSSI member agency, it has also provided useful support for the international standardization of Arctic vegetation and vegetation change mapping.

The remaining STAP recommendations on vegetation change dealt with the eventual need to adjust current vegetation mapping products, address continuing technical issues related to such efforts, inventorying existing long-term vegetation study sites, and completion of an analysis of methods and coverage in those studies. Because the NSSI land cover map was only recently completed, adjustment of this product would be premature. However, the need to revisit this and other vegetation mapping efforts with sufficient regularity to maintain their validity is a worthy consideration for future research and monitoring efforts on the North Slope. Through the STAP and SSC, the NSSI has now inventoried long-term monitoring studies on the North Slope, including vegetation studies (see: http://northslope.org/monitoring). No additional effort has been initiated through NSSI to determine if more or differently located on-the-ground sites are needed. However, when the STAP and SSC reviewed progress on this issue, they suggested it was likely that more sites would be needed to realistically detect wide scale change in different parts of the North Slope and in different plant communities. The

geospatial analysis associated with NSSI's ongoing Scenarios Project may also provide guidance for new study site locations.

Weather and Climate

At the time this issue summary was written, an improved understanding of weather and climate was considered by the STAP to be central to progress on many other emerging issues and "among the most pressing environmental issues facing society." STAP recommendations on this issue were presented as a sequence of core and subsequent actions. The core recommended action was an inventory all of the meteorological data and stations on the North Slope. At the center of their concern was that data from diverse past and current projects may be out of reach (stored in personal journals, university computers and so on) and unavailable to contribute to our understanding of weather and climate.

The Arctic Landscape Conservation Cooperative (ALCC) picked up on this shared need and initiated the "Imiq Hydroclimate Database" project (see: http://arcticlcc.org/projects/imiq). "Imiq" is an Inupiat word that means "freshwater." The following description of the Imiq database is paraphrased from materials posted on the ALCC website. This database houses hydrologic, climatologic and soils data collected on not only the North Slope but across Alaska and Western Canada from the early 1900s to the present. It unifies and preserves numerous data collections that had until then been stored in field notebooks, on desktop computers, and disparate databases. Imiq was built to enable data integration across sources, as well as to support program planning and observational network design (thus also helping address the second STAP recommendation for improving system design). It provides a searchable map-based view of where , what and when data have been obtained and can aggregate and export data records from multiple sources in a common format, with full metadata records that provide information about the source data.

Weather Service Office in Barrow with dome housing radiosonde tracking antenna. (NOAA)

Development of the Imiq Data Portal (http://arcticlcc.org/projects/imiq/data-portal) was funded by the Arctic LCC and the North Slope Science Initiative, and implemented by the Geographic Information Network of Alaska. Data were contributed and collected from many agencies and investigator-driven research projects. While the Imiq Hydroclimate Database project was a major undertaking and contributes significantly to the core and secondary recommendations of the STAP on this issue, any such database will need continuous updating and this task has not yet been put into standard operating practice nor has long-term funding for this task been secured.

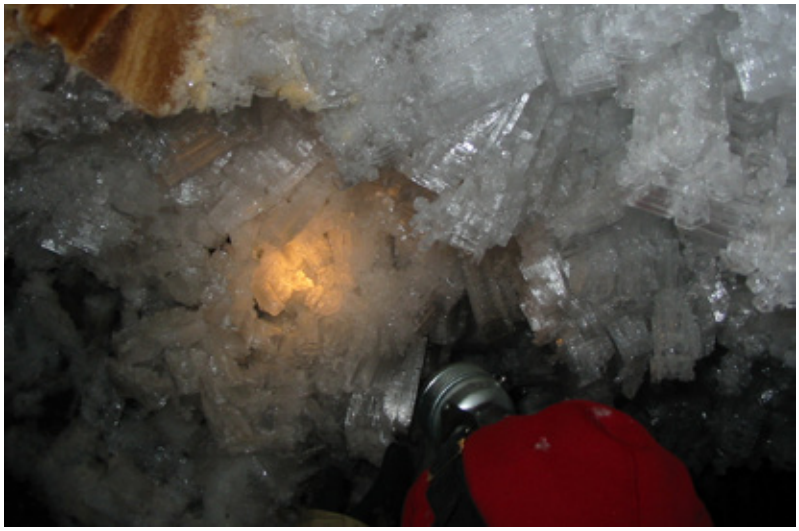
National Weather Service crew returns from taking ice thickness readings on an Arctic river. (NOAA)

The National Oceanic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information is also a repository for climate and weather data and information. However, these data are required to meet specific standards that make them suitable for specific NOAA analyses and assessments. Regarding system design, there is flexibility within NOAA in terms of observing system design. For NOAA, the focus is on the data requirements, and systems are either designed or procured (off-the-shelf) to meet these requirements. For partner observations, as long as the metadata is documented, the data can be used. Additionally, UAF (with funding from BOEM) recently developed a database that synthesizes meteorological observations from nearly 200 stations across northern Alaska, covering the period 1979-2009 and encompassing several different observational networks from land, offshore buoys and ships.

Other STAP recommendations under the weather and climate issue summary included analyzing gaps between the existing weather station networks and agency needs; the use of gridded model products to produce more spatially explicit weather and climate products; the pooling of resources to begin to install new hydro-met stations as identified in the gap analysis; improving data access; and improved downscaled climate prediction. Thus far, NOAA has completed a gap analysis for observing systems in Alaska and the Arctic relative to its own mission to deliver weather, water, and climate services and is taking incremental steps to fill the gaps identified. NOAA is also supporting or collaborating on research activities on gridded models, for example, through the Interagency Arctic Research Policy Committee and the Alaska Center for Climate Assessment and Policy.

Regarding the remaining STAP recommendations on this topic, NOAA is working with several partners to leverage infrastructure related to observing systems to expand the suite of measurements and to fill critical gaps in weather and water data. These data should also be useful for climate-scale analysis, as

they are part of sustained operational networks. This includes water level gauges (coastal and riverine) and meteorological stations. Both the open nature of NOAA's data systems and the Imiq Data Portal are helping address the STAP's data access concerns. Finally, it is worth noting that while several of the above-cited improvements should contribute to improved weather and climate modeling and prediction, there are other potential paths to this end given the new satellite-based data sets that are available and upcoming over the next few years.



Hoar frost forms in permafrost tunnel near Barrow, Alaska. (L.. Lynn, HDR)

Permafrost

In the emerging issue summary for permafrost, the STAP focused its recommendations on inventorying existing data and monitoring techniques, centralizing data, exploring new hybrid (ground and remote sensing) monitoring techniques, identifying areas where permafrost change could affect ecosystem or infrastructure changes, improving understanding of active layer thresholds, and understanding interactions between thermokarst and changes in vegetation and hydrology.

As this report was being drafted, a paper published in the journal Earth System Science Data (http://www.earth-system-science-data.net) announced that the Global Terrestrial Network for Permafrost (GTN-P, http://gtnp.arcticportal.org) now ìprovides the first dynamic database associated with the Thermal State of Permafrost (TSP) and the Circumpolar Active Layer Monitoring (CALM) programs, which extensively collect permafrost temperature and active layer thickness (ALT) data from Arctic, Antarctic and mountain permafrost regions.î It further describes that the purpose of GTN-P is ìto establish an early warning system for the consequences of climate change in permafrost regions and to provide standardized thermal permafrost data to global models.î The paper also identifies and quantifies the spatial gaps in the site distribution, describes the new data management system, and outlines the data sources and data processing including quality control strategies. This is an important development and directly addresses the STAPís leading recommendation on this topic.

Regarding hybrid techniques to achieve wider coverage, research using Interferometric Synthetic Aperture Radar (InSAR) satellite data has begun to prove useful for active layer determination. Again, the NASA ABoVE project has funded some initial studies of this type and a new NASA satellite SMAP (Soil Moisture Active Passive) also has the potential to address permafrost issues, with data and research findings expected to become available in late 2015. However, the STAP's recent review did not findings that these technologies have yet been implemented and put in the field for long term data collection.

There is an interesting but more geographically limited project currently underway through the Strategic Environmental Research and Development Program (SERDP) of the Department of Defense. The

project, titled "Improving Design Methodologies and Assessment Tools for Building on Permafrost in a Warming Climate," focuses directly on the problems of siting infrastructure across a warming landscape underlain by permafrost. It combines satellite and aerial imagery with on-the-ground drilling and other geophysical measurements. The intent is to characterize permafrost soils prior to construction, explore "next generation foundations" (instrumented to detect early signs of foundation failure), and synthesize existing and new information to develop a decision support system. For more information on this project, visit: https://www.serdp-estcp.org/Program-Areas and search for project #RC-2436.

Recent STAP review of this issue found that while permafrost heterogeneity is an area of major research interest, good mapping of variability in ice content (ice rich vs ice poor permafrost) does not yet exist. However, an Arctic LCC project on permafrost database development (see: http://catalog.northslope.org/catalogs/9630) does seek to provide an intermediate-level mapping of permafrost throughout Northern Alaska and is intended to improve landscape-level assessments, regional climate impact modeling and prediction. The STAP found little new research on the effects of threshold conditions on the acceleration of thawing. Finally, regarding the interaction of thermokarst, vegetation and hydrology, the work of Torre Jorgenson (Alaska Ecoscience), Vladimir Romanovsky (UAF, Geophysical Institute), Jennifer Harden (USGS) and their colleagues is advancing our knowledge of how these complex interactions may respond to climate change. Josh Koch (USGS, Alaska Science Center) and his colleagues have also published recent findings that are improving our understanding carbon loss and hydrologic modeling in relation to permafrost dynamics.

Hydrology and Lake Drying

The core recommendation of the STAP in its emerging issue summary for hydrology and lake drying was to convene a workshop "to identify and define hydrological and meteorological data needs, including a detailed planning design for a stream gauging and meteorological station network and that this design reflect the biological considerations for which the data will be used." While no workshop specifically designed to implement this recommendation was held, the Arctic Landscape Conservation

Spring flooding from the Sagavanirktok River overruns the Dalton Highway at Mile 413. (J.Organek, ADOT.)

Cooperative (ALCC) did initiate the development of a "Terrestrial Environmental Observation Network" (TEON). Its design calls for strategically located instrumentation across the North Slope and includes hydrological and meteorological data collection along with an array of other data types (e.g., soils, vegetation, permafrost, snow depth, and so on). The intent is "detect and forecast effects of a changing climate, hydrology, and permafrost regime on wildlife, habitat, and infrastructure in northern Alaska." Partial implementation of TEON has begun through the ALCC, but long-term funding for its full geographic scope and instrumentation has not been secured.

Recently drained lakes are becoming an increasingly common site in northern Alaska. (B. Jones, USGS)

In addition to this on-the-ground network, the STAP recommended "the development of remote sensing technologies that can supplement" these conventional hydrological and meteorological methods. The NSSI, through the Geographic Information Network of Alaska (GINA) and Michigan Tech Research Institute (MTRI), developed techniques to use synthetic aperture radar (SAR) data to map winter water availability – important information for locating fish overwintering habitat, characterizing lake suitability for piscivorous birds (e.g., yellow-billed loons), and to locate available water for constructing winter ice roads. This GINA and MTRI effort resulted in a winter liquid water availability map of the North Slope Coastal Plain. Data layers and additional details are available at the North Slope Science Catalog (http://catalog.northslope.org) or via a direct link on the NSSI homepage (http://northslope.org).

Other studies including radar remote-sensing and numerical modeling data have been used to analyze changes in ice thickness on North Slope lakes (see: http://www.the-cryosphere.net/8/167/2014/tc-8-167-2014.html), and Landsat data has been used to help develop baseline maps for location and extent of surface water in another ABoVE-funded study (see: http://above.nasa.gov/cgi-bin/above/inv_pgp.pl?pgid=713&fullab=1#abanchor). Remote sensing technologies for other hydrological measurements, for example seasonal inundation, soil moisture, freeze-thaw cycles, river discharge, and river bathymetry are still experimental and not yet sufficiently developed for applied use.

Finally, the STAP recommendation to "incorporate local knowledge into the planning and assessment" of hydrological monitoring and modeling efforts has shown promise in studies across the Arctic but does not appear to have yet been fully implemented on the North Slope. The utility of this approach was recently highlighted in a publication by three UAF professors (see: http://www.ecologyandsociety.org/vol20/iss1/art25) that focused on the link between hydrology and driftwood availability in interior

Alaska. The authors concluded that "information gathered from discussions with local stakeholders provided critical information for model development." In another study based in the Northwest Territories, Canada (http://pubs.aina.ucalgary.ca/arctic/Arctic60-1-37.pdf), scientists and traditional local knowledge holders exchanged information on climate variability, wind, lightning, lake ice, lake level, and streamflow. The authors concluded that this exchange "enhanced the potential for traditional knowledge to help direct and validate scientific investigations and for scientific knowledge to be used in conjunction with traditional knowledge to guide community decision making."

Erosion

Erosion along Arctic waterways, particularly the coastline, remains a very high concern for local, state and federal agencies, as well as private industry and certainly North Slope communities. When the NSSI Science Technical Advisory Panel considered this issue it focused on the science behind what was needed to understand the then current status of our knowledge about erosion and to develop better models of future erosion to inform management decisions. Their recommendations called for compilation of the needed imagery, collection and storage of historic shoreline data to serve as baselines for models, mapping to generate erosion rate information, improved modeling efforts and inclusion of local input on model assessment and monitoring programs.

Since that time, the Bureau of Safety and Environmental Enforcement (BSEE) has funded a project to catalog and host all North Slope coastal imagery (http://northslopecoast.net) and the Polar Geospatial Center (http://www.pgc.umn.edu) continues to collect high resolution commercial satellite data supported by the National Science Foundation and the National Geospatial-Intelligence Agency to assess coastal change. With funding from BOEM, NOAA's Alaska ShoreZone Project (http://www.shorezone.org) is taking an inventory of the biology and geology of Alaska's immense coastline by making millions of photographs and digital data of the Alaska coast, all of which are geo-referenced and available to the public online.

The State of Alaska's Division of Geological and Geophysical Surveys provides an interactive online "Alaska Shoreline Change Tool" (http://maps.dggs.alaska.gov/shoreline/#-16434084:9589812:5) which "displays historic and predicted shoreline position." Additionally, the U.S. Geological Survey's National Assessment of Shoreline Change project has completed an assessment of "Historical Shoreline Change Along the North Coast of Alaska, U.S.-Canadian Border to Icy Cape" (http://pubs.usgs.gov/of/2015/1048). The summary report for this assessment notes that along the Arctic coast of Alaska "coastal erosion

Eroding coastline near Barter Island on Alaska's North Slope. (B. Jones, USGS)

is widespread, may be accelerating, and is threatening defense and energy-related infrastructure, coastal habitats, and Native communities." USGS scientist Dr. Ben Jones and colleagues in a published report (http://onlinelibrary.wiley.com/doi/10.1029/2008GL036205/pdf) documented this increasing rate of coastal erosion for a segment of Beaufort Sea coastline, suggesting that Arctic changes responsible for this pattern "include declining sea ice extent, increasing summertime sea surface temperature, rising sea-level, and increases in storm power and corresponding wave action."An Arctic Landscape Conservation Cooperative (ALCC) project (http://arcticlcc.org/projects/geospatial-data/alaska-north-slope-lidar-data) builds on these USGS projects by providing support for acquiring and processing LiDAR data for Admiralty Bay, Smith Bay, Kogru River and the Fish Creek/Judy Creek delta.

The STAP did not find that significant progress has been made on their recommendation to more fully instrument the coastline with wind and wave sensors, with the exception of ongoing Coastal Ocean Dynamics Applications Radar (CODAR) near Barrow. The online CODAR newsletter (http://www.codar.com/newsletter_09_2010.shtml) reports that wave measurements provided by this UAF-based effort are intended to provide data to the offshore energy industry, for example for oil spill risk analysis, but may also help coastal communities "predict how sea ice conditions may change during subsistence hunting activities." Also relevant, a surface current circulation study using high frequency radar mapping installations along the Chukchi Sea, was conducted by UAF with funding from BOEM, Shell, and AOOS (see http://www.ims.uaf.edu/hfradar).

Erosion modeling efforts have increased significantly since this Emerging Issue Summaries was written. Dr. Tom Raven (University of Alaska Anchorage) and colleagues published a model for coastal erosion near Drew Point on the North Slope that considers multiple factors, as the STAP had recommended. The model was calibrated with historic shoreline change data for from 1979–2002 and validated with data from 2002–2007 (http://alaska.usgs.gov/products/pubs/info.php?pubid=1836). More recently Colorado-based scientist Katherine Barnhart and colleagues developed a numerical model of erosion (http://www.researchgate.net/publication/266390488) that analyzed many of the factors the STAP recommended. Model results highlighted the importance of water temperature and "nearshore wavefield" as particularly effective model components, thus reinforcing the STAP's prescient but still lagging recommendation to more fully instrument the Arctic coastline.

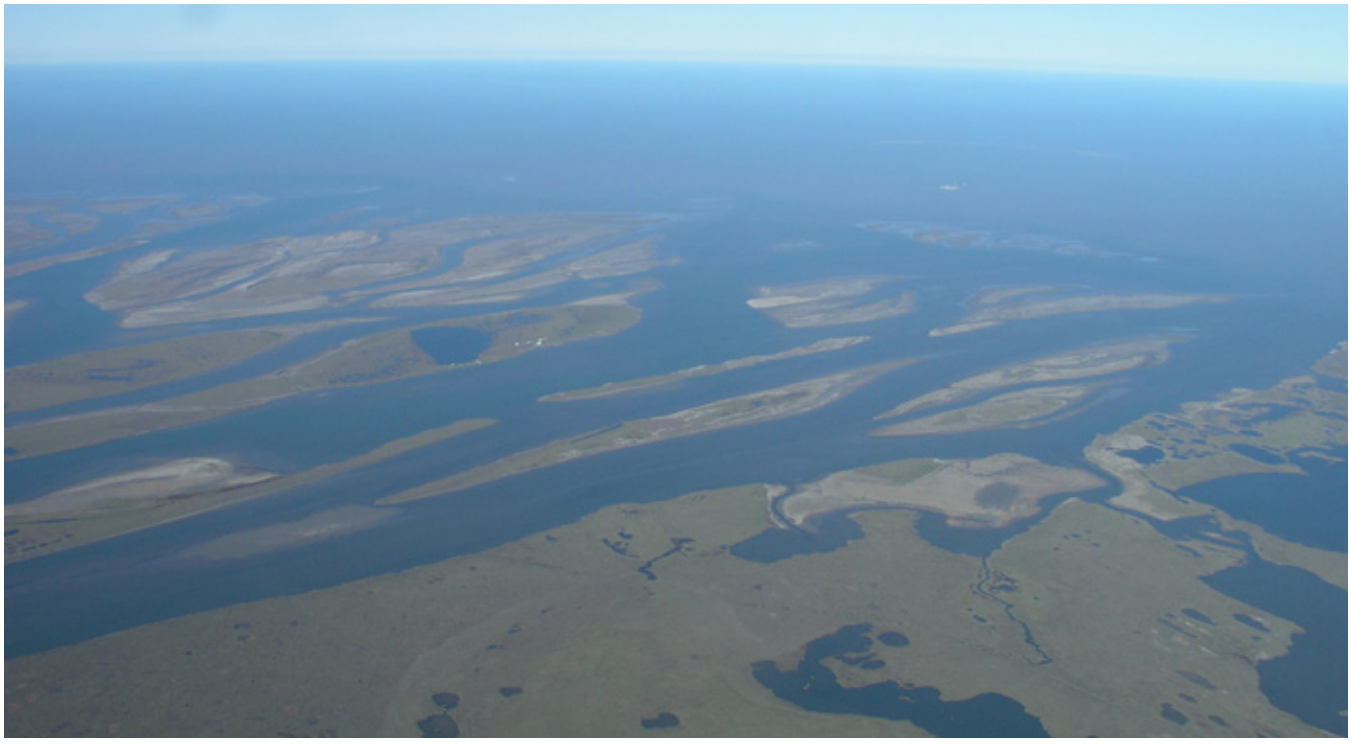
A couple of recent developments are also relevant to a review of progress on this topic. Under a January 2015 Presidential Executive Order (https://www.whitehouse.gov/briefing-room/presidential-actions/executive-orders) on "Enhancing Coordination of National Efforts in the Arctic" an Arctic Executive Steering Committee was formed. This group in turn formed a Coastal Erosion Working Group that specifically sought input from Alaska Native representatives to help inform its deliberations. In response to such input the working group compiled federal agency authorities and programs that may be of assistance to Alaska Native villages facing erosion and climate-related threats (see: https://toolkit.climate.gov/tool/climate-resilience-alaskan-communities-catalog-federal-programs). The Circumpolar Biodiversity Monitoring Program (CBMP) under the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF) Working Group has also begun to develop a coastal monitoring plan which will include erosion as an analytical factor (along with climate change, development, and pollution) in shaping coastal ecosystems across the Arctic.

Finally, a concise background paper on erosion as a driver of change on the North Slope was developed for the initial workshop in the ongoing NSSI Scenarios Project and can be found at: http://www.northslope.org/media/doc/2014/Nov/Erosion.pdf.

Coastal Salinization

Coastal salinization, whether from inundation, wind-carried spray or the intentional introduction of saline water into terrestrial and freshwater environments was addressed by the STAP in this Emerging Issue Summary. A range of management concerns (e.g., effects on plant communities, impacts on fish and avian habitat, water for ice roads) were addressed in the summary. Its recommendation section focused on the potential to develop predictive models for coastal salinization and then made management observations on the use of salt water and the nature of studies needed to assess potential impacts and mitigation measures (e.g, dilution with snow or other means).

The USGS coastal marine geology group in California is developing methods for assessing coastal salinization. The Arctic LCC funded an effort, focused on Arey Lagoon just west of Barter Island, to model saltwater inundation events from storm surges through the end of this century (http://arcticlcc.org/projects/geophysical/barrier-island-lagoon-systems). Also near Barter Island, Peter Swarzenski (USGS) led a recent effort using electrical resistivity profiles to document active layer thickness, permafrost boundary, and freshwater and seawater zones. His work is expected to be published soon in the peer-reviewed Journal of Environmental and Engineering Geophysics (http://jeeg.geoscienceworld.org). There has also been some recent work on these types of models in the Arctic of Norway and Sweden. One particular model that has had success with modeling coastal salinization, including salinity intrusion



Eroding coastline near Barter Island on Alaska's North Slope. (B. Jones, USGS)

and salinity plume due to desalination of plants, is the Generalized Environmental Modeling System for Surface waters (GEMSS®) framework (www.gemss.com) designed by Dr. Venkat Kolluru and developed by the water resources and modeling team of ERM (www.erm.com). Although the model has not been specifically applied to the North Slope, it has been successfully applied to other Arctic regions.

The second recommendation on this topic dealt with the potential use of saline water for ice road construction – essentially recommending against it. At the time of the STAPs writing there had apparently been a case, suspected based on finding extensive salt-killed vegetation and elevated water conductivities following drilling, where brackish water had been used for ice road and pad construction. As far as the STAP could tell from its recent review, however, there have not been any permit applications to use ocean or brackish water for terrestrial ice roads in the National Petroleum Reserve in Alaska or on State of Alaska lands. So, while this recommendation has apparently been largely heeded it may serve as a reminder if such a request is made.

Unmet data gaps do remain on this topic, particularly relating to more effective modeling of coastal inundation, including the need for improved understanding of thaw subsidence (as ice-rich permafrost thaws, land surface will subside); region-wide potential for sea level rise and storm surge; locations of high salinity gravel pits (if used, for example, as sources for road materials), and even surface topography. On this latter need, LiDAR data is available now for a narrow band along the coast but it does not capture the entire portion of the coastal plain that is currently prone to storm surge flooding nor does it fully capture the river deltas. Available InSAR data might be used to compensate for this to a degree, but not completely. So the lack of an adequate elevation model is still a significant data gap.

Marine Mammals

There were four recommendations relating to marine mammals and their prey put forth by the STAP in their Emerging Issue Summary on this topic. The first was a complex recommendation dealing with the need for improved understanding of habitat use, current conditions, and harvest in order to better identify future change and its cause(s). Considerable progress has been made over the past five years to assess marine mammal movements, habitat use, population status and health. However, most of these studies – particularly those addressing movements, habitat use, and population status – have occurred primarily during the ice-free season. Information on marine mammals and their prey is still largely lacking during ice-covered seasons.

There are only a few studies that have successfully identified the environmental features selected by particular marine mammal species; most studies of this type are new and substantial additional work will be necessary to understand how demographic parameters vary with changes in sea ice or increased human activity in the Arctic. The "Pacific Marine Arctic Regional Synthesis" effort (PacMARS, http://pacmars.cbl.umces.edu) conducted a compilation of data on marine mammals and new efforts to integrate data from multiple studies were pursued through the BOEM funded "Synthesis of Arctic Research" project (SOAR, http://www.boem.gov/IM_1602). Most federal, state, and university groups prioritize marine mammal projects focused on subsistence species, regardless of their ESA status. The STAP also reports that many projects are improved by specifically including subsistence hunters and members of Alaska Native Co-management Organizations (see: https://alaskafisheries.noaa.gov/protectedresources/comanagement.htm for an overview of such organizations).

The second recommendation calls for "more long-term integrative studies" to improve our understanding of marine mammal distribution. Several long-term studies of marine mammals and their prey (funded primarily by BOEM) have provided substantial information and are either now being integrated with other studies or are available to be integrated. Examples include bowhead whale and oceanography projects to the northeast of Barrow, Arctic cisco monitoring, a bowhead satellite telemetry project, a village-based walrus project, ice seal biomonitoring, and Chukchi Sea and southern Beaufort Sea polar bear studies. While these studies are "long-term" relative to many other Arctic projects, most have been conducted for less than 10 years, so may not provide insight into the full range of possible population responses to perturbation. However, these studies can provide information against which future studies can be compared – for example, to assess whether additional information can be gleaned about the causes of changes in distribution, movements, population status, or health over time. The recent SOAR project cited above resulted in multiple publications which synthesized and integrated information from various studies about marine mammals and their prey in the Arctic. The North Pacific Research Board (NPRB, http://www.nprb.org) with support from BOEM and Shell is also developing an integrated ecological study in the Chukchi Sea that could help provide a more in-depth understanding of how marine mammals are linked to their ecosystem.

Both beluga whales (left) and bowhead whales (right) are important subsistence resources for North Slope communities. (NOAA)

The third STAP recommendation on this topic was to "pursue studies that allow the assessment of cumulative impacts of multiple types of stressor over multiple years." Some progress has been made in this arena. A team was convened in 2010 to develop qualitative and quantitative methods to better model the cumulative effects of multiple stressors on a population. However, empirical studies that directly assess cumulative impacts on an individual or a population remain difficult to achieve. In most cases researchers are still trying to understand basic aspects of the biology of marine mammals and the impacts of individual stressors (natural and human-caused) on individuals, which must be done prior to understanding the cumulative impacts on a species. For example, the Alaska Department of Fish and Game has conclusively documented bowheads encountering multiple seismic operations in a single year during a fall migration, but evaluating the effects of such encounters on survival or reproduction is still very difficult. Similarly, long-term trends in contaminants in seals have been studied to see if some of the classic contaminants (e.g., PCBs and DDTs) that are no longer being manufactured are decreasing in seal tissues. Approaches for combining and understanding effects from different types of stressors (e.g., sound and contaminants) are still largely lacking.

The final recommendation on marine mammals and their prey promoted greater collaboration among organizations to pursue integrated studies of the Arctic. Various research groups have been investigating ways to partner to pursue funding for integrative studies funded by both the BOEM and the NPRB. Currently BOEM and several others, including the Office of Naval Research, Shell, North Slope Borough, U.S. Coast Guard, U.S. Geological Survey, and the U.S. Arctic Research Commission, are funding a program for an integrated study in the Chukchi Sea. More broadly the Interagency Arctic Research Policy Committee has established a "Chukchi and Beaufort Seas Collaboration Team" which has produced a framework for coordinating marine research in the Chukchi and Beaufort Seas (Wiese et al, 2015). The IAPRC as a whole also produced its biennial report which was just released by the White House (https://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/iarpc-biennial-final-2015-low.pdf).

Caribou

The body of the STAP's Emerging Issue Summary for caribou addressed a wide range of management concerns and data needs. However, the STAP recommendations focused primarily on the need for increased management collaboration and improved understanding, through both western and traditional knowledge, of the historic extent and variability in seasonal range use and harvest by subsistence and sport hunters.

Management of the four North Slope caribou herds is generally a cooperative process, but there remains no new or formal process for collaborative management other than the International Porcupine Caribou Board (IPBC) created in 1987 and the Western Arctic Caribou Herd Working Group (WAHWG), which

Caribou crossing the Hulahula River in mid-summer. (USGS)

has been in existence since 1999. To some extent, the Teshekpuk Herd is included in discussion by the WAHWG, and this is evidenced by the fact that the Board of Game has combined these two herds for discussion of the "amount needed for subsistence." To further improve cooperation, the STAP recommended there be a comprehensive gathering of land and wildlife managers, industry, and other stakeholder groups to identify existing data and its accessibility, coordinate data collection planning, and assess and prioritize specific directed studies. Because no meeting of this extent and purpose has yet taken place, this remains a largely unaddressed STAP recommendation at this time.

Management agency understanding of the historic extent and variability in seasonal range use and harvest by subsistence and sport hunters has continued to grow and there is some excellent caribou use mapping underway by the Alaska Department of Fish and Game (ADFG) in collaboration with the North Slope Borough (NSB). While some map products are now becoming available, the issue of access to the source data remains unresolved. The recent review of progress on this STAP recommendation also noted that a new text (Caribou Herds of Northwest Alaska, 1850-2000, by Ernest Burch) has contributed to this understanding by coupling local and traditional knowledge with ecological science. A promising development on this topic is that NASA's ABoVE program (http://above.nasa.gov) has just announced it will be funding an "Animals on the Move" project. This study will "use space-based wildlife tracking technology" to help determine "key drivers influencing movements and habitat selection" by a variety of migratory species including caribou.

While not presented as recommendations, the Emerging Issue Summary on caribou also identified a range of data needs. Since that time additional data has continued to be collected on caribou movements and is being incorporated into the ADFG/NSB study noted above; data on body condition and subsistence and sport harvest by herd is improving but remain sufficiently uncertain to be of limited use in harvest allocation decisions; our shared understanding of the potential link between weather patterns and caribou herd status remains weak with coverage of winter weather and snow and icing conditions generally poor for all herds; and the potential for aircraft disturbance of caribou and caribou harvest remains an issue of concern across the North Slope.

A brief summary of information on the "resilience of caribou to climatic shifts in the Arctic" was recently developed under the Changing Arctic Ecosystems program of the U.S. Geological Survey (http://pubs.usgs.gov/fs/2014/3103). Another factor that may affect North Slope caribou herds is energy and resource development. The results of the ongoing NSSI Scenarios Project will help analyze this potential and allow NSSI member agencies and their partners to consider their research and monitoring priorities under various development scenarios and identify focal opportunities for collaboration.

Fisheries

The Emerging Issue Summary on fisheries notes that "fish are a critical subsistence resource for North Slope communities." This is certainly still true today and was very well demonstrated in a presentation made by NSSI Senior Staff Committee member and active subsistence fisherman and hunter, Qaiyaan Harcharek, at the Arctic Biodiversity Congress in Trondheim, Norway in December of 2014. Qaiyaan's participation was facilitated by NSSI and helped bring indigenous knowledge and an Alaska Native voice to the discussion. The recommendations of the STAP in the fisheries summary focused on better assessing subsistence use, fish distribution and abundance, differentiating between

environmental and anthropogenic changes, standardization and long-term monitoring, modeling potential long-term changes, and better understanding the relationship of fisheries and the physical conditions of their environment.

Aanaakłiq (broad whitefish) are an important subsistence fish species on the North Slope. Here, current NSSI Senior Staff Committee member Gordon Brower (North Slope Borough) retrieves a net full of Aanaakłiq. (G. Brower)

In terms of subsistence use, the STAP's recent review found that while there have been several subsistence fisheries surveys across the North Slope in recent years (e.g., through the North Slope Borough, Alaska Department of Fish and Game, Bureau of Land Management, Bureau of Ocean Energy Management, Fish and Wildlife Service, and private industry – all of which are accessible through a search of the North Slope Science Catalog at: http://catalog.northslope.org), no comprehensive monitoring program has yet been developed. The review concluded that "perhaps the best prospects for developing a time series lie with the North Slope Borough's monitoring of subsistence gillnet catches." This project has been ongoing for several years and has the potential of identifying changing patterns of catch and use, but at the time of the STAP's review was limited to only the Barrow area. The North Slope Borough is also actively monitoring fish health (metals, disease) in the area around Nuiqsut and maintains these data.

Surveys of subsistence fishermen have also helped provide insights on possible climate-induced changes in Arctic fisheries. A recent BOEM-funded a study (http://catalog.northslope.org/catalogs/11456-subsistence-use-and-knowledge-of-salmon-in-barr) interviewed subsistence fishermen from Barrow and Nuiqsut in an effort to determine if the abundance and use of salmon was changing along the North Slope. The study concluded that "while perceptions about overall abundance patterns vary, the weight of evidence suggests that salmon catches in Barrow and Nuiqsut are increasing" and that "dramatic cultural and environmental change has resulted in alteration of the timing, location, and technique of subsistence fishing practices."

Regarding fish abundance and distribution and access to such information, the Bureau of Ocean Energy Management (BOEM) and U.S. Geological Survey (USGS) have completed a synthesis of information on Arctic marine fishes (Arctic Fish Ecology Catalogue, see: http://catalog.northslope.org/catalogs/526-arctic-fish-ecology-catalogue-ak-07). Other current data sets include data from the Arctic Marine Synthesis (Audobon and Oceana), Essential Fish Habitat (NOAA), Anadromous Waters Catalog (ADFG), and results of a joint US/Russian Survey of the Chukchi called RUSALCA (NOAA).

However, the STAP did not find that a "comprehensive and easily accessible database" of such information had yet been developed.

Several other data sets, including integrated shoreline surveys underway through the North Slope Borough, are currently in various stages of completion and will eventually appear in the North Slope Science Catalog (http://catalog.northslope.org) and, for those that solely address marine species, may also appear in the data management system of the Alaska Ocean Observing System (AOOS, http://www.aoos.org).

With regard to differentiating between environmental and anthropogenic changes and the need for long-term studies of marine fishes, the STAP was unable to find sufficiently comprehensive studies that combined long-term fish population and environmental monitoring to be able to fully address the differentiation issue. However, several long-term studies of more limited spatial scales are underway. The longest time series is likely the fyke net catches at West Dock in Prudhoe Bay. This 32 year time series is maintained by LGL Alaska Research Associates, Inc. LTD. An ongoing study demonstrates the utility of this long-term data set. Bill Streever (BP, former Chair of the NSSI Science Technical Advisory Panel), along with private consultants is assessing responses of nearshore Beaufort Sea fish to airgun sounds. Their study takes advantage of catch data from 32 years of sampling at the fyke net locations prior to airgun operations as well as catch data coupled with acoustic measurements at each of the four fyke nets during airgun operations in 2014. Results of their study are expected to be submitted to a peer reviewed journal soon.

The North Slope Borough also maintains another time series for fyke nets sampling in Elson Lagoon and NOAA has been sampling the nearshore around Pt. Barrow with beach seines since 2007. The BOEM-sponsored Synthesis of Arctic Research (http://www.boem.gov/IM_1602) recently published a review of fishery oceanography surveys conducted in the Chukchi and Beaufort Seas. NOAA, with funding from BOEM and CIAP, has begun conducting broad scale surveys of the Chukchi and Beaufort Seas.

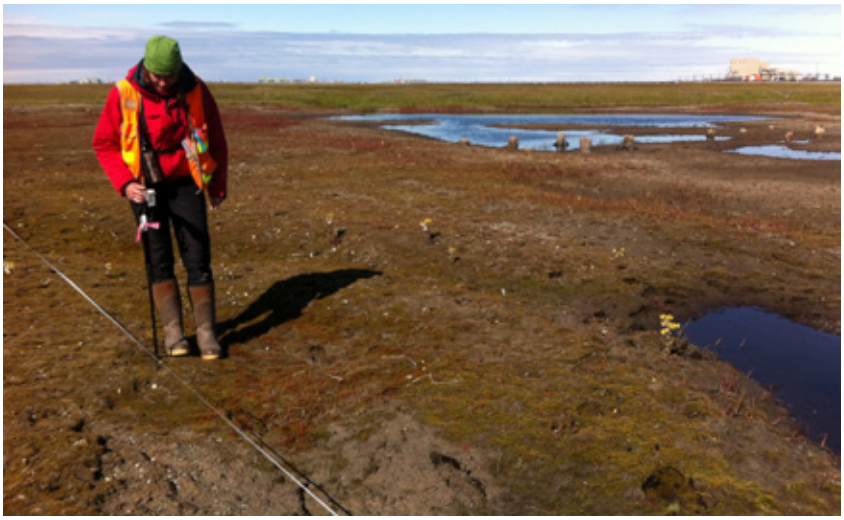
Long-term monitoring and standardization of survey techniques were among the STAP recommendations. However, the STAP's recent review concluded that standards for long-term monitoring of fish populations have not been initiated for the North Slope and will depend on the management objectives. They further concluded that standards developed for fisheries research in the Bering Sea are not applicable to the Chukchi and Beaufort Seas due to different habitat characteristics and fish communities. NOAA surveys in the Chukchi occupied stations in the Distributed Biological Observatory (DBO, http://www.arctic.noaa.gov/dbo) but there are no standardized fish methods prescribed for the DBO. The goal,

Robert (Capt. Bob) Meyer, a current NSSI Science Technical Advisory Panel member, and his crew sort a trawl sample from the Chukchi Sea. (NOAA)

however, of the DBO is "full-implementation of standardized ocean sampling in five regions of high productivity and biodiversity that extend from the northern Bering Sea, to the Chukchi and Beaufort Seas." UAF, with BOEM funding, recently completed marine fish surveys in the Central and Eastern Beaufort Sea with final reports expected in 2016.

Ecosystem models for North Slope fish populations are still under development. For example, an EcoPath model has been constructed as one of the products of the Arctic Ecosystem Integrated Survey project (https://web.sfos.uaf.edu/wordpress/arcticeis). This model seeks to identify the trophic linkages among fish, their prey and predators in the Chukchi Sea with hopes of developing into a reliable tool for predicting future change. Acquisition of isotopic data during Arctic EIS is expected to aid in refining the model. The broader Arctic EIS survey (funded predominantly by BOEM) was a fishery oceanography survey that combined measurements of water column characteristics with observations of zooplankton abundance and distribution to explain patterns in fish abundance, diet, distribution and condition. In combination with the DBO effort, discussed above, these hold considerable promise for better understanding the relationship between fisheries and the physical conditions of their environment.

Tundra Rehabilitation and Restoration



Vegetation monitoring at a tundra rehabilitation site on the North Slope. (L.Lynn, HDR)

The Emerging Issue Summary on rehabilitation and restoration of disturbed tundra (http://northslope.org/issues/tundra) provided an excellent summary of some of the advances and shortcomings of past and current efforts and directly addresses a series of management-focused questions. The STAP's recommendations on this topic focused on the need for updated guidelines, opportunities for collaboration and the need for more detailed information and data analyses from various site monitoring reports. Early indications from the NSSI's ongoing Energy and Resource Development Scenarios Project (see next section) are that the implications of a low production scenario could make the decommissioning and reclamation of infrastructure sites a very high priority. This underscores the potential importance of making progress on addressing tundra rehabilitation and restoration science needs.

Industry guidelines were reviewed and revised in 2014. The Alaska Department of Environmental Conservation, with assistance from ABR consultant Tim Cater and others, prepared "Tundra Treatment Guidelines: A Manual for Treating Oil and Hazardous Substance Spills to Tundra, Third Edition in 2010" with a section on "Tundra Rehabilitation Tactics" (see: http://dec.alaska.gov/spar/ppr/r_d/ttman/web/Tundra%20Treatment%20Guidelines%203rd%20Ed.%202010.pdf). The Alaska Department of Fish and Game (led by Al Ott, Jack Winters, Bill Morris, and Parker Bradley) also prepared "North

Slope Flooded Gravel Mine Sites, Case Histories, Technical Report 12-04" in 2014 (http://www.adfg.alaska.gov/static/home/library/pdfs/habitat/12_04.pdf). This publication offers insights relevant to gravel mine site rehabilitation. However, no systematic effort is in place to review guidelines by regulatory agencies on a periodic basis (e.g., every 10 years, per STAP recommendation).

The STAP recommended that industry, state, federal and local agencies meet annually to discuss progress on existing rehabilitation projects and plans for future restoration projects. Annual meetings and site visits of this sort have occurred, typically organized by regulated industries but with participation from agencies, consulting firms, and others. The most recent annual meeting was held on 6 May 2015, with about thirty participants.

With regard to providing more detailed information and data analyses, the Alaska Gasline Development Corporation has recently contracted for an annotated review of rehabilitation methods. Aside from the NSSI Emerging Issue Summary itself, no single paper has been generated to summarize recent advances, although the STAP reports that papers are in press or in preparation to summarize individual efforts. For example, Tim Cater (ABR), Inupiaq elder Charles Hopson, and Bill Streever (BP) have a paper on "The Use of the Iñupiaq Technique of Tundra Sodding to Rehabilitate Wetlands in Northern Alaska" that is to be published later this year in peer-reviewed journal Arctic (http://arctic.ucalgary.ca/papers-appear-arctic).

Progress on the Energy and Resource Development Scenarios Project

The North Slope Science Initiative is in the midst of a scenarios project to help identify plausible energy and resource development futures for the North Slope and adjacent seas in order to inform future investment in appropriately targeted research and monitoring. The use of scenarios, an approach recommended in the "Integrated Arctic Management" Report to the President (Clement et al. 2013), is a deliberative and inclusive process that helps engage diverse stakeholders in thinking creatively yet realistically about plausible futures in a complex and uncertain environment. Listening to both local knowledge holders and regional or issue experts will provide direct benefits to NSSI by helping us get a realistic picture of what the future may hold and how that translates into the long-term information that will be needed to inform future management decisions.

The NSSI Scenarios Project is designed around a series of three workshops, the first to help identify plausible energy and resource development scenarios; the second to identify the plausible implications of those scenarios; and the third to translate those implications into the research and monitoring that may be needed to understand and manage the implications of the identified scenarios. The project is being carried out through an agreement between the NSSI and a team formed by personnel from the University of Alaska Fairbanks (with their extensive Arctic and North Slope experience) and GeoAdaptive LLC (a consulting firm with global experience in geospatial and participatory scenarios projects).

The first workshop, the "Scenario Identification Workshop," was held in November 2014 with participants from North Slope communities, industry, non-governmental organizations, state and federal agencies, and academia. All participants jointly engaged in a thoughtful discussion of the range of plausible futures for energy and resource development on the North Slope and adjacent seas.

The participants considered what a high, medium and low scenario for development might look like and what factors may affect how each future could come to pass. After the workshop, the organizers evaluated workshop outcomes for identified drivers of change, operational assumptions, scenario narratives, geographic representations (schematic maps), and participant assessments of scenario plausibility.

Ice cellar near Wainwright, Alaska, is threatened by permafrost degradation and increasing coastal inundation. (L.Erikson, USGS)

Scenario narratives were transcribed; map annotations were converted to a digital spatially-referenced format; and spatial and statistical analysis was applied to explore energy and resource development under each scenario. These were then compared against the best available data from scientific efforts and industry sources to further refine the locations of major activities and infrastructure that were highlighted in the three selected scenarios. To prepare for the second workshop, visual representations were made of the high, medium and low scenarios selected in the Scenario Identification Workshop and an initial characterization of the types and locations of the potential implications associated with each scenario was developed.

The second, or "Scenario Implications Workshop," was held in June 2015 and brought together a similarly diverse group of knowledge holders to begin to assess the potential biological, physical and socio-economic implications of the scenarios that participants identified in the first workshop. The types of potential implications and their geographic extent were discussed in breakout groups, each of which included a cross-section of participant expertise and background. Each group assessed the three scenarios to prioritize and select what they felt were the most critical of the plausible implications in terms of its importance to resource management decisions, the intensity or geographic extent of the implication, and the level of existing knowledge (or uncertainty) about the implication. Each breakout group then explained to all workshop participants why their top 7 categories were selected for each of the 3 scenarios and took the broader group's input on how they may further consider their choices.

The breakout groups reconvened to consider the maps and narratives of the high, medium, and low development scenarios, and indicated which features of the scenarios they thought would trigger changes to the 7 previously identified subcategories. After further prioritization within the breakout groups, the extent of each implication was then sketched on maps of each scenario. Each group's results were presented to all workshop participants and a preliminary selection process was undertaken to collect feedback from participants on the most plausible implications, as well as the top ranking suite of implications for each scenario.

All results are still preliminary at the time of writing this report, but the range of identified high priority areas of importance for future research and monitoring certainly highlighted how integrated natural resources, subsistence cultural practices, and socio-economic issues are on the North Slope. For example, understanding the potential implications of a marine oil spill were preliminarily identified as a high priority under the high development scenario, as were the complex potential interactions between energy development and both marine subsistence harvest and terrestrial hunting and trapping. Similarly, under the medium development scenarios, marine oil spill implications were again preliminarily identified as high priority, along with monitoring and understanding the potential effects of development on community culture. Physical factors like permafrost degradation and erosion also ranked out as fairly high priorities, in some cases even under the low development scenario. Interestingly, other high priority issues preliminarily identified as in need of future research and monitoring under the low development scenario included health and safety issues (relating to diet and potential lack of infrastructure) and the potential for extensive decommissioning and reclamation if infrastructure is abandoned under this scenario.

The final workshop will further explore the specific nature of how, and possibly where, research and monitoring can help NSSI member agencies and their partners begin to appropriately target their information gathering efforts in order to best inform future resource management decisions. The full NSSI Scenarios Project is slated for completion in early 2016 and will be followed by extensive outreach to NSSI member agencies and the publics they serve, in particular including the North Slope villages who will surely be the most directly influenced by whatever scenario actually comes to pass.

Jim Hemsath (AIDEA, left), Gordon Brower (NSB Planning, center), Bob Winfree (NPS, retired, right) and others participate in assessing drivers of change in the first NSSI Scenarios Project workshop. (GeoAdaptive)

George Olemaun (Inupiat Community of the Arctic Slope) and others in his breakout group consider a range of potential scenario implications during the second workshop of the NSSI Scenarios Project. (GeoAdaptive)

Qaiyaan Harcharek (NSB Division of Wildlife Management, seated with cap on) works with Cheryl Rosa (USARC, drawing on map) to help map out potential implications during the second workshop of the NSSI Scenarios Project. (GeoAdaptive)

Data Management and Information Sharing

Central to the NSSI mission is the coordination and collection of management-relevant scientific information to promote a better understanding of the terrestrial, aquatic and marine ecosystems of the North Slope of Alaska and their links to the circumpolar Arctic region. To accomplish this, the NSSI has been working with the University of Alaska – Geophysical Institute to develop a web-based information exchange called North Slope Science Catalog (http://catalog.northslope.org). Located within the Geographic Information Network of Alaska (GINA), Catalog provides project tracking information and data resources to scientists and the general public.

North Slope Science Catalog (http://catalog.northslope.org) has been updated to incorporate new technology and tools in 2013 and 2014. (NSSI)

Project Tracking

Catalog maintains project tracking information that describes the who, what, when and where of ongoing scientific research relevant to the North Slope. This allows researchers and the general public to be better informed of ongoing work by a host of scientists and provides managers with a strategic view of scientific research by describing current efforts and anticipated data products. A wide range of ongoing science-based projects are described in the project tracking system including field sampling, modeling, teacher training and facility/systems infrastructure development. NSSI works closely with its members to update project information.

Catalog project tracking information was used by the NSSI Science Technical Advisory Panel (STAP) to complete an inventory of long-term monitoring projects in the U.S. Arctic. This listing is updated annually based on STAP and partner input and is available at the Catalog website. Information from this system was also extensively used by the STAP to review recent progress made in addressing the recommendations made in the NSSI's Emerging Issue Summaries series (see related section in this Report). Energy industry sources in Alaska have also noted the value of this regularly updated compilation of information saying it is "very, very helpful to have in one place" (B.Streever, BP Alaska).

Western Arctic Caribou Herd. (K. Joly, NPS)

Data Management

Catalog works closely with the data management systems of our partners to leverage existing capacity and provide a wide range of online products and data management services. Catalog is designed to serve as a permanent data repository providing web-based data management services for users that might not otherwise have access to data archival resources. In addition, information products from over 40 additional public repositories are discoverable at the Catalog website using advanced search tools. Products are downloaded directly if they are stored within Catalog or the user is directed to the appropriate remote site for download. This allows information products to be curated by the authoritative source, ensuring users get up to date and accurate information and eliminating duplicative effort. NSSI is a founding member of the Alaska Data Integration Working Group (ADiWG) and uses

the ADiWG metadata standards. Over the coming year Catalog will increase data interoperability with other federal data holdings using this standard. The technology behind Catalog will also be undergoing substantial software update to take advantage of continually improving technology and resources.

Data Development

The NSSI also uses Catalog to work closely with partners to build and distribute comprehensive data sets that provide a uniform and consistent description of North Slope resources. These comprehensive data can be crucial for regional planning and are produced in collaboration with partners through the careful compilation of many existing site-specific data sets as well as additional research. In previous years NSSI has produced the first comprehensive North Slope land cover map and a North Slope wide inventory of winter lake water resources. Working with Arctic Landscape Conservation Cooperative (ALCC) and other partners, NSSI has developed a northern Alaska map of ecological landscapes and permafrost. This data set was recently updated to incorporate further analysis. Together with the ALCC, North Slope Science Catalog is continuing to update a comprehensive database of North Slope meteorological and hydrological records. Having the individual data sets compiled and reviewed by appropriate scientists allows the development of a standardized database with parameters and values that are comparable over time and across the North Slope region. This kind of data was identified by the NSSI Science Technical Advisory Panel as an overarching priority for addressing a wide range of management concerns.

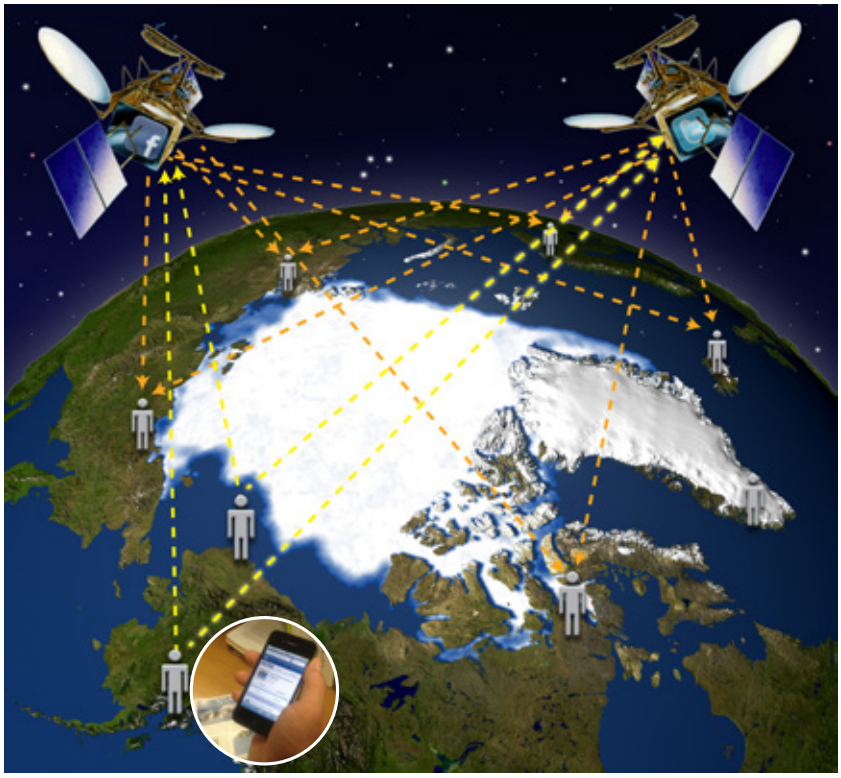
The NSSI continues to work with GINA to develop satellite ortho-imagery resources for the North Slope. Recently the delivery of ortho-imagery for the North Slope region was completed and provides comprehensive detailed images throughout the North Slope. GINA is continuing to develop imagery resources and recently completed production of ortho-imagery from 1949 for the Prudhoe Bay region that can be used for change detection. In the coming year, the NSSI will work with partners to develop a North Slope infrastructure data base. This work will involve compilation of existing information from a variety of sources and validation of those data using ortho-imagery as appropriate.

A very high data management priority over the last year has been coordination with the ongoing NSSI Scenarios Project (see related section in this Report). That project requires coordinated input from NSSI and partners to ensure access to accurate information. We continue to work closely with the Bureau of Land Management's Rapid Ecological Assessment program and other data providers to compile a wide range of North Slope social and ecological data for the Scenarios effort.

The NSSI, through Catalog, is also partnering with NASA and the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR) to assist in compiling data and information products relevant to the North Slope. For example, the NASA Arctic-Boreal Vulnerability Experiment (ABoVE) specifically leveraged NSSI's Catalog technology to compile existing geobotanical data and imagery (http://agc.portal.gina.alaska.edu/above) and will be sharing its records with North Slope Science Catalog as this major NASA field campaign advances. The EPSCoR Northern Test Case is similarly using Catalog to archive relevant data as part of its research into community resilience and adaptive capacity. This partnership with EPSCoR is particularly relevant to North Slope managers and residents because a core focus is on examining the mechanisms by which communities adapt to environmental and social change.

Outreach and Communications

Communicating about science on the North Slope is essential to NSSI's mission. With increased focus on the Arctic related to the U.S. Chairmanship of the Arctic Council, NSSI is playing an important role as a conduit for communicating the latest science to inform policy discussions. It is with that in mind that the NSSI has been active on the web and social media during the past year.



NSSI communications span the Arctic to support a growing connection from local to international science and knowledge. (NASA and NSSI)

The NSSI website http://www.northslope.org was revamped in 2015 to update the look and sharpen its focus. The emphasis is now on up-to-date NSSI content, with a special section for Arctic-related documents and publications. This section is intended to help provide context for greater understanding of the strategic priorities to address the unique challenges facing the Arctic. In addition, the website now features multiple links to direct visitors to the research and monitoring data found on the North Slope Science Catalog site.

NSSI saw increased visibility through its social media activities in 2015 as the number of people following NSSI's Facebook posts more than doubled. In addition, the NSSI Facebook page is now linked to the NSSI Twitter account, so all Facebook postings are automatically posted to Twitter. The NSSI Twitter account saw modest growth in followers during the past year.

The NSSI 2015 calendar proved to be an especially popular communication tool. The calendar featured photos of North Slope subsistence activities and species. The calendar communicates the NSSI mission to residents of the North Slope, as well as the international network of Arctic scientists, government agencies, indigenous organizations and conservation groups. In addition, it makes the important link between subsistence species and the need for increased understanding of Arctic ecosystems in a time of rapid change. NSSI will continue to use this important tool in the future to communicate about science being done on the North Slope.

To stay current with North Slope issues and information, anyone can now "Like" our Facebook pages and "Follow" us on Twitter at:

http://www.facebook.com/NorthSlopeScienceInitiative http://www.twitter.com/NSlopeScience

Perafrost Erosion. (USGS)

NSSI Uses its Expertise to Influence Arctic Monitoring

The North Slope Science Initiative continues to represent the U.S. as co-lead for the Circumpolar Biodiversity Monitoring Program (CBMP) along with the Kingdom of Denmark (Denmark, Greenland and Faroe Islands). The NSSI, at the request of the Department of the Interior (DOI), initiated the first partnership with the CBMP several years ago when the CBMP was charged with developing a coordinated monitoring plan for Arctic terrestrial ecosystems. The DOI recognized that the NSSI was deeply involved with addressing much of the North Slope terrestrial environment and deemed that our experience on the North Slope with long-term monitoring would be a natural fit. During the development of the terrestrial CBMP strategy, the Bureau of Land Management offered considerable expertise using its recently developed Assessment, Inventory and Monitoring Program (AIM) which was being piloted in the National Petroleum Reserve in Alaska.

The efforts of NSSI and BLM were so successful with the terrestrial CBMP that the Conservation of Arctic Flora and Fauna Working Group of the Arctic Council asked if the NSSI and BLM would co-lead the entire CBMP which included the marine, freshwater, terrestrial and coastal monitoring strategies. NSSI and BLM accepted the challenge to develop a significant international partnership with all eight Arctic Council nations and has since successfully coordinated the marine, freshwater and terrestrial monitoring programs. The final international monitoring plan under development is the coastal CBMP. This is the most complex of the four plans as coastal landscapes are the intersection of the marine, freshwater and terrestrial environments, and an area with significant challenges related to climate change, industrial activities and human settlements. During the past year, NSSI, BLM, USGS and Canada have begun working with the other Arctic Council nations that have coastal territory to develop a comprehensive and coordinated monitoring strategy.

Some background on the CBMP

The CBMP is an international network of scientists, government agencies, indigenous organizations and conservation groups working together to harmonize and integrate efforts to monitor the Arctic's living resources in the marine, freshwater, terrestrial and coastal environments – the Arctic's major ecosystems. Results from the implementation of these four thematic areas will be channeled into effective conservation, mitigation and adaptation policies supporting the people and ecosystems of the Arctic.

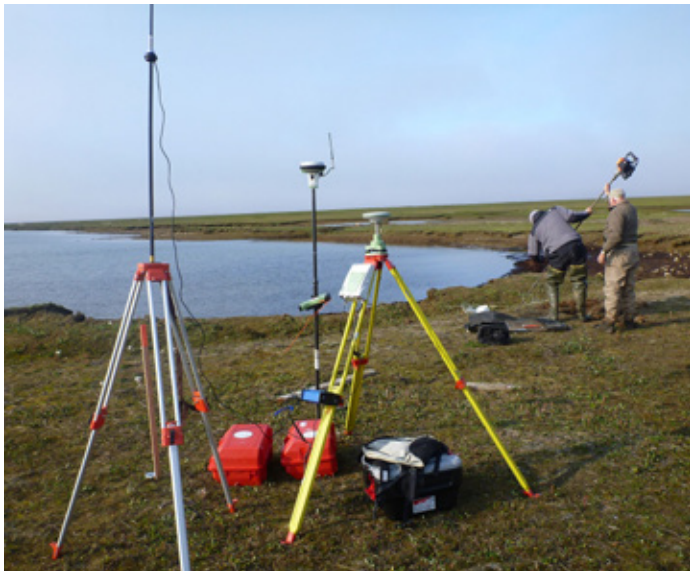
The CBMP facilitates Arctic biodiversity conservation and the sustainable use of the region's natural resources. Its goal is to facilitate more rapid detection, communication, and response to significant biodiversity-related trends and pressures. It does this by:

- Harmonizing and enhancing Arctic monitoring efforts, thereby improving the ability to detect and understand significant trends; and,
- Reporting to, and communicating with, key decision makers and stakeholders, thereby enabling effective conservation and adaptation responses to changes in Arctic biodiversity.

There are hundreds of biodiversity-related monitoring programs currently underway in the Arctic. Over half a billion dollars is spent on monitoring the Arctic's living resources annually. However, this monitoring remains largely uncoordinated, which limits the ability to detect and understand circumpolar changes. Lack of coordination and technical information can impede coherent and effective decision-making.

Meanwhile, Arctic biodiversity faces a multitude of pressures and stressors, leaving communities vulnerable and increasing the urgency to manage responsibility. The Arctic's significant contribution to the Earth's physical, chemical, and biological balance makes the maintenance of healthy Arctic ecosystems a global imperative. Yet, the Arctic is under increasing stress from climate change and resource development, with unpredictable consequences for biodiversity.

The CBMP is coordinating the wide range of Arctic biodiversity monitoring activity spanning biological, geographical, and climatic disciplines. This includes standardizing practices, coordinating and integrating information across the Arctic, and providing services in biodiversity management through the Arctic Biodiversity Data Service, which effectively interface with the NSSI data catalog and project management tracking systems (http://catalog.northslope.org), helping decision-making on the North Slope and in other Arctic nations.



Ground surveys on Ikpikpuk River delta. (B. Jones, USGS)

In the context of arctic biodiversity monitoring, this "network of networks" approach recognizes:

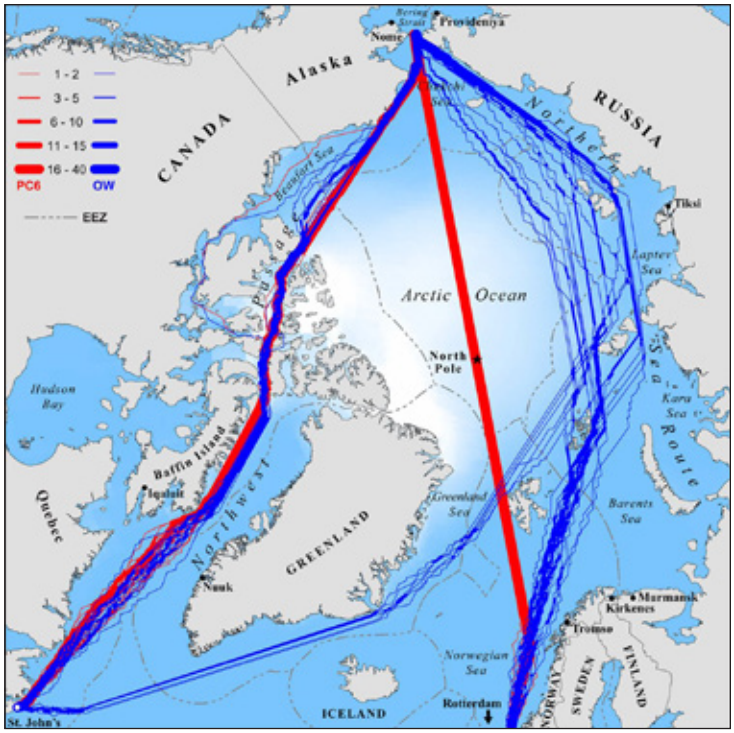
- The importance of some species and species groups to both the people and biodiversity of the Arctic;
- The value of building on existing arctic monitoring capacity, which is mostly organized via networks;
- That species-based monitoring is an established and effective method well suited for standardization across the circumpolar Arctic; and,
- The importance of building on the strong linkages between scientific and community-based monitoring found in some networks.

The CBMP works with partners to develop and promote measures for biotic elements across the Arctic, including expansion to new networks. Linkages will be established with other monitoring networks focusing on abiotic or extra-Arctic biological elements with impacts on and/or which overlaps with arctic biodiversity.

Southeast end Deadhorse runway flooding resulted from aufeis on the Sag River. (J.Organek ADOT)

Coordination and Cooperation

One of the primary goals of local, state, and federal partners when forming the North Slope Science Initiative was to improve upon their awareness and collective understanding of each other's missions, management concerns, and science needs and to promote cooperation in addressing their shared concerns and needs. This purpose was solidified under the enabling legislation that emphasized coordination of ongoing and future inventory; monitoring and research activities; and cooperation among NSSI parties and the broader scientific community. The structure and organization of the NSSI was designed to enable, and NSSI leadership has promoted, the communications needed to accomplish this purpose.



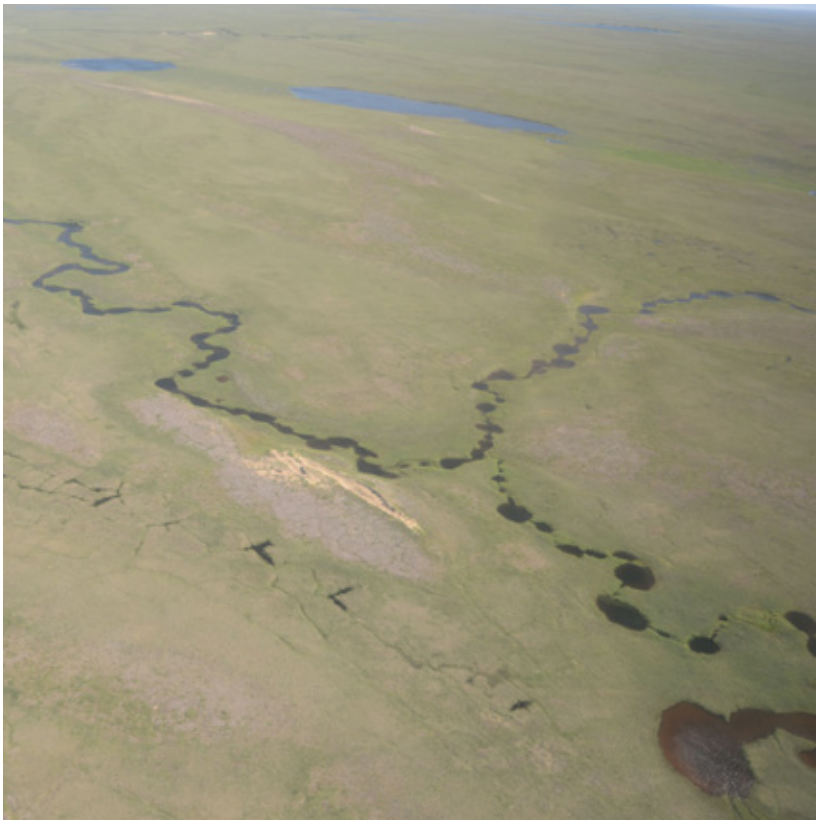
Projection of potential future ship traffic across the circumpolar Arctic. (NAS)

External Communication

The mission and administrative structure of NSSI requires a viable network of external contacts with academia, non-governmental entities, industry, and other science organizations. These contacts bring together potential partners, add a broader knowledge of North Slope endeavors, and assure scientific excellence in NSSI products. Networking for NSSI is accomplished in three major categories through: 1) internal communications with member agencies to gain knowledge of projects or programs occurring or planned for the North Slope (facilitated by an annual coordination meeting of the Senior Staff Committee and through the North Slope Science Catalog); 2) Science Technical Advisory Panel expertise (enabled through several face-to-face meetings each year); and 3) academia, workshops, seminars, interaction with the National Science Foundation Office of Polar Programs, and other external networks having knowledge of arctic and pan-arctic environments (see Appendix 4).

Collaboration under Presidential Executive Order 13580

Executive Order 13580 (July 2011), Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, declares it to be U.S. policy that "Interagency coordination is important for the safe, responsible, and efficient development of oil and natural gas resources in Alaska, both onshore and on the Alaska Outer Continental Shelf (OCS), while protecting human health and the environment, as well as indigenous populations." In furtherance of this policy statement, the Executive Order established the Alaska Interagency Working Group (AIWG), led by the Department of the



Beaded stream network on coastal plain. (B. Jones, USGS)

Interior with representation from the Departments of Defense, Commerce, Agriculture, Energy, Homeland Security, the Environmental Protection Agency and the Office of the Federal Coordinator for Alaska Natural Gas Transportation Projects.

Among the assigned functions of this working group were to "facilitate the sharing of information and best practices," "ensure the sharing and integrity of scientific and environmental information and cultural and traditional knowledge among agencies", and "promote interagency dialogue." A regional, Alaska-based working group complements and informs the national AIWG. Given these charges, the NSSI has fully engaged with and supported both the regional and national AIWG discussions.

For example, the NSSI-generated Emerging Issue Summaries (see: http://northslope.org/issues) contribute directly to AIWG purposes such as helping the federal government to use a comprehensive, science-based approach and to fill science needs in a broad spectrum of disciplines. We also help the AIWG in its efforts to facilitate the delivery of relevant scientific information to officials responsible for making decisions related to energy development in Alaska and to include non-federal scientists, NGOs, industry officials, Alaska Natives, and State and Federal decision-makers in that dialogue. The structure of the NSSI, particularly with regularly scheduled and structured interactions between the Science Technical Advisory Panel and the NSSI Oversight Group, directly contributes to the delivery of this commitment. NSSI staff also participates in the AIWG's coordination calls and contributes information and services (e.g., web-hosting) as needed.

Collaboration with Arctic Research and Policy

The Arctic Research and Policy Act of 1984, Public Law 98-373, July 31, 1984; amended as Public Law 101-609, November 16, 1990 (ARPA), provides for a comprehensive national policy dealing with national research needs and objectives in the Arctic. The Act was followed on January 9, 2009, by two Presidential Directives (NSPD-66 and HSPD-25) that brought U.S. Arctic policy to the forefront of security and climate change. The ARPA established the U.S. Arctic Research Commission (USARC) and an Interagency Arctic Research Policy Committee (IARPC) to help implement the Act. The NSSI is a formal member of the IARPC as an independent organization. NSSI membership and participation

in IARPC programs is important and mutually beneficial to both entities because of their difference in reach, but similarity in mission. For example, the NSSI Executive Director (as panelist) and Deputy Director (as facilitator), on behalf of the IARPC, helped organize and run a "Collaborative Research Approaches" workshop in Anchorage in January 2013.

The mission of IARPC:

- Helps set priorities for future Arctic research;
- Works with the Arctic Research Commission to develop and establish an integrated national Arctic research policy to guide federal agencies in developing and implementing their research programs in the Arctic;
- Consults with the Arctic Research Commission on matters related to Arctic research policy, programs and funding support;
- Develops a five-year plan to implement the national policy, and updates the plan biennially;
- Coordinates preparation of multi-agency budget documents for Arctic research;
- Facilitates cooperation between the federal, state, and local governments in scientific Arctic research;
- Coordinates and promotes cooperative scientific Arctic research programs with other nations;
- Promotes federal interagency coordination of Arctic research activities, including logistical planning and data sharing; and,
- Submits a biennial report to Congress through the President, containing a statement of the activities and accomplishments of the IARPC since its last report.

Having principal investigator status in the development of the Arctic Observing Network and the larger Sustained Arctic Observing Network furthers the goals of the NSSI and expands networking capabilities and future partnership opportunities for Arctic activities outside the NSSI organization. There is strategic value to the NSSI in developing information sharing tools for the long-term sustainability of Arctic data. To this end, the NSSI has positioned itself as a key player and contributor for the design and development of both the U.S. and the international observing systems.

Large dolly varden, *Salvelinus malma*. (J. Wenberg USFWS)

NSSI Internal Communication

Even before the formation of the NSSI, the various member organizations each supported a range of inventory, monitoring, and research activities. That level of ongoing activity continues, but the substantial benefit of the organizational structure of the NSSI is that the Oversight Group members and their senior staff regularly communicate and coordinate new and ongoing projects and their implications to management decisions. The Oversight Group generally meets three to four times a year; the Senior Staff Committee often meets jointly with the Science Technical Advisory Panel a similar number of times a year. These groups discuss each agency's specific North Slope issues and use of science for better decision making. Each of the accomplishments described in this report has benefited from NSSI-assisted coordination.

NSSI Member Agency Cooperative Science on the North Slope

The NSSI has also provided a forum for its members to build on their own agency's study or research programs. Each year, the members of the Senior Staff Committee gather to present their individual agency projects planned for the upcoming fiscal year. This forum provides a basis for additional cooperation and collaboration that is focused on the work each agency is planning within their mandates. They can share, collaborate, and coordinate both knowledge and resources (e.g., monetary, equipment, and human capital). Such interface also helps determine future information needs by providing these forums for emerging management questions. Descriptions of some of the coordinated science efforts of each NSSI agency that has an operational component on the North Slope can be viewed either on the NSSI website through the Data and Projects Search portal (http://catalog.northslope.org/search) or on each of the member agency websites.

Polar Bear on the coast. (Mike and Patsy Aamodt)

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For additional information on the North Slope of Alaska, or the membership organizations of the North Slope Science Initiative, please visit these websites:

Federal:

Bureau of Land Management, Alaska	http://www.blm.gov/ak
Bureau of Ocean Energy Management, Alaska OCS Region	http://www.boem.gov/Alaska-Region/
Bureau of Safety and Environmental Enforcement, Alaska OCS Region	http://www.bsee.gov
National Park Service, Alaska Region	http://www.nps.gov/akso
National Marine Fisheries Service, Alaska Region	http://alaskafisheries.noaa.gov
National Weather Service, Alaska Region	http://www.arh.noaa.gov
U.S. Arctic Research Commission	http://www.arctic.gov
U.S. Fish and Wildlife Service, Alaska Region	http://alaska.fws.gov
U.S. Geological Survey, Alaska Science Center	http://alaska.usgs.gov
U.S. Department of Energy, Arctic Energy Office	http://www.netl.doe.gov/technologies/oil-gas/AEO/main.html
U.S. Coast Guard	http://www.uscg.mil

North Slope:

North Slope Borough	http://www.north-slope.org
Arctic Slope Regional Corporation	http://www.asrc.com

State of Alaska:

Alaska Department of Fish and Game	http://www.adfg.alaska.gov
Alaska Department of Natural Resources	http://dnr.alaska.gov

Appendix 1: Oversight Group Charter

1. **Official Designation:** North Slope Science Initiative, North Slope Science Oversight Group (hereafter the Oversight Group).

2. **Background and Need:** Alaska's North Slope and adjacent seas provide important terrestrial, estuarine, and marine habitat for a wide range of fish, migratory birds, terrestrial and marine mammals (for example, caribou, seals, whales), and other species that are culturally important to many Alaska Natives and their communities. This area is also believed to have some of the largest remaining oil, gas, and coal potential in the United States. As production from these reserves becomes more economically feasible, the strategic and economic importance of the North Slope's energy resources will be even greater. In sustaining these resources and planning for safe energy exploration and development, managers also face the challenge of a rapidly changing Arctic climate. The domestic and international scale of these challenges, opportunities, and changes are of such magnitude that there is federal, state, and local consensus that enhanced, coordinated, and sustained inventory, monitoring, and research are vital to supporting an integrated ecosystem-based management approach. In response, federal, state, and local governments collectively formed the North Slope Science Initiative, which was formally authorized under the Energy Policy Act of 2005 (Public Law 109-58, Sec. 348).

3. **Mission:** The mission of the Oversight Group is to enhance the quality and quantity of the scientific information available for aquatic, terrestrial, and marine environments on the North Slope and to make this information available to decision makers, governmental agencies, industry, and the public. This mission will be accomplished through a coordinated and integrated approach to conducting inventory, monitoring, and research activities on the North Slope.

4. **Goals:** The Oversight Group directs and facilitates a coordinated approach to information gathering and analysis on the North Slope and its associated marine environment, including the integration of contemporary and traditional local knowledge. Specifically, the Oversight Group will:

    - Develop an understanding of informational needs for regulatory and land management agencies, local governments, and the public;
    - Identify and prioritize informational needs for inventory, monitoring, and research activities to address the impacts of past, ongoing, and anticipated development activities on the North Slope;
    - Coordinate ongoing and future inventory, monitoring, and research activities to minimize duplication of effort, share financial resources and expertise, and assure the collection of quality information;
    - Identify priority needs not addressed by existing agency science programs, and develop a funding strategy to meet these needs;

- Maintain and improve public and agency access to accumulated and ongoing research, and to contemporary and traditional local knowledge; and

- Ensure through appropriate peer review that the science conducted under the oversight of the NSSI and by participating NSSI agencies and organizations is of the highest technical quality.

5. **Membership:** The Oversight Group consists of the following member agencies with voting privileges: the State Director of the Bureau of Land Management; the Regional Directors of the U.S. Fish and Wildlife Service, National Park Service, National Marine Fisheries Service, and the Bureau of Ocean Energy Management; the Commissioners of the Alaska Department of Natural Resources and the Alaska Department of Fish and Game; the Arctic Slope Regional Corporation President; and the Mayor of the North Slope Borough. These represent the principal agencies at the regional, State, and Federal levels with management responsibilities for public lands, fish, and wildlife on the North Slope. In addition, the U.S. Geological Survey, National Weather Service, and U.S. Arctic Research Commission will participate on the Oversight Group as the primary advisory agencies on science issues related to the North Slope, but will not have voting privileges.

6. **Summary of Agency Missions and Roles:**

A. Federal/Voting

1. Bureau of Land Management collaboratively manages its Alaska lands and its uses on the North Slope to promote healthy and productive ecosystems for present and future generations, in accordance with the Federal Land Policy Management Act (FLPMA) and the Naval Petroleum Reserves Production Act of 1976 (NPRPA). The NPRPA encourages oil and gas leasing in the National Petroleum Reserve in Alaska (NPR-A), while requiring protection of important surface resources and uses, including any activities related to the protection of environmental, fish and wildlife, and historical or scenic values.

2. U.S. Fish and Wildlife Service is one of the primary natural resource-management agencies on the North Slope. The mission of the Fish and Wildlife Service is to work with others to conserve, protect, and enhance the fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The Fish and Wildlife Service manages the 19-million acre Arctic National Wildlife Refuge in northeast Alaska and has primary management authority for migratory birds, certain threatened and endangered species, polar bear, and Pacific walrus. The Service also cooperates with other Federal and State agencies and various industries to minimize the effects of development on fish and wildlife resources. To accomplish this mission, the Service is involved in a variety of research, monitoring, and management projects on the North Slope and in the adjacent coastal waters of the Beaufort Sea.

3. Bureau of Ocean Energy Management manages the exploration and development of the nation's offshore resources. It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies. Functions include: Leasing,

Plan Administration, Environmental Studies, National Environmental Policy Act (NEPA) Analysis, Resource Evaluation, Economic Analysis and the Renewable Energy Program.

4. National Park Service preserves the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

5. NOAA/National Marine Fisheries Service (NMFS) provides stewardship of living marine resources through science-based conservation and management and the promotion of healthy ecosystems. NMFS activities on Alaska's North Slope include consultation and coordination regarding federal water development projects under the Fish and Wildlife Coordination Act and other laws, consultation regarding the effects of federal actions on species listed under the Endangered Species Act, and authorizations for the unintentional take of small numbers of marine mammals under the Marine Mammal Protection Act. NMFS also conducts research concerning marine mammals and fish under NMFS jurisdiction. NMFS assesses populations of bowhead whales, ribbon seals, ringed seals, spotted seals, and bearded seals, and works routinely with partners in Alaska Native Organizations such as the Alaska Eskimo Whaling Commission and the Ice Seal Committee. Additionally, NMFS staffs the U.S. delegation to the International Whaling Commission.

B. Federal/Ex Officio

1. U.S. Geological Survey serves the Nation as the Department of Interior's lead science agency by providing scientific expertise responsive to important natural resources issues and natural hazards assessments. The mission of the USGS Alaska Science Center (ASC) is to provide scientific leadership and accurate, objective, and timely data, information, and research findings about the earth and its flora and fauna to Federal and State resource managers and policy makers, local government, and the public to support sound decision making regarding natural resources, natural hazards, and ecosystems in Alaska and circumpolar regions. To meet the specific information needs of resource-management agencies for the marine and terrestrial ecosystems of the North Slope of Alaska, the ASC will combine and enhance the Center's diverse science programs, capabilities, and talents with capabilities of USGS from across the nation to strengthen its scientific capacity and contribution to the resolution of the complex natural resource issues associated with change within the North Slope region.

2. NOAA/National Weather Service Alaska Region provides weather, hydrologic, climate forecasts and volcanic ash and tsunami warnings for the state of Alaska and its surrounding waters to protect lives and property and enhance the economic interests of our Nation. Alaska Region offices and facilities include the Weather Forecast Offices, Weather Service Offices, Alaska-Pacific River Forecast Center, Alaska Aviation Weather Unit, Anchorage Center Weather Service, and the Alaska Region Headquarters.

3. U.S. Arctic Research Commission principal duties are (l) to establish the national policy, priorities, and goals necessary to construct 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 promote Arctic research, to recommend Arctic research policy, and to communicate our research and policy recommendations to the President and the Congress; (3) to work with the National Science Foundation as the lead agency responsible for implementing the Arctic research policy and to support cooperation and collaboration throughout the Federal Government; (4) to give guidance to the Interagency Arctic Research Policy Committee (IARPC) to develop national Arctic research projects and a five-year plan to implement those projects; and (5) to interact with Arctic residents, international Arctic research programs and organizations and local institutions including regional governments in order to obtain the broadest possible view of Arctic research needs.

C. State of Alaska

1. Department of Fish and Game protects, maintains, and improves the fish and game resources of the State, and manages their use and development for the maximum benefit of the people of the State, consistent with the sustained yield principle. The Alaska Department of Fish and Game has a responsibility to collect biological information necessary to evaluate land-development activities, present this information to decision makers so they can make informed decisions, and provide options for development activities that will minimize or mitigate negative impacts of development.

2. Department of Natural Resources is the lead resource-development agency for the State of Alaska. Several divisions in DNR have major responsibilities regarding North Slope developments. (a) The Division of Oil and Gas develops and manages the State's oil and gas leasing programs. The division staff identifies prospective lease areas; performs geologic, economic, environmental, and social analyses; develops a five-year leasing schedule; and conducts public review of proposed sales. The division conducts competitive oil and gas lease sales and monitors collection of all funds resulting from its programs.

   (b) The Division of Geological and Geophysical Surveys (DGGS) generates, analyzes, and interprets data on geologic resources and natural conditions and maps and inventories mineral and energy resources on State land for use by government, private industry, scientists, educators, and the public.

   (c) The Division of Mining, Land, and Water is the primary manager of Alaska's land holdings. Responsibilities include ensuring the State's title; preparing land use plans and easement atlases; classifying land; leasing and permitting State land for commercial and industrial uses; and coordinating needed authorizations for major developments on the North Slope. The division allocates and manages the State's water resources on all lands in Alaska, adjudicates water rights, provides technical hydrologic support, and assures dam safety.

(d) The Office of Project Management and Permitting administers the State of Alaska's Large Projects Team which is responsible for coordinating State agency participation on major resource development projects throughout Alaska.

D. Arctic Slope Regional Corporation (ASRC)

The ASRC is the Alaska Native-owned regional corporation representing more than nine thousand Iñupiat Eskimos of Alaska's North Slope. The shareholders of ASRC own surface and subsurface title to more than four million acres of North Slope lands. By virtue of this title, the ASRC represents the largest private landowner on the North Slope. The ASRC ownership stems from an earlier claim of aboriginal title, covering the entire Alaskan North Slope, that was eventually settled in part by the Alaska Native Claims Settlement Act of 1971 (ANCSA). The mission of ASRC includes actively managing its lands and resources in order to enhance Iñupiat cultural and economic freedoms. ASRC is involved with a number of North Slope resource development activities, and has a variety of subsidiary companies that are active in North Slope resource development and other sectors.

E. North Slope Borough

The North Slope Borough's responsibilities include planning, zoning, and permitting; coastal management; wildlife research with a focus on subsistence; and support for the traditional culture of the North Slope. The Borough's planning and zoning authority through its Home Rule Charter mandates active land use management across Federal, State, Native and municipal lands. The Borough has a coastal management plan which stresses the health, safety, and cultural welfare of NSB residents and compliance with environmental policies of local concern. The Borough monitors and conducts scientific research on marine and wildlife resources to ensure healthy population levels and to sustain a continued subsistence harvest for its residents. All of the Borough's planning and research activities are conducted in part to guarantee strong local input into subsistence resource management, with a special emphasis on the blending of contemporary and traditional local knowledge as a mechanism to sustain the resources and the local indigenous culture.

7. Officers and Organization

Chair and Vice Chair: The Oversight Group shall designate a Chair and Vice Chair. The Chair shall alternate annually between Federal and non-Federal voting members. The Chair may participate in discussion and debate at the meetings and may vote on all questions before the Oversight Group. The Vice Chair shall assume the responsibilities of the Chair in the event of the Chair's absence. The Vice Chair shall be the Chair Elect for the annual rotation. The Chair will hold the position from July 1 through June 30 of each year.

Designees: Oversight Group members may appoint designees to act on their behalf in their absence.

Advisory Groups: The Oversight Group may recommend to the Secretary of the Interior the establishment of formal advisory groups, such as the North Slope Science Technical Advisory Group, as appropriate. Charters for any advisory group must be reviewed and approved by the Oversight Group and forwarded to the Secretary of the Interior following the guidance provided by the Federal Advisory Committee Act.

Staffing and Budget: Base staffing and budget will be provided through the BLM, as the administrative agency of record. For operations and/or salary beyond the base budget provided by BLM, this Charter, along with an interagency, intergovernmental, assistance agreement, or other legal instrument will be established through the Executive Director. Salary and/or operational funding provided through such process shall have overhead expenses waived by BLM.

The Executive Director will report programmatically to the Chair and Vice Chair of the Oversight Group. Annual performance evaluations of the Executive Director are completed by the BLM with input from the Chair and past-Chair (both are required as the Chair rotates based on a State fiscal year of July 1 through June 30, while the performance evaluation period is based on a Federal fiscal year of October 1 through September 30).

Committees: The Oversight Group may establish other ad hoc and standing committees as deemed necessary, and will specify the purpose and duration of each committee. Any ad hoc committees established would automatically expire upon completion of their committee assignment. The Oversight Group will establish a standing staff-level committee composed of one member from each representative Oversight Group member agency or organization. Staff committee members will advise their respective Oversight Group members on issues prior to each Oversight Group meeting, and will provide assistance to the Executive Director of NSSI, as appropriate. Salary, travel or other expenses incurred by staff committee members are paid by their respective supporting organization.

8. Oversight Group Meetings and Procedures

A. Notice of Meetings: Reserved.

B. Conduct of Meetings: Oversight Group meetings will be open to the public and will be generally conducted according to Roberts Rules of Order. The Oversight Group shall provide a reasonable opportunity for public comment.

C. Voting Procedures: A quorum of Oversight Group members, or their designees, shall be convened prior to any voting (a quorum shall consist of at least three Federal members and two non Federal members). All decisions shall be made by the voting members by consensus. Oversight Group members may participate by telephone or teleconference. The U.S. Geological Survey, National Weather Service, and U.S. Arctic Research Commission will not have voting privileges. The use of a proxy by voting members is not permitted.

D. Recusal: Oversight Group members may recuse themselves from voting, if necessary to avoid a conflict of interest.

E. Records: Meeting minutes and summaries of key decisions will be posted on the NSSI website. Hard copies will be available upon request.

F. Closed Meetings (Executive Sessions): The Oversight Group members, or their designees, and the Executive Director may close meetings, or portions of meetings, on matters pertaining to confidential personnel issues, litigation, confidential information such as archaeological information, and other matters included under applicable State and Federal laws and Borough ordinances. Ex Officio members, or their designees, may participate in Executive Sessions by permission of the Oversight Group Chair.

G. Frequency and Location of Meetings: The Oversight Group will meet a minimum of two times per year-preferably once in Anchorage and once in Barrow.

H. Expenses for Oversight Group: Expenses related to salary, travel, lodging, and per diem for Oversight Group meetings shall be borne by the representatives' respective member agencies.

9. Availability of Funds

This agreement shall not be construed as a commitment by any Federal agency signatory to expend funds in excess of available appropriations. However, it does suggest the sharing of funds, without direct or indirect overhead, to accomplish the collaborative mission of the NSSI.

SIGNATURE AUTHORITY:

Voting Members

James J. Kendall — Date 11/09/12
Regional Director, Bureau of Ocean Energy Management, Alaska Region

Geoffrey Haskett — Date 12/4/12
Regional Director, U.S. Fish and Wildlife Service, Alaska Region

Sue Masica — Date 10/31/12
Regional Director, National Park Service, Alaska Region

James W. Balsiger — Date 11/15/12
Administrator, NOAA/National Marine Fisheries Service, Alaska Region

Bud C. Cribley — Date 12/5/12
State Director, Bureau of Land Management, Alaska State Office

Daniel S. Sullivan — Date 11/7/2012
Commissioner, Alaska Department of Natural Resources

Cora Campbell — Date 4 DEC 2012
Commissioner, Alaska Department of Fish and Game

Charlotte E. Brower — Date 6th - May 2013
Mayor, North Slope Borough

Rex A. Rock, Sr. — Date 6/12/13
President, Arctic Slope Regional Corporation

Ex Offico Members

Leslie E. Holland-Bartels — Date 6 Dec 2012
Regional Executive, U.S. Geological Survey, Alaska Area

Aimee Devaris — Date 12/13/12
Acting Regional Director, NOAA/National Weather Service, Alaska Region

John Farrell — Date 11/13/12
Executive Director, U.S. Arctic Research Commission

Appendix 2: Science Technical Advisory Panel Charter

1. **COMMITTEE'S OFFICIAL DESIGNATION:** North Slope Science Initiative Science Technical Advisory Panel (Panel).

2. **AUTHORITY:** The Panel is a statutory advisory committee established under Section 348(d), of the Energy Policy Act of 2005 (42 U.S.C. 15906); Section 309 of the Federal Land Policy and Management Act (FLPMA), as amended (43 U.S.C. 1739); the Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1600); Section 14 of the National Forest Management Act of 1976 (16 U.S.C. 472a); and the Wilderness Act (16 U.S.C. 1131). The Panel is established in accordance with the provisions of the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C. Appendix 2.

3. **OBJECTIVES AND SCOPE OF ACTIVITIES:** The Panel will advise the North Slope Science Oversight Group through the Designated Federal Officer (DFO) on proposed inventory, monitoring, and research functions.

4. **DESCRIPTION OF DUTIES:** The Panel's duties and responsibilities are as follows:

    a. Advise the Oversight Group on proposed inventory, monitoring, and research functions;

    b. Advise the Oversight Group on scientific information relevant to the Oversight Group's mission;

    c. Review selected reports to advise the Oversight Group on their content and relevance;

    d. Review ongoing scientific programs of North Slope Science Initiative (NSSI) member organizations on the North Slope to promote compatibility in methodologies and compilation of data;

    e. Advise the Oversight Group on how to ensure that scientific products generated through NSSI activities are of the highest technical quality;

    f. Periodically review the North Slope Science Plan and provide recommendations for changes to the Oversight Group;

    g. Provide recommendations for proposed NSSI funded inventory, monitoring, and research activities to the Oversight Group; and

    h. Provide other scientific advice as requested by the Oversight Group.

5. **AGENCY OR OFFICIAL TO WHOM THE PANEL REPORTS:** The Panel reports to the Secretary of the Interior through the DFO.

6. **SUPPORT:** Administrative support and funding for activities of the Panel will be provided by the Bureau of Land Management.

7. **ESTIMATED ANNUAL OPERATING COSTS AND STAFF YEARS:** The annual operating costs associated with supporting the Panel's activities are estimated to be $45,000, including all direct and indirect expenses and 0.50 Federal staff years.

8. **DESIGNATED FEDERAL OFFICER:** The DFO is the Executive Director, North Slope Science Initiative, who is a full time employee appointed in accordance with Agency procedures. The DFO will approve or call all Panel and subcommittee meetings, prepare and approve all meeting agendas, attend all Panel and subcommittee meetings, adjourn any meeting when the DFO determines adjournment to be in the public interest, and chair meetings when directed to do so by the Secretary.

9. **ESTIMATED NUMBER AND FREQUENCY OF MEETINGS:** The Panel will meet approximately two to four times annually, and at such other times as designated by the DFO.

10. **DURATION:** Continuing.

11. **TERMINATION:** The Panel will become inactive 2 years from the date the charter is filed, unless, prior to that date, it is renewed in accordance with the provisions of Section 14 of the FACA. The Panel will not meet or take any official action without a valid current charter.

12. **MEMBERSHIP AND DESIGNATION:** The Panel shall consist of a representative group of not more than 15 scientists and technical experts from diverse professions and interests, including:

    a. the oil and gas industry;

    b. subsistence users;

    c. Native Alaskan entities;

    d. conservation organizations;

    e. wildlife management organizations; and

    f. academia.

    Members are appointed as special Government employees (SGEs) and may be required to file on an annual basis a Confidential Financial Disclosure Report.

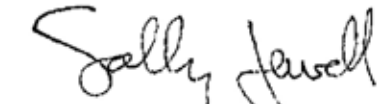
13. **ETHICS RESPONSIBILITIES OF MEMBERS:** No Panel or subcommittee member will participate in any specific party matter including a lease, license, permit, contract, claim, agreement, or related litigation with the Department in which the member has a direct financial interest. As provided in 43 CFR 1784.2-2, members of the Panel shall be required to disclose their direct or

indirect interest in leases, licenses, permits, contracts, or claims that involve lands or resources administered by the BLM, or in any litigation related thereto. For the purposes of this paragraph, indirect interests include holdings of a spouse or dependent child.

The Department of the Interior will provide materials to members appointed as SOEs explaining their ethical obligations. Consistent with the ethics requirements, members will endeavor to avoid any actions that would cause the public to question the integrity of the Panel's operations, activities, or advice. The provisions of this paragraph do not affect any other statutory or regulatory ethical obligations to which a member may be subject.

14. **SUBCOMMITTEES:** Subject to the DFO's approval, subcommittees may be formed for the purposes of compiling information or conducting research. However, such subcommittees must act only under the direction of the DFO and must report their recommendations to the Panel for consideration. Subcommittees must not provide advice or work products directly to the Agency. The Panel's Chair, with the approval of the DFO, will appoint subcommittee members. Subcommittees will meet as necessary to accomplish their assignments, subject to the approval of the DFO.

15. **RECORDKEEPING:** The Records of the Panel, and of formally and informally established subcommittees of the Panel, shall be handled in accordance with General Records Schedule 26, Item 2, and other approved Agency records disposition schedule. These records shall be available for public inspection and copying, subject to the Freedom of Information Act, 5 U.S.C. 552.



Secretary of the Interior

JUN 18 2014

Date

JUN 19 2014

Date Charter Filed

Appendix 3: Organizations and Initiatives Related to the Arctic

Advanced Cooperative Arctic Data and Information Service (ACADIS) (http://www.aoncadis.org/home.htm)

Alaska Center for Climate and Policy (ACCAP) (http://accap.uaf.edu)

Alaska Climate Change Executive Roundtable (http://www.doi.gov/csc/alaska/Stakeholder-Advisory-Council.cfm)

Alaska Department of Commerce, Community & Economic Development (http://www.commerce.state.ak.us)

Alaska Department of Environmental Conservation (://www.dec.alaska.gov)

Alaska Department of Transportation & Public Facilities (http://www.dot.state.ak.us)

Alaska Fisheries Science Center (NOAA, NMFS) (http://www.afsc.noaa.gov)

Alaska Nanuuq Commission (http://www.thealaskananuuqcommission.org)

Alaska Native Tribal Health Consortium Local Environmental Observer Network (http://www.anthc.org/chs/ces/climate/leo)

Alaska Oceans Observing System (AOOS) (http://www.aoos.org)

Alaska Oil and Gas Association (AOGA) (http://www.aoga.org)

Arctic Science Portal (of USARC) (http://www.arctic.gov/portal)

Alaska Sea Grant (http://seagrant.uaf.edu)

Arctic Council (http://www.arctic-council.org)

Arctic Contaminants Action Program (ACAP) (http://www.arctic-council.org/index.php/en/about-us/working-groups)

Arctic Domain Awareness (http://www.piersystem.com/clients/c780/261751.pdf)

Arctic Health (http://arctichealth.nlm.nih.gov/home)

Arctic Landscape Conservation Cooperative (http://www.arcticlcc.org)

Arctic Monitoring and Assessment Programme (AMAP) (http://www.arctic-council.org/index.php/en/about-us/working-groups)

Arctic Observing Network (AON) (http://www.arcus.org/search/aon)

Arctic Ocean Biodiversity (ArcOD) (http://www.arcodiv.org)

Arctic Portal (http://arcticportal.org)

Arctic Research Consortium of the United States (ARCUS) (http://www.arcus.org)

Arctic Research Mapping Application (ARMAP) (http://www.armap.org)

Arctic Systems Science Program (ARCSS) (http://www.arcus.org/arcss)

ArcticNet, Canadian Network of Excellence (http://www.arcticnet.ulaval.ca)

Appleton Charitable Foundation (http://www.appletonfoundation.org/arctic%20initiatives.html)

Canadian Sea Ice Service (http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=0A70E5EB-1)

Circumpolar Active Layer Monitoring (CALM) (http://www.gwu.edu/~calm)

Conservation of Arctic Flora and Fauna (CAFF) (http://www.caff.is)

Emergency Prevention, Preparedness and Response (EPPR) (http://www.arctic-council.org/eppr)

Forum of Arctic Research Operators (FARO) (http://faro-arctic.org)

Group on Earth Observations (GEO) (http://earthobservations.org)

Integrated Global Observing Strategy (IGOS) (http://www.un.org/earthwatch/about/docs/igosstr.htm)

Interagency Arctic Research Policy Committee (IARPC)
(http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp)

Interagency Ocean Observing Committee (http://www.iooc.us)

International Arctic Science Committee (IASC) (http://iasc.info)

International Long-Term Ecological Research (ILTER) (http://ilternet.edu)

International Permafrost Association (IPA) (http://ipa.arcticportal.org)

International Polar Year (IPY) (http://www.ipy.org)

Marine Biological Laboratory (MBL), Woods Hole (http://www.mbl.edu/ecosystems)

National Energy Technology Laboratory (http://www.netl.doe.gov/)

National Science Foundation, Office of Polar Programs (OPP)
(http://www.nsf.gov/div/index.jsp?div=PLR)

National Security Presidential Directive/NSPD-66 & Homeland Security Presidential Directive/HSPD-25 (http://www.fas.org/irp/offdocs/nspd/nspd-66.htm)

National Snow and Ice Data Center (NSIDC) (http://nsidc.org)

Naval Research Laboratory Arctic Initiatives (http://www.star.nesdis.noaa.gov/star/documents/meetings/Ice2011/dayOne/Stewart.pdf)

NOAA Arctic Theme Page (http://www.arctic.noaa.gov)

Nordic Council (http://www.norden.org)

North Pacific Research Board (NPRB) (http://nprb.org)

North Pole Environmental Observatory (http://psc.apl.washington.edu/northpole)

Office of Science and Technology Policy (OSTP) (http://www.whitehouse.gov/administration/eop/ostp)

Polar Bear Specialist Group (http://pbsg.npolar.no/en)

Polar Research Board (PRB) (http://dels.nas.edu/prb)

Prince William Sound Oil Spill Recovery Institute (OSRI) (http://www.pws-osri.org)

Protection of the Arctic Marine Environment (PAME) (http://www.pame.is)

SCANNET, Circumpolar Arctic Network of Terrestrial Field Bases (http://www.scannet.nu/content/view/85/152)

State of Alaska, Governor's Sub-Cabinet on Climate Change (http://www.climatechange.alaska.gov)

Study of Environmental Arctic Change (SEARCH) (http://www.arcus.org/search-program)

Sustainable Development Working Group (SDWG) (http://www.sdwg.org)

Sustained Arctic Observing Network (SAON) (http://www.arcticobserving.org)

U.S. Arctic Research Commission (http://www.arctic.gov)

U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) (http://des.nh.gov/organization/divisions/waste/hwrb/fss/dos/crrel.htm)

United States Global Change Research Program (www.globalchange.gov)

University of Alaska Fairbanks-Arctic Research (http://www.uaf.edu/uaf/research)

Unmanned Aircraft Systems Program (UAS) (http://uas.noaa.gov)

Vision for the Canadian Arctic Research Initiative

(http://scienceadvice.ca/en/assessments/completed/canadian-arctic.aspx)

Woods Hole Research Center (http://www.whrc.org)

World Wildlife Fund – Arctic Initiative (http://worldwildlife.org/places/arctic)

North Slope Science Initiative
ALASKA

http://northslope.org

http://www.facebook.com/NorthSlopeScienceInitiative

http://www.twitter.com/NSlopeScience

Front Cover Photo Captions:
(Top) **Bowhead whale harvest.** (North Slope Borough; *(Inset 1)* **White-fronted goose.** (USFWS); *(Inset 2)* **Arctic Sea Ice ponds.** (Kathryn Hansen, NASA); *(Inset 3)* **Beach Seine Retrieval near Barrow, Alaska.** (R. Heintz, NOAA); *(Inset 4)* **Walrus.** (USFWS)

Back Cover Photo Caption: April sunset at the Teshekpuk Lake Observatory (Ben Jones, USGS)