Climate & Communities

Conducting Marine Research in a Changing Arctic

March 2014

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Cover image: Aerial view of Nome, Alaska and the Bering Sea (2013 Jordan Diamond)

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Table of Contents

Executive Summary

In all of the United States, the Alaskan Arctic is experiencing the most immediate and dramatic consequences of climate change. Alaska Native subsistence communities that rely on the Arctic environment and natural resources for survival have seen the changes first-hand. These communities possess a deep base of traditional knowledge (TK)—stemming from sophisticated environmental observations over many generations—that provides context for current changes. This TK plays an indispensable role in the research of and response to rapid Arctic change. TK and subsistence community perspectives can enhance climate change research before, during, and after projects, both by identifying research priorities and optimizing research implementation. Conversely, communities may benefit greatly from increased delivery of research results that support adaptation to changing conditions. To achieve the optimal outcome—where climate change research and TK are integrated, with trust and respect forming the basis for mutual understanding, and research results are effectively shared with those most affected—communities and researchers must meaningfully engage with one another.

The overarching goal of this report is to examine how scientists link with Alaska Natives through project conception and design, implementation, and results dissemination in order to improve marine management of the Arctic in a time of rapid climate change. Specifically, the report identifies and assesses research policies of different entities and climate change-related projects that engage the community, in order to make recommendations for best practices throughout the research process. The authors hope that this report will serve as a resource for managers, funders, researchers, and communities to improve marine research project design and implementation in order to facilitate effective and efficient adaptation to climate change in the U.S. Arctic.

This report combines research and analysis of laws, policies, and procedures related to Alaskan Arctic marine research with in-depth conversations with Alaska Natives, climate change researchers, federal agency staff, policymakers, and members of funding entities, among others. For the purposes of this report, *community members* include those who have lived or worked in Alaskan tribal communities and self-identify as a tribal member. *Researchers* include those who have planned, designed, or implemented social or natural science projects in the Alaskan Arctic.

While this report greatly benefits from and would not exist without the input of those interviewed, and the project partner the Alaska Eskimo Whaling Commission (AEWC), the authors highlight that any errors in the report are the sole responsibility of the Environmental Law Institute (ELI).

Climate Change Research Priorities

Holders of TK understand the interconnectedness of ecosystems and the importance of each component on a subsistence lifestyle. They incorporate knowledge about present conditions with knowledge of past conditions to form projections for the future. Today, TK input variables are shifting so dramatically that it could stress communities' abilities to adapt. A constant theme of interviews was that, given the rapid, unprecedented changes in the Arctic, the many variables that affect subsistence resources may be affected by climate change. Therefore, community research priorities encompass all aspects of the subsistence lifestyle and the environmental factors that affect it.

The specific research needs identified vary from community to community and are dependent on the subsistence resources that are most important to each community. In one meeting, research needs identified stemming from concerns about abundance and availability of subsistence resources include stock assessments, population studies, migration tracking, and projections related to these analyses. Other research needs identified by meeting participants and interviewees include the effects of shipping, noise, and seismic exploration mining, among other things, on subsistence resources.

In addition, myriad federal institutions engage in and/or support Arctic research in order to meet science-based management objectives and expand understanding of the Arctic. The following themes recur across the federal institutions' research policies: sea ice forecasting and effects of decreasing sea ice, cooperation and coordination, marine ecosystem processes, species and habitat data, vessel traffic, effects of mineral extraction, climate, community resilience, adaptation and food security, and cooperation and coordination.

While the specific research project needs identified by researchers and communities are numerous, one overarching theme that literature, interviewees, and meeting attendees identified is the need for communication and engagement between researchers and communities. In short, information flow can be as important as information generation. Given the increased presence of researchers, along with the expected increase in development and environmental change, a key climate change research need is linking science and communities in the research process.

Climate Change Research Policies

Research communication policies have the potential to structure community-researcher interactions in a way that is more productive, from creating more efficient research designs to spurring more effective research implementation and information dissemination. The National Science Foundation, which funds many projects in the region, has a strong policy on paper and has demonstrated a commitment to engagement with the Alaska Native community. Other research funding entities have some policies in place as well. However, interviewees consistently identify community-researcher linkages as a primary point of weakness in the Arctic research framework.

Several Alaska Native communities are passing ordinances detailing specific outreach requirements. The research policies developed by Alaska Native organizations and regional and local institutions focus on the Alaska Native perspective for how researchers undertaking projects that involve Alaska Natives should interact with communities, from the earliest moments of conceptualizing anticipated research to dissemination of results. Interviews indicate that the communication policy framework has yet to solve information flow challenges related to climate change research.

Climate Change Research Practices

Fair dealing and open communication is at the heart of Arctic research policies. To make the policies meaningful, they must be translated into practice from the inception of research ideas through the completion of projects and dissemination of results. At the same time, the existing limits of research funding may constrain the ways that researchers are able to effectively engage with communities.

Before projects, examples of engagement identified include researchers attending local meetings, developing collaborations with tribal councils or regional bodies, and conducting local reviews of project proposals, among other strategies.

During projects, there is a need for ongoing engagement at the research site and in the community. Practical strategies that have been used in the Arctic include using local guides, involving community members in research projects, holding public lectures, using radio to describe research plans, and utilizing social media and electronic outreach to engage community members in ongoing research projects.

After projects, efforts to disseminate results are essential to ensure information flow. A primary climate change research need described by Alaska Native communities is for research results to make their way back to involved and/or affected communities. Strategies include outreach methods like flyers, posters, and summaries, presenting at local, regional, or state-wide meetings, lecturing at local schools, and conducting electronic outreach through newsletters or social media.

Across all stages of the research process, funding, capacity, and resource allocation can present obstacles to effective engagement. Communication efforts require adequate resources, both financial investment and personnel time. At any time, but especially in light of today's tightly constrained budgets, resources for outreach and communication must be specifically built in to the funding process if researchers and communities are going to have the capacity to engage.

Research Opportunities and Recommendations

The first step in realizing meaningful communication and engagement is establishing robust policies. The second is ensuring they are implemented in practice. Opportunities exist for researchers, community members, and institutions operating in the Alaskan Arctic to optimize research practice to the benefit of specific projects and community-researcher relations generally.

General Issues	
Theme	**Options**
Building Trust, Demonstrating Respect	(1) Develop training programs, manuals, and/or fact-sheets that educate researchers on effective communication with Alaska Native communities. (2) Gather examples of effective visual presentations and research summaries. (3) Establish a mentor program that provides new Arctic researchers with the option to contact researchers who have worked successfully in the region.
Building Relationships and General Outreach	(1) To help develop long-term relationships that build mutual trust and respect, researchers should, when possible, attend meetings to make presentations and interact with community members. (2) Research projects (and researchers when appropriate) should establish a social media and traditional website presence. (3) To the extent possible, researchers should strive to establish long-term research programs in the Arctic, rather than one-time projects.
Coordination	(1) Develop a database that gathers and sorts proposed and approved projects in the region, with an option for researchers to submit projects at the pre-proposal stage as well. (2) Communities and regions could develop research guidelines, which could be sorted into a similar database for community needs and research requirements.

Before Projects	
Theme	**Options**
Funding Entity Policy	(1) Agencies and funding entities could include explicit outreach requirements before, during, and after projects in all RFPs or project descriptions, with an additional requirement that community-targeted outreach reports are returned back to communities after projects are completed. (2) Funding entities and agency budgeting could condition part of project funds on outreach, with a provision that the funds cannot be allocated for any other purpose. (3) Agencies and funding entities could require reports of outreach methods that

	detail positives and negatives of each approach, which can subsequently be communicated to communities and other researchers. (4) Consider providing mini-grants to communities or researchers to develop community-oriented projects. (5) Allow grant recipients to use part of their funding to support community boards to review, provide input on, and solicit ideas for project design and implementation.
Designing Projects	(1) Researchers should include community partners on RFPs and project plans. (2) When possible, researchers should include research partnerships with community members that facilitate the inclusion of Alaska Native co-authors. (3) Researchers should strive to include a TK component in all proposals. (4) Consider soliciting and vetting ideas in communities and at meetings.
Preparing for Research	(1) Researchers should reach out early, a year in advance of project initiation if possible, to the tribal council or other community representatives. (2) Communities and agencies should consider developing a database of contacts.

During Research	
Theme	**Options**
Community Involvement	(1) When possible, contact tribal councils or other community contacts to make local hires. (2) Researchers should compensate for TK, or make it clear at the beginning of a discussion when there is no compensation.
Ongoing Outreach and Engagement	(1) Researchers should provide understandable, plain language information related to project progress through posters, summaries, museum-like signs, and lectures, among other strategies. (2) When possible, researchers should make themselves available in the community. (3) Researchers should capitalize on every opportunity to conduct ongoing outreach and engagement, including sharing past project results when conducting outreach related to a new project.

After Research	
Theme	**Options**
Sharing Results	(1) Researchers should provide summary documents, visual presentations and posters, and publish an online report that is relevant to communities. (2) Communities should be given an opportunity to review and comment on

	draft research reports.
Transparency and Accountability	(1) Researchers should report back to communities and relevant agencies/funding entities with one document that describes the methods of outreach used, effectiveness of that outreach, and how community input influenced the project.

Most of all, **throughout the research process**, there is a need for open and transparent communication between researchers and communities. All of these points speak to the importance of researchers and communities taking active steps to engage with one another from project inception to results dissemination, in a manner that demonstrates respect and builds trust. Given the pressing threats posed by climate change, it is important that researchers and communities engage effectively to best inform climate change knowledge and management.

I. GOALS AND METHODOLOGY

The overarching goal of this report is to examine how scientists link with Alaska Natives in the climate change research process through project conception and design, implementation, and dissemination in order to improve marine management of the Arctic in a time of rapid change. Specifically, the report identifies research policies of different organizations and climate change-related projects that engage the community in order to make recommendations for best practices in the research process. It is the hope that this report will serve as a resource for managers, funders, researchers, and communities to improve project design and implementation in order to facilitate effective and efficient adaptation to climate change in the U.S. Arctic.

This report combines research and analysis of laws, policies, and procedures related to climate change research with in-depth conversations with Alaska Natives, climate change researchers, federal agency staff, policymakers, and members of funding entities, among others.[1] Analysis of laws and policies related to research in the U.S. Arctic provides the structural framework for climate change research. However, an examination of the current policies does not adequately identify the research needs of Alaska Native communities or the research process in practice. Thus, the authors conducted individual or group interviews during the period of March 2012 to December 2013 with Alaska Native community members and researchers who work in the region. A majority of the people interviewed and meeting participants were either from communities or otherwise doing research in the Northern Bering Sea region or the Chukchi and Beaufort Seas region with a particular emphasis on those working or living in Barrow, which is the largest community in the North Slope Borough, the official seat of the Alaska Eskimo Whaling Commission (AEWC), and a community renowned for its involvement in many research projects.[2] For the purposes of this report, *community members* include those who have lived or worked in Alaskan tribal communities and self-identify as a tribal member. *Researchers* include those who have planned, designed, or implemented social or natural science projects in the Arctic regions of Alaska.

The interviews focused on two sets of questions. First, the authors asked questions related to climate change research priorities needed to support subsistence communities in the U.S. Arctic. The first set of questions the authors used to guide the conversation included:

- What information do U.S. Arctic communities need about climate change impacts to subsistence hunting and fishing?
- What scientific and climate change information is needed to support continued hunting and fishing?
- What information about present and future conditions is needed to best manage subsistence resources?

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[1] While this report greatly benefits from and would not exist without the input of those interviewed, the authors highlight that any errors in the report are the sole responsibility of the Environmental Law Institute (ELI).
[2] *See* Barrow, OFFICIAL WEBSITE OF THE NORTH SLOPE BOROUGH, http://www.north-slope.org/our-communities/barrow. The AEWC was a partner in this project.

Second, after several early interviews identified researcher-community engagement as a primary need, the authors developed targeted questions about the process used to engage with communities before, during, and after research projects. The second set of questions that guided the interviews were as follows:

What is the best way for researchers and communities to interact to get this needed information?
- **Before (Project Design):** What is the ideal process for researchers and communities to interact before research projects begin? How does it occur in practice?
- **During (Implementation):** How could researchers engage and/or work with communities during research projects? How does it occur in practice?
- **After (Sharing Results):** How should research results be shared once projects are completed? How does it occur in practice?

To gather data using this interview structure, the authors spoke with 50 people on an individual or group basis. The authors used *semi-directed interviews*, gathering qualitative data by asking open-ended questions that built off of the pre-determined framework described above, allowing for an understanding of the interviewees' points of view.[3] In addition, ELI hosted discussion sessions and roundtable meetings at the Kawerak Inc. Regional Conference in Nome, Alaska—a meeting that brings together Alaska Native members from 20 communities.[4] Similar to the interviews, the meetings focused on semi-structured discussions of issues affecting subsistence resources and the Alaska Native way of living. These interviews and meetings provided indispensable insight into climate change research needs and methods for communicating about the research process, without which it would not be possible to identify research practices and make recommendations for improving the research process.

To preserve the confidentiality of those interviewed, this report does not attribute specific recommendations or identified needs to any one person unless the information has been obtained from a previously published document.[5] However, the authors endeavor to indicate whether a recommendation was identified by one or more interviewees or whether it is a recommendation or observation that comes directly from the authors' insight and expertise, maintaining the language used by the interviewees whenever possible.

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[3] *See Interviewing in Qualitative Research*, *in* RESEARCH TRAINING FOR SOCIAL SCIENTISTS 312–31 (Alan Bryman ed. 2004), *available at* http://www.comp.dit.ie/dgordon/Podcasts/Interviews/chap15.pdf. The report is not a quantitative assessment of researcher and community perspectives on climate change research needs. Early in the process of gathering results for this report, the authors explored the use of a survey to collect data on research needs. However, that method of research proved inadequate in Alaska due to social and geographic constraints. Therefore, the discussions with researchers, Alaska Native community members, and others were used to identify climate change research needs. As discussed in the report, a primary climate change research need identified by early interviewees was communication and engagement throughout the research process, leading to the second line of questions addressing this research need.

[4] The communities in the Kawerak region are Brevig Mission, Council, Diomede, Elim, Gambell, Golovin, King Island, Koyuk, Mary's Igloo, Nome, Savoonga, Shaktoolik, Shishmaref, Solomon, St. Michael, Stebbins, Teller, Unalakleet, Wales, and White Mountain. *See* Kawerak, Inc., Communities, http://www.kawerak.org/tribalpages.html.

[5] All interviews were conducted in 2012 and 2013 and are on file with the authors.

Although not identified by name, the authors want to acknowledge and express their gratitude for the time and effort that the interviewees and meeting participants provided. Without their expertise, experience, and willingness to share their knowledge, this report would not be possible.

II. INTRODUCTION: CLIMATE CHANGE IN THE U.S. ARCTIC

Indigenous peoples in the Arctic are particularly susceptible to climate change.[6] Subsistence communities rely on season-to-season and year-to-year patterns of weather, hunting conditions, ice flow, and animal populations for their sustenance, economy, and culture.[7] While subsistence communities have adapted to fluctuations throughout their history, the Arctic is now changing at an unprecedented rate and magnitude that is threatening their way of life.[8]

The magnitude of change in the Arctic is greater than anywhere else on Earth, approximately twice the world average.[9] The rapid change is partially due to the ice-albedo positive feedback cycle. Ice is highly reflective, reflecting as much as 70% of incoming solar radiation back into space.[10] Ocean water, meanwhile, only reflects around 6% of solar radiation.[11] Thus, a small initial ice melt can substitute reflective ice for absorbent ocean or land, causing a cascading feedback cycle where significantly more heat is absorbed, melting even more ice.[12] As a result of anthropogenic greenhouse gas emissions around the globe, the ice-albedo effect that is unique to the Arctic, and other factors relating to the climate system, parts of Alaska are more than 4°F hotter than thirty years ago, some glaciers are retreating 15% every decade, permafrost is becoming impermanent, erosion is causing the loss of coastal land, and sea ice is retreating rapidly.[13] Some models predict an Arctic that is sea-ice free by 2037,[14] with temperature increases around 8°C by 2100.[15]

Changes in short-term weather and long-term climate are disturbing the traditional abundance and migration patterns of marine mammals and other resources that subsistence communities rely upon.[16] In some locations, sea ice retreat and other factors influencing access to subsistence resources are impeding hunting efforts altogether.[17] In others, shifts in wind direction are preventing boating at

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[6] Daniel R. Wildcat, *Introduction: Climate Change and Indigenous Peoples of the USA*, 120 CLIMATIC CHANGE 509, 509 (2013).
[7] ALASKA NATIVE SCIENCE COMMISSION, IMPACT OF CLIMATE CHANGE ON ALASKA NATIVE COMMUNITIES (2012), *available at* http://www.nativescience.org/assets/Documents/PDF%20Documents/Impact%20of%20Climate%20Change%20on %20Alaska%20Native%20Communities.pdf.
[8] Patricia Cochran et al., *Indigenous Frameworks for Observing and Responding to Climate Change in Alaska*, 120 CLIMATIC CHANGE 557 (2013).
[9] ARCTIC COUNCIL, ARCTIC CLIMATE IMPACT ASSESSMENT: IMPACTS OF A WARMING ARCTIC 8–9 (2004).
[10] Michael Winton, *Sea Ice-Albedo Effect and Non-linear Arctic Climate Change*, *in* ARCTIC SEA ICE DECLINE: OBSERVATIONS, PROJECTIONS, MECHANISMS, AND IMPLICATIONS 111 (Eric T. DeWeaver, Cecilia M. Bitz & L. Bruno Tremblay, eds. 2008).
[11] *Id.*
[12] *Id.*
[13] ALASKA NATIVE SCIENCE COMMISSION, *supra* note 7.
[14] Muyin Wang & James E. Overland, *A Sea-Ice Free Summer Arctic Within 30 Years?*, 36 Geophysical Research Letters L07502 (2009).
[15] *See id.*
[16] Kathy Lynn et al., *The Impacts of Climate Change on Tribal Traditional Foods*, 120 CLIMATIC CHANGE 545 (2013).
[17] *Id.*

traditional harbors used by communities during hunting seasons.[18] For example, one interviewee discussed potential climate change impacts on St. Lawrence Island, where communities rely on walrus hunting for subsistence. According to the interviewee, traditionally, winds were from the north in the winter and from the south in the summer. This wind pattern left the southern port clear of ice during the winter and the northern port ice-free during the summer. During peak walrus season, communities could hunt 15 to 20 days per month. Now, winds often blow from the west, changing the ice distribution at the traditional ports. Hunting is frequently limited to 5 or 6 days per month, threatening the subsistence walrus harvest.

Table 1 identifies categories of subsistence resources that may be impacted by climate change.

Table 1. Subsistence Resources and Climate Change[19]		
Type of Resource	**Sample Species**	**Possible Negative Effects**
Marine Mammals	Polar bear, walrus, bearded seal, ringed seal, harp seal, hooded seal, ring seal, spotted seal, beluga, narwhal, bowhead whale, fin whale, minke whale, humpback whale, gray whale, killer whale	Decrease in recruitment and body condition, migration alteration, declining populations due to habitat loss
Terrestrial Mammals	Caribou, arctic fox, arctic ground squirrel, Dall's sheep	Shifting habitat range, changing food supply, changing water availability (also may be positive)
Fish	Grayling, dolly varden, broad whitefish, humpack whitefish, Arctic cisco, least cisco, rainbow smelt	Loss of habitat, migration disruption, juvenile dispersal, direct physiological stresses
Birds	Ptarmigan species, greater white-fronted Canada goose, elder species, black brant, murre species	Changes in predator-prey relationships, changes in habitat and water availability, changes in migration patterns

Rapid changes in the Arctic create substantial challenges for subsistence communities and threaten their way of life.[20] Hunters depend on knowledge of season-to-season and year-to-year patterns of weather, hunting conditions, ice flow, and animal behavior, among other things, for successful hunts and for safety. Changing habitat, food supplies, predator-prey relationships, and migration cycles are shifting animal ranges outside of the reach of subsistence hunting communities.[21] Short-term animal behavior is changing as well—recent beaching events, die-offs, stampedes, and haul-outs that are difficult to

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[18] *Id.*

[19] Adapted from ARCTIC LANDSCAPE CONSERVATION COOPERATIVE, LINKING CLIMATE AND HABITAT CHANGE IN ARCTIC ALASKA: RECOMMENDED MONITORING AND MODELING ACTIVITIES (2012), *available at* http://arcticlcc.org/assets/resources/ArcticLCC_Species_and_Habitat_WG_Report_2012.pdf

[20] ALASKA NATIVE SCIENCE COMMISSION, *supra* note 7.

[21] Kathy Lynn et al., *The Impacts of Climate Change on Tribal Traditional Foods*, 120 CLIMATIC CHANGE 545 (2013).

attribute to specific causal agents, though are possibly related to climate change.[22] These hunting impacts are layered on top of rising seas and coastal erosion—issues that threaten the continued geographic existence of some Alaska Native communities.[23]

In addition, changing environmental conditions have facilitated increased development, which could affect marine resource access and availability for subsistence communities. Loss of sea ice is enabling expansion of Arctic oil and gas development, tourism, and shipping, with the possibility of associated infrastructure development.[24] Habitat of bowhead whales, seals, and other subsistence resources all intersect with existing or proposed development areas.[25] Commercial tankers, oil rigs, and cruise ships could impact the subsistence harvest and communities' way of life.

With expanding concern about climate change impacts to the Arctic comes expanding investment in Arctic research. Research conducted in the Arctic provides an opportunity to shed light on climate change impacts in order to support communities as they adapt to foreseeable change. At the same time, researchers may put additional strain on Arctic communities.[26] In 2008, scientific research in Alaska was a $300 million proposition and characterized by the state as a "growth sector."[27] Multiple interviewees say that indigenous peoples have witnessed increases in researcher presence in and around communities, both on land and at sea. Given the remote and unforgiving nature of the Arctic region, many projects involve the interaction of communities, researchers, and subsistence resources. However, the needs of relatively abundant researchers can overwhelm small Arctic communities.[28]

This report examines the research communication framework in the Arctic in order to identify practices that can make the process better from the perspective of both researchers and communities. After this introduction to climate change in the U.S. Arctic, the report presents the marine management framework and its relationship to traditional knowledge and climate change research. Next, it explores the climate change research framework, which informs climate change research policies and practices.

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[22] *See id.* These observations were echoed in many interviews the authors conducted and in meetings the authors attended related to marine mammal subsistence resources.

[23] *See* ALASKA NATIVE SCIENCE COMMISSION, *supra* note 7.

[24] ALASKA STATE LEGISLATURE, FINAL COMMISSION REPORT: ALASKA CLIMATE IMPACT ASSESSMENT COMMISSION (2008), *available at* http://www.housemajority.org/coms/cli/cli_finalreport_20080301.pdf.

[25] *See e.g.*, Nat'l Marine Fisheries Serv., Endangered Species Act: Section 7 Consultation, Biological Opinion, Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska; and Authorization of Small Takes Under the Marine Mammal Protection Act 5 (2008) ("[T]he bowhead whale is most likely to be affected by oil and gas leasing and exploration…"); Lori T. Quakenbush et al., *Fall and Winter Movements of Bowhead Whales (Balaena mysticetus) in the Chukchi Sea and Within a Potential Petroleum Development Area*, 63 ARCTIC 289, 289 (2010) ("All [19 bowhead] whales [tagged for the tracking study] traveled through a potential petroleum development area at least once."). *See also* JEFF GOODYEAR, BEN BEACH & CHUCK CLUSEN, AURORA ENVTL. RESEARCH & NATURAL RESOURCES DEF. COUNCIL, ENVIRONMENTAL RISKS WITH PROPOSED OFFSHORE OIL AND GAS DEVELOPMENT OFF ALASKA'S NORTH SLOPE (2012), *available at* http://www.nrdc.org/land/alaska/files/drilling-off-north-slope-IP.pdf.

[26] *Id.*

[27] *Id.*

[28] Henry P. Huntington et al., *Less Ice, More Talk: The Benefits and Burdens for Arctic Communities of Consultations Concerning Development Activities*, 1 CARBON CLIMATE L. REV. 33 (2012).

It then examines the policies that are currently in place for community-science interactions. The report subsequently analyzes key issues in the research communication framework, focusing on best practices before, during, and after research projects.

III. The Marine Management Framework, Traditional Knowledge & Climate Change Research in the Arctic

Science-based decision-making plays a central role in managing marine resources in the Arctic, and a variety of laws and policies inform the linkages between Alaska Native communities, agency researchers, and agency decision-making. Two frameworks, in particular, link marine subsistence communities to science-based decision-making: co-management and consultation. This section provides a brief overview of the requirements for research and information sharing under these frameworks, discusses the importance of traditional knowledge (TK) for decision-making, and describes some of the policies in place that call for TK to inform decision-making.

Co-Management

Under Section 119 of the Marine Mammal Protection Act (MMPA), the lead marine mammal management agencies, the National Oceanic and Atmospheric Administration (NOAA) and the Fish and Wildlife Service (FWS), have authority to enter into cooperative agreements with Alaska Native organizations in order to "conserve marine mammals and provide co-managent of subsistence use by Alaska Natives."[29] This authority further allows cooperative agreements to include grants to Alaska Native organizations to collect and analyze data, monitor harvest, and participate in marine mammal research, among other things.[30] Specific agreements further spell out the relationship between the agency and Alaska Native organizations as it relates to research and monitoring. The Alaska Eskimo Whaling Commission (AEWC) and NOAA have developed such an agreement, which among other things, calls for AEWC to share information about whaling activities, the numbers of whales struck, and information about landed whales.[31] AEWC further agrees to encourage whaling captains to make specimens available to researchers upon written request. In addition, NOAA provides technical assistance in support of information collection and cooperates with AEWC to facilitate accurate monitoring.

The Alaska Beluga Whale Commission (ABWC) and National Marine Fisheries Service (NMFS) agreement provides another example.[32] In this document, the ABWC agrees to obtain harvest information and biological samples. In addition, the parties agree that "[t]he ABWC, in consultation with NMFS, may conduct research on the biology, natural history and TK of the Western Alaska population of beluga whales." Both parties agree to share information about inspections, samples, harvest data, and research.

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[29] 16 U.S.C. § 1388(a).
[30] 16 U.S.C. § 1388(b).
[31] Cooperative Agreement between National Oceanic and Atmospheric Administration and the Alaska Eskimo Whaling Commission (2008) (as amended by the 2011 Agreement).
[32] Agreement between the National Marine Fisheries Service and the Alaska Beluga Whale Committee for Co-Management of the Western Alaska Beluga Whale Population (1999)

Consultation

Executive Order 13175 calls upon agencies to "have an accountable process to ensure meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications."[33] Information sharing is an important component of consultation.[34] Information exchange includes challenges before, during, and after consultation occurs—among these challenges are the form, timing, and content of formal and informal communication.[35] Generally, it is important that information sharing is based on two-way dialogue and discussion of options, rather than a non-collaborative process lacking mutual input.[36] Similar principles are at the core of effective and meaningful engagement between researchers and communities.

Traditional Knowledge (TK)

TK includes specific environmental knowledge, knowledge of ecosystem relationships, and a code of ethics governing ecosystem relationships.[37] It can (1) incorporate the conservation values of the Native peoples and their knowledge and understanding of the ecosystem, and (2) extend scientific understanding of ecosystems. As defined by the Inuit Circumpolar Council,

> Traditional knowledge is a systematic way of thinking applied to phenomena across biological, physical, cultural and spiritual systems. It includes insights based on evidence acquired through direct and long-term experiences and extensive and multigenerational observations, lessons and skills. It has developed over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation.[38]

A key challenge is linking TK andscience,[39] including climate change science. That said, many agencies recognize the importance of these linkages and have developed policies to link TK andagency science to inform decision-making. For example, policies under the Endangered Species Act (ESA) and MMPA explicitly require that decision-makers consider TK during consultation and decision-making.[40]

The integration of TK and science is brought to bear in consultation policies. For example, Secretarial Order 3225, which details the consultation policies for Section 10 of the ESA, requires NMFS and FWS to

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[33] Exec. Order 13,175, Consultation and Coordination with Indian Tribal Governments § 5 (2000).
[34] For a discussion of this issue, *see* ENVIRONMENTAL LAW INSTITUTE, STRENGTHENING GOVERNMENT-TO-GOVERNMENT CONSULTATION RELATED TO MARINE SUBSISTENCE RESOURCES IN ALASKA (in press, 2014).
[35] *Id.*
[36] *Id.*
[37] Marc Stevenson, *Indigenous Knowledge in Environmental Assessment*, 49 ARCTIC 278, 280 (1996)
[38] Inuit Circumpolar Council, Application of Traditional Knowledge in the Arctic Council (2013), *available at* http://www.iccalaska.org/servlet/content/Food%20Security.html.
[39] *Id.*
[40] *See, e.g.,* Secretarial Order 3225 (consultation policy for ESA § 10(e) concerning subsistence uses of endangered or threatened species in Alaska); ESA Section 7 Consultation Handbook, "Coordination with Tribal Governments," §2.6; Memorandum of Agreement for Negotiation of MMPA Section 119 Agreements; and Magnuson-Stevens Act §305(j)(2)(E), 18 U.S.C. § 1855(j)(2)(E). Unless the definition requires that the different terms be considered separately, this report refers to all of these considerations as TK or "traditional knowledge."

consult with Native tribes when there are "conservation concerns" regarding a species that Alaska Natives also use for subsistence. The goal of the consultation is to both preserve the subsistence rights of Alaska Natives and protect the species. The agencies are called upon to "seek input from, and [] collaborate with, Alaska Natives when gathering information."[41] The Order calls upon the agencies to ensure participation of Alaska Natives to the maximum extent practicable in "research design, data collection, and the use of traditional knowledge," among other things.[42]

Policies that implement the MMPA also require NMFS to incorporate TK into decisions about co-management. Under a memorandum of agreement between FWS, NMFS, and the Indigenous Peoples' Council for Marine Mammals (IPCoMM) for negotiation of cooperative agreements under the MMPA, "[t]he best available scientific information, and traditional and contemporary Alaska Native knowledge and wisdom (TKW), will be used for all decisions regarding Alaska marine mammal co-management, to the extent allowable by law."[43]

Interviewees indicate that adaptation to the unprecedented changes occurring in the Arctic should integrate scientific analysis with the TK held by members of Arctic communities. Another pressing research need identified by many interviewees is the need for communication between communities and researchers, to obtain appropriate permission, to inform communities of research findings, and to optimize the design and implementation of research projects.

TK can inform project proposal, design, and implementation in a way that makes research more efficient and effective. One Arctic researcher, in discussing the important link between scientific research and TK, analogized the relationship to a farmer with a sick animal. When the animal is sick, the first thing the veterinarian should do is ask the farmer for a history and an idea of what is wrong. Just as the farmer knows the animal and can interpret signals that the trained veterinarian cannot, subsistence communities know their environment in a way that outside researchers cannot.

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[41] Department of the Interior Secretarial Order 3225, Endangered and Species Act and Subsistence Uses in Alaska (supplement to Secretarial Order 3206), January 19, 2001, *available at* http://alaska.fws.gov/external/pdf/SO3225.pdf.

[42] *Id.*

[43] Memorandum of Agreement for Negotiation of the Marine Mammal Protection Act Section 119 Agreements among U.S. Department of Commerce National Marine Fisheries Service, U.S. Department of Interior Fish and Wildlife Service and Indigenous Peoples Council for Marine Mammals §2(G) (Oct. 30, 2006).

IV. CLIMATE CHANGE RESEARCH FRAMEWORK

The climate change research framework informs the types of projects that can and do occur in the U.S. Arctic. Multiple interviewees indicated that climate change research needs cannot be viewed independently from funding, the type of research, and the difficulty of conducting projects given Alaska's remote geography and harsh climate. Therefore, this section presents a brief overview of funding entities and project types in order to provide background and definitions of key terms that are important for analysis of climate change research needs and the research process.

A. Funding Entities:

Funding entities operating in the U.S. Arctic include, among others, federal and state agencies, the private sector, and foundations.

For example, the National Science Foundation (NSF) has Arctic research opportunities and "invites investigators at U.S. organizations to submit proposals to conduct research about the Arctic."[44] NSF policy and the relevant requests for proposals (RFPs) provide general and specific requirements that could structure research priorities and communication.[45] NSF and other funding entity policies are discussed in greater detail later in the report.[46]

Many federal and state government agencies fund Arctic research. These agencies include NOAA and FWS, among others. As an example, the Interagency Arctic Research Policy Committee (IARPC), dedicated to setting priorities or Arctic research,[47] includes 15 principles, among them NOAA, FWS, and the Environmental Protection Agency (EPA).[48]

Other funding arrangements exist as well. For example, Shell and the North Slope Borough "agreed to work together on scientific research offshore in the Arctic in an effort aimed at ending political and

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[44] Arctic Research Opportunities, NAT'L SCI. FOUND., https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5521.
[45] *See, e.g.*, Principles for the Conduct of Research in the Arctic, NAT'L SCI. FOUND., http://www.nsf.gov/geo/plr/arctic/conduct.jsp (last visited Dec. 27, 2013) (general NSF policy listing principles of researcher-community interaction); Arctic Research Opportunities Program Solicitation 13-592, NAT'L. SCI. FOUND., http://www.nsf.gov/pubs/2013/nsf13592/nsf13592.htm (specific RFP related to projects involving the Arctic Natural Sciences Program, Arctic System Science Program, Arctic Social Sciences Program, Arctic Observing Network, and Polar Cyberinfrastructure).
[46] *See* CLIMATE CHANGE RESEARCH COMMUNICATION POLICIES, *infra*.
[47] EXECUTIVE OFFICE OF THE PRESIDENT, ARCTIC RESEARCH PLAN FY 2013-2017 (2013), http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf.
[48] Interagency Arctic Research Policy Committee Principals, 2013-2014, https://www.nsf.gov/geo/plr/arctic/iarpc/iarpc_principals2013.jsp (last updated Jan. 7, 2014).

regulatory fights over exploration and development."[49] The science collaboration involved $5 million funding from Shell.[50] Other funders include foundations and non-profit organizations.[51]

Project funding arrangements generally include both the substantive research goals and procedural considerations related to achieving those goals.[52] This report primarily focuses on research funded by NSF and other federal entities, which are discussed in detail later in the report.

B. Project Types:

Funding entities have different priorities, with climate change research projects falling into two general categories that may influence the interaction between researchers and communities.

The first category is **social science research**, including projects involving social, behavior, and economic science focused on Arctic culture and environment, resources and economic change, development of social and political institutions, ethnic and regional identities, and knowledge systems.[53] Examples include community approaches to climate change adaptation and TK related to subsistence hunting.[54]

The second category is **natural science research**, which is the primary focus of this report. Natural science research can be further subdivided into basic and applied projects. *Basic natural science* projects involve fundamental science focused primarily on physical and chemical processes in the Arctic.[55] *Applied natural science* projects generally focus on ecosystems and the interaction of basic processes with the broader environment.[56]

NSF, for example, separates its Arctic Social Sciences and Arctic Natural Sciences programs. The Arctic Social Sciences Program includes "anthropology, archaeology, economics, geography, linguistics, political science, psychology, science and technology studies, sociology, TK, and related subjects."[57] Notably, these projects stress the importance of collaboration and partnership with community members, with special emphasis that researchers "ensure that subjects are protected from research risks in conformance with the relevant federal policy."[58]

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[49] Patti Epler, *Shell and North Slope Borough to Join Forces on Arctic Research*, ALASKA DISPATCH (Oct. 28, 2010), http://www.alaskadispatch.com/article/shell-and-north-slope-borough-join-forces-arctic-research.

[50] *See* The Role of Science in Responsible Development, INST. OF THE NORTH, https://www.institutenorth.org/programs/arctic-advocacy-infrastructure/Arctic_Policy_Forum/science-development.

[51] *See, e.g.*, Funding Areas—Arctic, WILBURFORCE FOUNDATION, http://www.wilburforce.org/funding-areas/priority-regions/arctic.

[52] *See, e.g.*, Program Solicitation, *supra* note 45.

[53] NAT'L SCI. FOUND. ARCTIC SOCIAL SCIENCES PROGRAM, OPPORTUNITIES IN ARCTIC RESEARCH (1999).

[54] *See id.*

[55] INTERNAT'L STUDY OF ARCTIC CHANGE, SCIENCE PLAN (2010), *available at* http://www.arcticchange.org/storage/ISAC%20Science%20Plan%20Final%20Publication.pdf.

[56] *See id.*

[57] Arctic Social Sciences, NAT'L SCI. FOUND., http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13425.

[58] *Id.*; *see also* Federal Policy for the Protection of Human Subjects, 45 C.F.R. § 690.

The NSF Natural Sciences Program focuses on Arctic processes, including research on "marine and terrestrial ecosystems, arctic atmospheric and oceanic dynamics and climatology, arctic geological and glaciological processes, and their connectivity to lower latitudes."[59] While the program page does not have the same language as the Social Sciences program, which emphasizes collaboration and partnership,[60] general NSF policies note the need for community engagement in most Arctic projects.[61]

The substantive and procedural requirements required by the agency or funding entity and the type of project are important in determining the linkages between research and the community—linkages that include how much the community is involved in the research itself and the direct utility of the results from a community perspective.

C. Project Execution:

The final piece in the research framework puzzle is how research is carried out on the ground. Variables must be considered that are unique to Alaska and the U.S. Arctic.

First, research sites are often remote and in extreme environments that require substantial expertise to navigate. In Barrow, for example, the average temperature is under zero degrees Fahrenheit from December to March.[62] The harsh climate and difficulty of communication in some cases introduces process considerations that affect how research occurs.

Second, researchers often must acquire permission to access resources. For example, the AEWC Co-Management agreement requires consultation on any action taken or proposed to be taken that affects bowhead whales or the subsistence hunt.[63] The agreement also has provisions regarding how researchers can acquire samples.[64] These coordination requirements may necessitate permission for many research activities that occur in the region involving bowhead whales and other resources.

Third, building from the resource access issues, researchers often must acquire permission to access places as well. For example, Chapter 6 of the Tanacross Tribal Policy on research says, "No research on the Tanacross people or traditional lands shall be conducted without the express permission of the

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[59] Arctic Natural Sciences, NAT'L SCI. FOUND.,
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13424&org=NSF.
[60] *See id.*
[61] *See* Principles for the Conduct of Research in the Arctic, *supra* note 45.
[62] Monthly Averages for Barrow, AK, WEATHER.COM,
http://www.weather.com/weather/wxclimatology/monthly/graph/USAK0025 (last visited Dec. 26, 2013).
[63] Cooperative Agreement between National Oceanic and Atmospheric Administration and the Alaska Eskimo Whaling Commission (2008) (as amended by the 2011 Agreement).
[64] *Id.*

Tanacross Tribal Council."[65] In order to receive permission, researchers must comply with a list of requirements before, during, and after projects.[66]

Fourth, researchers may need to satisfy subsistence priority requirements on federal land. Fish and wildlife management on federal lands and waters must ensure rural subsistence priority.[67] Specific aspects of subsistence priority could affect proposed research depending on the location and time of year.

It is important to note that in some instances, researchers live and work in communities, thus are experienced with the considerations of working in the harsh Arctic climate. For example, the North Slope Borough is a political subdivision of the state that includes Barrow and employs scientists in the Borough's Department of Wildlife Management that have spent decades in the community. However, much of the time, researchers come to Arctic field sites from other parts of Alaska and the United States.

In sum, the unique climate change research framework in Alaska introduces special challenges that must be considered when analyzing research priorities, policies, and practices.

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[65] NATURAL AND CULTURAL RESOURCES - TANACROSS TRIBAL GOVERNMENT (adopted Sept. 3, 2013) (on file with author).
[66] *See id.*
[67] *See* Subsistence Management Regulations for Public Lands in Alaska-2012-13 and 2013-14 Subsistence Taking of Wildlife Regulations, 77 Fed. Reg. 35,481 (Jun. 13, 2012). *See also* U.S. Forest Serv., Subsistence Hunting and Fishing (Program Partnership Paper, Feb. 2013).

V. CLIMATE CHANGE RESEARCH NEEDS AND PRIORITIES

In all of the United States, the Alaskan Arctic is experiencing the most immediate and dramatic consequences of climate change. Interviewees described numerous observations that indicate the abrupt and intense nature of ecological and environmental changes over the last few decades. Many interviewees and meeting attendees described an Arctic that is changing at astonishing rates, pushing the bounds of what is dictated by TK. Climate change research can enhance understanding of these changes and assist informed adaptation.

A. Community Research Priorities:

i. Climate Change and Traditional Knowledge:

TK is formed over generations, with experience informing understanding and education over centuries. In interviews, Alaska Native community members stress that their culture and subsistence lifestyle has adapted countless times during their history, and TK is adaptive to environmental change.

Numerous interviewees identify that today, however, many things are changing rapidly in the Arctic. Some changes are now outside of the experiences understood by TK. One interviewee stressed that this could lead to a disconnect between the belief of the adaptability of subsistence resources and what may actually occur with climate change—subsistence resources may struggle to adapt in some instances.

Interviewees and meeting attendees emphasized that subsistence communities rely on every aspect of the environment. For example, one interviewee described that the community of Barrow did not have a whale for the 2013 summer celebration due to unstable ice. According to the interviewee, the unstable ice was partly caused by rising temperatures, and partly caused by wind and storms. In this instance, climate change impacts may have hindered access to subsistence resources.

In another context, meeting participants described the whale migration pattern as connected to food sources, which are connected to the conditions and chemistry of the ocean, which are connected to currents and weather, and so on. Thus, many factors—from annual or decadal climate variation to smaller-scale food-web and weather changes—impact subsistence resource availability.

TK holders understand the interconnectedness of ecosystems and the importance of each component on a subsistence lifestyle. They incorporate knowledge about present conditions with knowledge of past conditions to form projections for the future.[68] Now, TK input variables are shifting so dramatically that it could stress communities' abilities to adapt. A constant theme of interviews was that, given the rapid, unprecedented changes in the Arctic, the many variables that affect subsistence resources may be

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[68] *See* Inuit Circumpolar Council, Application of Traditional Knowledge in the Arctic Council (2013), *available at* http://www.iccalaska.org/servlet/content/Food%20Security.html.

affected by climate change. Therefore, community research priorities encompass all aspects of the subsistence lifestyle and the ecological and environmental factors that affect it.

ii. Abundance and Availability of Subsistence Resources:

One interviewee described that the fundamental concern of communities is the continued availability of subsistence resources. The abundance and availability of subsistence resources are integral to subsistence communities' diet, lifestyle, and culture. Abundance is a function of population and stock resources; availability is a function of migration patterns and hunter access.

In one meeting, research needs identified stemming from concerns about abundance and availability of subsistence resources include stock assessments, population studies, migration tracking, and projections related to these analyses. In addition, research needs identified by meeting participants and interviewees include the effects of shipping, noise, and seismic exploration mining, among other things, on subsistence resources. Increased shipping, commercial activity, tourism, and scientific research introduce population stress on top of concerns related to the physical consequences of climate change.

Multiple meeting participants addressed concerns related to the intersection between subsistence resources and development. Research needs discussed included understanding how noise from industrial activities could interfere with subsistence resource migration patterns. In addition, meeting participants and interviewees discussed the need to better understand impacts from commercial shipping lanes, vessel traffic generally, oil spills, heavy metal contamination, other types of pollution, and airplane noise.

The specific research needs identified vary from community to community and are dependent on the subsistence resources that are most important to each community. While not enough interviews were conducted to quantitatively determine community differences, the focus of research needs varied based on where interviewees were from. For example, when conducting meetings and interviews in the Kawerak region with communities that are located near the Northern Bering Sea, many of the research needs focused on potential impacts from shipping. Generally, interviewees from different locations alternatively identified whales, walrus, seal, salmon, and other species as research priorities, along with numerous variables that influence their abundance and migration patterns.

iii. Summary:

As discussed, TK holders take a holistic view of the environment, integrating many variables over time and across disciplines, which helps them maintain their subsistence lifestyles and thrive in the harsh conditions of the Arctic. Information on abundance and availability of resources was a specific need identified by many community members and researchers interviewed. However, community members and researchers also expressed broader climate change research needs. Multiple interviewees emphasized that, in the Arctic, everything is affected by climate change, thus the climate change research needed to support a continued subsistence lifestyle is broad.

In April 2013, NSF funded the Workshop on Improving Local Participation in Research in Northwest Alaska, convening more than 60 people, including community members from 11 Northwest Alaska villages.[69] The workshop summary identifies research needs that parallel the authors' research.[70] While the workshop was not specifically focused on climate change, the workshop results are instructive.

According to the 2013 workshop, research needs were divided into five categories: People, Environment, Development, Animals, and Other. Table 2 summarizes the workshop's research needs findings by category.

Table 2. Prioritization of Research[71]	
People	• Document subsistence use • Socio-economic impacts of development – before and after • Document all kinds of TK • Science and TK in schools • Compare benefits of Western and subsistence diet
Environment	• Erosion – coast and rivers • Effects of climate change • Effects of climate change on people • Synthesis of studies – big picture of change/adaptation • Environmental changes • Studies of rivers and lakes • Changes over time for a community • Effects of too much rain • Effects of climate change on food
Development	• Before/after studies (e.g., mining) • Effects of shipping & boats • Impacts of mining • Effective strategies to mitigate impacts • Impacts of offshore oil and gas
Animals	• Beluga whale studies • Animal diseases • Endangered species • Stress to marine mammals
Other	• Baseline data all in one place

While the participants in that workshop cautioned against using the research needs categories as an exhaustive list because many of the needs are interconnected,[72] the results help illustrate the broad research priorities in a rapidly changing Arctic.

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[69] UNIV. OF ALASKA FAIRBANKS, CHUKCHI CAMPUS, NORTHWEST ARCTIC BOROUGH, WORKSHOP ON IMPROVING LOCAL PARTICIPATION IN RESEARCH IN NORTHWEST ALASKA (2013).
[70] *See id.* at 10–11.
[71] Adapted from Workshop Summary. *Id.*
[72] *Id.* at 10.

Likewise, interviewees identified broad research needs with an emphasis on applied natural science and social science projects. For example, at a roundtable meeting co-hosted by ELI in Kawerak in April 2013, participants focused on fish stocks and enhancement, marine mammal abundance and availability, heavy metals tissue-sampling of subsistence resources, and the impacts of increased vessel traffic in the Bering Sea. This focus on subsistence resources parallels the general applied natural science and social science research needs in the 'People,' 'Environment,' 'Development,' and 'Animals' categories of the NSF-funded workshop.

Other workshops found similar results regarding community research needs. Table 3 summarizes climate change-related research needs from two recent workshops.

Table 3. Climate Change Research Priorities[73]	
Alaska Native Science Commission Regional Meeting (2003)	• Changes in species kinds, size, numbers, distribution, migration, and health • Shifting weather patterns • Adaptation by communities • Economic and cultural impacts of climate change • Effect of global climate change on local ecosystems
North Slope Science Initiative Workshop (2011)	• How changes will affect use of ice for travel and hunting • How changing conditions will affect the reliability of oil spill trajectory predictions • How earlier insect emergence could affect calving caribou • How increased rainfall will affect drying of subsistence foods • How fish and wildlife are changing migration patterns • Understand trends in marine populations, including new species • Monitor caribou using aerial surveys and radio collars • Address effects of aircraft on wildlife (e.g., track flights)

Similar to the interviews and meetings conducted for this report, past workshops identify both natural science (e.g., the abundance of availability of subsistence resources, the impacts of increased development) and social science (e.g., the impacts of climate change on the subsistence way-of-life and local communities) relating to subsistence resources as the primary research needs.

B. Agency and Funding Entity Research Priorities:

Myriad federal institutions engage in and/or support Arctic research in order to meet science-based management objectives and expand understanding of the Arctic. The following section focuses on the research priorities and goals of some of the key entities affecting research plans and programs in the region: the U.S. Arctic Research Commission (USARC), IARPC, NOAA, NMFS, and Bureau of Ocean Energy Management (BOEM).[74] Table 4 lists these institutions' research goals and priorities.

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[73] Adapted from Workshop Summary. *See id.* at Attachment A, 2–3.
[74] Background on some of these entities, including USARC and IARPC, are described *supra* Section VI in the context of their policies for engaging communities.

Table 4. Research Goals and Priorities	
USARC	Five priority research goals: 1. Observe, understand, and respond to environmental change in the Arctic 2. Improve Arctic human health 3. Understand natural resources 4. Advance civil infrastructure research 5. Assess indigenous languages, identities, and cultures
IARPC	Seven overlapping research areas: 1. Sea ice and marine ecosystems 2. Terrestrial ice and ecosystems 3. Atmospheric studies of surface heat, energy, and mass balances 4. Observing systems 5. Regional climate models 6. Adaptation tools for sustaining communities 7. Human health
NOAA	Six priority goals: 1. Forecast sea ice 2. Strengthen foundational science to understand and detect Arctic climate and ecosystem changes 3. Improve weather and water forecasts and warnings 4. Enhance international and national partnerships 5. Improve stewardship and management of ocean and coastal resources in the Arctic 6. Advance resilient and healthy Arctic communities and economies
NMFS	Three research themes: 1. Monitor and assess fish, crab, and marine mammals populations, fisheries, marine ecosystems, and the associated communities which rely on these resources 2. Understand and forecast effects of climate change on marine ecosystems 3. Describe and assess the role of habitats in supporting healthy marine ecosystems and populations of fish, crab, and marine mammals
BOEM	Three general goals for the Environmental Studies Program: 1. Provide the information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the outer continental shelf and the potentially affected coastal areas 2. Predict impacts on the marine biota which may result from chronic, low level pollution or large spills associated with OCS production, from drilling fluids and cuttings discharges, pipeline emplacement, or onshore facilities 3. Monitor human, marine, and coastal environments to provide time series and data trend information for identification of significant changes in the quality and productivity of these environments, and to identify the causes of these changes

The broad research priorities (including goals, milestones, and anticipated outputs) encompass an array of natural and social science topics. The broad priorities are discussed below in more detail, grouped under the following themes that recur across the federal institutions: Sea Ice Forecasting & Effects of Decreasing Sea Ice, Cooperation & Coordination, Marine Ecosystem Processes, Species & Habitat Data, Vessel Traffic, Effects of Mineral Extraction, Climate, Community Resilience, Adaptation & Food Security, and Cooperation & Coordination.

i. Sea Ice Forecasting & Effects of Decreasing Sea Ice

A key need expressed by IARPC and NOAA is improved observation, modeling, and forecasting of Arctic sea-ice extent—and melting—at various scales.[75] This includes closely linked weather forecasting, as atmospheric and climatic processes both affect and are affected by sea ice.[76] In its program solicitation, NSF echoes the need for research regarding all types of Arctic ice and snow.[77] There is also a call to determine the impacts of the changing extent of sea ice on the marine ecosystem,[78] and specific effects on various species in the Bering, Chukchi, and Beaufort Seas.[79]

ii. Marine Ecosystem Processes

Numerous federal priorities relate to improved monitoring and understanding of marine ecosystem processes. Efforts to implement an Arctic Distributed Biological Observatory are ongoing, with the purpose of facilitating consistent oceanographic monitoring of biophysical responses to changing conditions.[80] Covering a far-reaching spectrum of resources and parameters, the information gathered as part of the Biological Observatory is envisioned to serve as "a knowledge-resource base to improve the ability of resource management agencies (e.g., BOEM and NOAA) to determine the effects of their actions."[81] NOAA and IARPC highlight that information gathered is expected to support subsistence use of cetaceans and ice seals, as well as other subsistence uses.[82]

NMFS emphasizes the importance of understanding ecological and trophic interactions among species,[83] and BOEM describes the importance of distinguishing anthropogenic versus naturally-caused changes to

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[75] IARPC, ARCTIC RESEARCH PLAN: FY2013-2017 11, 12, 15 (2013) [*hereinafter* IARPC Plan], *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf; NOAA, NOAA'S ARCTIC VISION AND STRATEGY 7–8 (2011) [*hereinafter* NOAA REPORT], *available at* http://www.arctic.noaa.gov/docs/NOAAArctic_V_S_2011.pdf.

[76] IARPC Plan, *supra* note 75, at 12; NOAA Report, *supra* note 75, at 8.

[77] NSF, ARCTIC RESEARCH OPPORTUNITIES, PROGRAM SOLICITATION NSF 13-592 4 [hereinafter NSF Opportunities], *available at* http://www.nsf.gov/pubs/2013/nsf13592/nsf13592.pdf.

[78] NOAA Report, *supra* note 75, at 9; NOAA FISHERIES, NOAA ALASKA FISHERIES SCIENCE CENTER PLAN (2010) [hereinafter NMFS Report], at 10, *available at* http://www.afsc.noaa.gov/GeneralInfo/AFSCSciencePlanFINALJUNE12010.pdf.

[79] NOAA Report, *supra* note 75, at 18; NMFS Report, *supra* note 78, at 10.

[80] NOAA Report, *supra* note 75, at 10; IARPC Plan, *supra* note 75, at 15–19; Arctic Distributed Biological Observatory, NOAA, http://www.arctic.noaa.gov/dbo/about.html (last visited Dec. 30, 2013).

[81] IARPC Plan, *supra* note 75, at 17–19.

[82] NOAA Report, *supra* note 75, at 10, 18; IARPC Plan, *supra* note 75, at 21.

[83] NMFS Report, *supra* note 78, at 10.

fish stocks.[84] NSF's Arctic Natural Sciences Program supports research projects that "advance knowledge of the processes of the Arctic Ocean and adjacent seas" broadly.[85]

iii. Species and Habitat Data

NMFS describes needs to maintain, support, and improve population estimates for fish, shellfish, and marine mammals, as well as collecting and analyzing associated biological and socioeconomic information to support management decisions by the agency and its partners.[86] This includes habitat (and critical or essential habitat) information and the effects of human activities on the species.[87] BOEM articulates the need for "[m]ore comprehensive abundance estimates" for bowheads, polar bears, and other ice-associated threatened and endangered species, to enable adequate analyses for compliance with federal frameworks for protecting such species.[88]

iv. Vessel Traffic

USARC developed a number of short-term recommendations for mitigating adverse effects from the predicted increasing vessel traffic, especially in the Bering Strait region. Recommendations include improved communication equipment, navigational information and aids, and marine charting through shared industry data.[89] NOAA's goals include working at national and international scales to increase protection of resources and surveying and mapping regional waters.[90]

v. Effects of Mineral Extraction

Several agencies suggest research questions about the broader impacts of mineral extraction, highlighted by IARPC and BOEM.[91] IARPC, USARC, NOAA, and BOEM highlight the importance of oil spill prevention and response. IARPC calls for coordinated work to strengthen oil spill response planning through the Oil Spill Recovery Institute and improved field guides;[92] USARC calls for prevention and response research;[93] NOAA calls for incorporation of Arctic communities' knowledge into better strategies for responding to Arctic spills, including training;[94] and BOEM describes the importance of accurate information on conditions and weather for understanding spilled oil behavior and

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[84] BUREAU OF OCEAN ENERGY MANAGEMENT, ENVIRONMENTAL STUDIES PROGRAM, STUDIES DEVELOPMENT PLAN FY 2014-2016: ALASKA OCS REGION 20 (2013).
[85] NSF Opportunities, *supra* note 77, at 4.
[86] NMFS Report, *supra* note 78, at 5–7.
[87] NMFS Report, *supra* note 78, at 12–13.
[88] BOEM Report, *supra* note 84, at 20.
[89] U.S. ARCTIC RESEARCH COMM'N, REPORT ON THE GOALS AND OBJECTIVES FOR ARCTIC RESEARCH: 2013-2014 15 (2012) [hereinafter USARC REPORT], *available at* http://www.arctic.gov/reports_goals.html,
[90] NOAA Report, *supra* note 75, at 16, 20–21.
[91] IARPC Plan, *supra* note 75, at 21; BOEM Report, *supra* note 84, at 20.
[92] IARPC Plan, *supra* note 75, at 15.
[93] USARC Report, *supra* note 89, at 12.
[94] IARPC Plan, *supra* note 75, at 19, 21.

weathering.[95] As a nationwide goal, USGS prioritizes increased understanding of the life cycle of energy and minerals resources, from origin to effects, and translating the information into economic terms to support policymaker decision-making.[96]

vi. Climate

As expected, climate processes, feedback, and change are priority research areas for myriad federal agencies. In the Arctic this includes, among other things, identifying key climate feedback sites,[97] improved forecasting and modeling of feedback and effects,[98] and mapping the effects of climate change on Arctic ecosystems and communities.[99] NMFS calls for forecasting socioeconomic impacts on coastal communities and marine mammal subsistence harvests.[100] IARPC emphasizes the improved understanding of climate change effects on ecosystems and the relevance to not only policy decision-making but also subsistence uses.[101] IARPC specifically highlights overlaying GIS data layers with known traditional use areas.[102] IARPC also discusses the need for faster incorporation of knowledge into working models, as well as building models at various scales and that can be coupled with various approaches.[103] NOAA describes the focus on information to support forecasting services for weather, sea ice, and storm surge and the necessity of linking them to response and decision-making processes.[104] NOAA notes the need to improve baseline observations, and to expand the Alaska Ocean Observing System and its Arctic ecosystem research program generally.[105] NSF encourages proposals that use Arctic Observing Network data and/or contribute to its development.[106]

vii. Community Resilience, Adaptation & Food Security

In addition to understanding climate feedbacks and climate change, many agencies also emphasize the necessity of developing approaches to mitigation and adaptation.[107] This includes identifying ecosystem and community vulnerabilities to climate change and to socioeconomic stressors, helping communities understand them, and increasing community adaptation (with systems for evaluating effectiveness).[108]

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[95] BOEM Report, *supra* note 84, at 19–20.

[96] U.S. GEOLOGICAL SURVEY, FACING TOMORROW'S CHALLENGES: U.S. GEOLOGICAL SURVEY SCIENCE IN THE DECADE 2007-2017 (2007), at ix, 25-28, *available at* http://pubs.usgs.gov/circ/2007/1309/pdf/C1309.pdf.

[97] IARPC Plan, *supra* note 75, at 14, 28.

[98] IARPC Plan, *supra* note 75, at 29; NMFS Report, *supra* note 78, at 10.

[99] IARPC Plan, *supra* note 75, at 15, 28; NOAA Report, *supra* note 75, at 8.

[100] NMFS Report, *supra* note 78, at 11.

[101] IARPC Plan, *supra* note 75, at 29.

[102] IARPC Plan, *supra* note 75, at 28.

[103] IARPC Plan, *supra* note 75, at 52–53.

[104] NOAA Report, *supra* note 75, at 14.

[105] NOAA Report, *supra* note 75, at 9, 17.

[106] NSF, *supra* note 78, at 4–5.

[107] *See e.g.,* IARPC Plan, *supra* note 75, at 18.

[108] IARPC Plan, *supra* note 75, at 22, 63–66; NOAA Report, *supra* note 75, at 18–21.

USARC and IARPC discuss the need for human health assessments and expansion of diagnostic and treatment services in remote areas.[109]

USARC, IARPC, NOAA, and BOEM discuss food security and subsistence uses. This focus area includes research necessary to determine the current state of food security, changes in food security and the projected effects, and the extent of contamination, as well as specific information on individual subsistence resources.[110]

viii. Cooperation & Coordination

At the international level, several efforts aim to increase coordination between U.S. research programs and those undertaken by international partners and observation networks through agreements as well as international fora. For example, the federally appointed U.S. Arctic Research Commission is coordinating with the Canadian Polar Commission, sharing best practices of successful Arctic initiatives and hosting bilateral meetings to address shared challenges of the North American Arctic.[111]

At the domestic level, emphasis is placed on improving information exchange and integration among agencies and industry, federal and state agencies, and among different federal agencies. There are also calls for collaboration on intensive research efforts that require significant resources.[112] As discussed previously, a key issue is the incorporation of TK into the various management efforts and databases overseen by the federal agencies. Many agencies note the importance of incorporating TK; for example, BOEM states that it "continue[s] to seek and include firsthand knowledge of local subsistence hunters to enhance the scientific knowledge base."[113]

C. Overarching Research Need: Community-Researcher Linkages

Community climate change research needs and agency/funding entity research priorities demonstrate general overlap, with one key point of diversion. Based on existing reports, workshop outputs, and our research, communities are primarily interested in research that addresses abundance and availability of resources. While researchers and agencies often have similar goals, they may also have broader interests in understanding basic information about, for example, global climate science, sea ice dynamics, ocean circulation patterns, and other topics, without direct linkages to the community implications of those findings

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[109] USARC Report, *supra* note 89, at 2; IARPC Plan, *supra* note 75, at 72–75.

[110] USARC Report, *supra* note 89, at 2, 10; BOEM Report, *supra* note 84, at 19–20.

[111] USARC Report, *supra* note 89, at 18; IARPC Plan, *supra* note 75, at 16, 19, 26; NOAA Report, *supra* note 75, at 10–11, 15–16, 18.

[112] USARC Report, *supra* note 89, at 11; IARPC Plan, *supra* note 75, at 21, 26-27, 29, 47, 53, 55 72; NOAA Report, *supra* note 75, at 15–16.

[113] BOEM, *supra* note 84, at 22.

Given the proliferation of Arctic research concerning the impacts of climate change, it is critical that there is communication between the growing number of researchers and the communities that rely on the land for subsistence.[114] Interviewees consistently said that community-researcher linkages were a primary climate change research need. According to interviews, meetings, and the existing literature, it is essential to have a robust communication framework in place before, during, and after projects.

From the perspective of the community members interviewed and from meeting discussions, current research approaches may be inadequate for two reasons. First, there remains important knowledge gaps on certain issues. For example, the Arctic Landscape Conservation Commission published a report on habitat and ecosystem change that recommended study on different "gaps" in current research related to subsistence resources.[115] Research gaps related to subsistence resources include those discussed above—generally, the future of the abundance and availability of the animals subsistence communities depend upon is the most pressing research need, which includes a broad range of environmental and ecosystem projects.

Second, research may be inadequate due to insufficient inclusion of Alaska Natives in the projects themselves. The USARC has included outreach and communication components in all of its identified research needs, including incorporation of Alaska Natives into the research process.[116] Similarly, many interviewees and meeting attendees, including researchers, agency staff, and Alaska Native community members, emphasized that community-science linkages make the research process more effective and efficient. Communication of research from project design through implementation and results dissemination allows for the timely adaptation—of both the communities and of the projects—needed when facing rapid Arctic climate change.

i. Communication with Communities Helps Researchers

From the researcher perspective, interviewees indicated that interaction with communities is essential. As a threshold matter, several researchers indicated that they could not work in the harsh conditions of the Arctic without the experience and knowledge of local guides. It is difficult to conduct research in Alaska, where there are special considerations for everything from food to transportation, and community involvement is often needed, including third-party contractors provide the logistical support. In one instance, a researcher did not interact with the community before conducting an aerial survey, and the helicopter had to be re-routed.

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[114] *See, e.g.*, Marine Mammal Commission Workshop on the Impacts of Changes in Sea Ice and Other Environmental Parameters in the Arctic (Feb. 15–17, 2000), http://www.arctic.noaa.gov/workshop_summary.html (identifying a "strong and urgent case for addressing the challenges posed by environmental change," which necessitates improved communication, better research policy, and education).

[115] ARCTIC LANDSCAPE CONSERVATION COOPERATIVE, *supra* note 19.

[116] *See* Walter B. Parker, Commissioner, U.S. Arctic Research Commission, Keynote Address at the Joint EU – Russia - Canada – US Workshop on Collaborative Technological Research for Arctic Development (Oct. 25, 2001), *available at* http://www.arctic.noaa.gov/essay_parker.html.

Substantively, communication can make the research projects better. One interviewee emphasized that best information available includes TK, which incorporates observational information that cannot be gathered elsewhere. In general, communities have a much longer history of observation than science, and communities' approach and understanding can help define questions of interest that drive the research process.

TK also can help solve problems that arise during the research process. The benefit of collaboration is clearest for projects that directly align with the communities' areas of interest, such as marine mammal tagging studies that enlist the expertise of local hunters. However, basic science projects that have indirect community linkages can substantively benefit from collaboration as well. One researcher working on microbial ecology described an instance when the initial sampling sites were not feasible— once community members knew the goals of the research project, they helped identify sites that worked. Similar observations were discussed by many interviewees and are addressed in subsequent sections of the report.

ii. Communication with Researchers Helps Communities

One interviewee noted that communities have adapted for millennia, and they will again adapt to the effects of climate change; however, they need to do so efficiently. For this reason, supporting research is in a community's best interest. Communities have concerns over the continued availability and abundance of subsistence resources—communication can help address these concerns by relaying research needs and assuring that communities will be aware of available information that is relevant to the subsistence way of life. At one marine mammal meeting, for example, a participant stated that subsistence resources research is necessary for the survival of subsistence communities. Research can inform adaptation of the subsistence lifestyle to the realities of rapid Arctic climate change.

D. Summary:

In adapting to the ecological and environmental changes of the 21st century, communities in the U.S. Arctic will be operating at the intersection of TK and information gathered through climate change research. Many of the interviewees in this project and other workshop results and papers make it clear that climate change challenges, priority responses, and research needs to address climate change impacts focus primarily on subsistence resources. However, subsistence resources are interconnected with all aspects of the ecology and the environment.

In addition, while the specific research project needs are numerous, one overarching theme that literature, interviewees, and meeting attendees identified is the need for communication and engagement with communities. **In short, information flow is as important as information generation**. Given the increased presence of researchers, along with the expected increase in development and environmental change, a key climate change research need is linking science and communities in the research process.

The remainder of the report will examine how to link researchers and communities before, during, and after projects. First, the report examines on-the-books policies for funding entities, research institutions, and some Alaska Native communities. Next, the report summarizes actual practices, to make recommendations for researcher-community engagement in order to make the research process more effective and efficient.

VI. CLIMATE CHANGE RESEARCH COMMUNICATION POLICIES

Several agencies have black-letter policies related to outreach and communication with Alaska Native communities before, during, and after the research process. For example, NSF has Principles for the Conduct of Research in the Arctic—compliance with these Principles is required of all Arctic research as a condition of NSF funding.[117] This policy and other agency, funding entity, and tribal guidance forms the foundation for how research communication should occur in practice.

A. Federal Government and Coordinating Entity Policies:

Table 5 summarizes NSF's Arctic policies. In some instances, the NSF policies described are quoted from the policy document in order to preserve their original meaning.

Table 5. NSF Arctic Research Communication and Engagement Policies	
Overview	**NSF** is an independent federal agency that funds 20% of all federally-backed basic science research.[118] The agency requires compliance with the Principles for the Conduct of Research in the Arctic in order to receive funding for projects in the region.[119]
Before Projects	The Principles direct researchers to inform appropriate community authorities of planned research on lands or waters they use or occupy. Researchers are directed to consult with and, where applicable, include communities in project planning and implementation.[120] In addition, research directly involving Alaska Natives should not proceed without their clear and informed consent. To obtain informed consent, researchers should disclose funding sources, the people involved with the project, the purposes, goals, and time-frame of the research, the data-gathering techniques, and foreseeable positive and negative implications and impacts of the research.[121] In summary, researchers are directed to consult with and, where applicable, include communities in project planning.[122]
During Projects	As a threshold matter, researchers are directed to consult with and include communities in project implementation. In addition, NSF's Principles include a Code of Conduct designed to govern interactions between researchers and communities. Researchers must respect local cultural traditions, languages, and values, and

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[117] Principles for the Conduct of Research in the Arctic, NAT'L SCI. FOUND., http://www.nsf.gov/geo/plr/arctic/conduct.jsp (last visited Dec. 27, 2013).
[118] About the National Science Foundation—NSF at a Glance, NAT'L. SCI. FOUND., http://www.nsf.gov/about (last visited Dec. 27, 2013).
[119] Principles for the Conduct of Research in the Arctic, *supra* note 117.
[120] *Id.*
[121] *Id.*
[122] *Id.*

| | researchers are responsible for all actions and decisions that affect the community relating to the project.[123]

In designing projects, researchers should use TK and experience. When possible, researchers should translate results and communications into the local language. Ongoing projects should be explained in an understandable way, and it is the responsibility of the researcher to inform the community.[124]

Sacred sites, cultural materials, and cultural property cannot be disturbed without consent.[125]

Finally, reasonable opportunities should be provided for the communities to express interests and to participate in the research. |
|---|---|
| After Projects | Researchers are directed to provide research reports, data descriptions, and other relevant materials to the local community. Special efforts should be made to communicate results that are responsive to local concerns.[126]

Research results should be explained in non-technical terms and should be communicated by means of study materials that can be used by local teachers or in displays that can be shown at local community centers or museums. |

NSF's Principles focus on communication from the earliest stages of research design to the final stages of information dissemination. In theory, the Principles emphasize numerous issues that interviewees identified as important—including obtaining consent, involving communities in research design and implementation, respecting cultural differences, and communicating relevant information in a clear, understandable manner.

Aside from NSF, several federal entities exist that help coordinate planning and research in the Arctic:

The **U.S. Arctic Research Commission (USARC)** was established in 1984 to recommend Arctic research policy and work with NSF to implement the policy.[127]

The **Interagency Arctic Research Policy Committee (IARPC)** was established in 1984 and is designed to coordinate Arctic research conducted by 14 federal agencies.

The **North Pacific Research Board (NPRB)** was created by Congress in 1997 to recommend marine research activities in the Gulf of Alaska, Bering Sea, Aleutian Islands and Arctic Ocean to the Secretary of Commerce. [128]

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[123] *Id.*
[124] *Id.*
[125] *Id.*
[126] *Id.*
[127] Arctic Research and Policy Act, P.L. 101-609, 104 Stat. 3125.
[128] About Us, NORTH PACIFIC RESEARCH BOARD, http://www.nprb.org/nprb/about-us.

Table 6 summarizes the engagement policies of the USARC, IARPC, and the NPRB.

Table 6. Research Coordination Entities Engagement Policies	
USARC	The USARC recommends key goals and objectives for the Arctic Research Program Plan every two years. The plan is prepared with input from the Alaska public. USARC also sponsors meetings on topics ranging from oil spill response to the impacts of diminishing sea ice on maritime operations.[129] In general, USARC is more focused on broad research goals than specific project implementation.
IARPC	IARPC drafts five-year plans for Arctic research that are "developed through a coordinated interagency effort that included inputs from Alaskan and other Arctic residents and indigenous leaders."[130] Community sustainability and resilience analysis should be developed in collaboration with communities. In addition, the plan instructs researchers to design research, education, and outreach tools and processes.[131] Researchers should also "engage indigenous communities and tribal groups in research activities and projects in the Arctic." To that end, an overarching goal of the plan is to involve indigenous communities "in decisions that affect them."[132] Specifically, the plan endeavors to engage stakeholders at meetings like the Alaska Marine Science Symposium.[133] The plan also aims to make a research database available within 1 to 3 years. Related to specific research goals and tasks, researchers are instructed to consult with local communities regarding their priorities related to traditional use and TK.
NPRB	The NPRB consists of 20 board members that receive advice from a Science Panel and an Advisory Panel. The Board includes an Alaska Native representative. Of the $4 million NPRB awards through RFPs annually, $200,000 is dedicated to "Local and Traditional Knowledge (LTK) and Community Involvement."[134] The intent of the funding is to address local concerns and benefit from local knowledge.[135] All projects, even those that do not fall under the LTK funding category, must include an outreach plan and allocate a minimum of $2,000 for this purpose.[136] NPRB provides "outreach tools" that have been successfully used by past researchers, including information on community presentations, documentary and film resources, exhibits and demonstrations, K-12 education, news media, and website tools.[137]

[129] *See* U.S. ARCTIC RESEARCH COMMISSION, *supra* note 89.
[130] EXECUTIVE OFFICE OF THE PRESIDENT, SCIENCE AND TECHNOLOGY COUNCIL, ARCTIC RESEARCH PLAN FY 2013-2017 (2013), available at http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf.
[131] *Id.*
[132] *Id.*
[133] *Id.*
[134] NORTH PACIFIC RESEARCH BOARD, 2014 REQUEST FOR PROPOSALS (2013), *available at* http://www.nprb.org/assets/images/uploads/files/2014_rfp_full_doc_final_26Sep13.pdf
[135] *Id.*
[136] *Id.*
[137] Outreach Tools, NORTH PACIFIC RESEARCH BOARD, http://www.nprb.org/annual-research-program/resources-for-investigators/outreach-tools (last visited Dec. 29, 2013)

While not specifically related to the Arctic, the **U.S. Global Change Research Program (USCRP)** was established in 1990 to assist research of and response to global change.[138] To that end, the USCRP publishes strategic plans for global change research. Given the nature of rapid climate change in the Arctic, this topic prominently involves Alaska Native interests. Generally, the Strategic Plan aims to facilitate communication and education by increasing engagement and using technology to reach diverse audiences.[139] Specifically, USCRP scientists plan to conduct research that helps Arctic decision-makers respond proactively to future changes.[140]

Cross-institution collaborative efforts merit mention as well. The **Study of Arctic Environmental Change (SEARCH)** is multi-agency initiative led by NSF's Office of Polar Programs and is a "system-scale, cross-disciplinary, long-term arctic research program" involving a collaboration between agencies and private scientists.[141] The SEARCH project database includes 127 projects,[142] focusing on five-year science goals. SEARCH notes that, during the research process, "collaboration with local communities in the investigation, analysis, and communication of studies is central for the most comprehensive understanding on local, regional, national, and global levels."[143] SEARCH strategic planning includes a focus on education and outreach, recognizing the importance of engagement in the classroom and in the community.[144]

The **North Slope Science Initiative (NSSI)** is a state and federal collaboration designed "to facilitate and improve collection and dissemination of ecosystem information pertaining to the Alaskan North Slope region, including coastal and offshore regions."[145] The NSSI focuses on communication and outreach, including hosting workshops and consulting with communities regarding research projects.[146]

A large portion of Arctic research is conducted by federal agency scientists, thus agency engagement policies play a significant role in determining how communities are involved in the research process. Table 7 lists some of the agencies conducting marine research in the Arctic, along with their applicable Arctic-specific policies.

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[138] Global Change Research Act of 1990, U.S. Global Change Research Program, http://www.globalchange.gov/about/global-change-research-act (last visited Dec. 29, 2013).

[139] U.S. Global Change Research Program, The National Global Change Research Plan 2012-2021 (2012), *available at* http://downloads.globalchange.gov/strategic-plan/2012/usgcrp-strategic-plan-2012.pdf

[140] *Id.*

[141] Welcome to SEARCH, Study of Environmental Arctic Change, http://www.arcus.org/search (last visited Dec. 16, 2013).

[142] SEARCH Project Catalog, Study of Environmental Arctic Change, http://www.arcus.org/search/catalog/display (last visited Dec. 16, 2013).

[143] Analyze Societal and Policy Implications of Arctic Environmental Change, Study of Environmental Arctic Change, http://www.arcus.org/search/society (last visited Dec. 16, 2013).

[144] Study of Environmental Arctic Change, Plans for Implementation During the International Polar Year and Beyond 53–57 (2008)

[145] North Slope Science Initiative Homepage, http://www.northslope.org (last visited Dec. 29, 2013).

[146] North Slope Science Initiative, 2012 Report to Congress (2012), *available at* http://northslope.org/media/doc/meetings/2012_NSSI_Report_to_Congress_3-14-2013_1.pdf

Table 7. Examples of Federal Agency Research Engagement Policies	
FWS	Within FWS, Landscape Conservation Cooperatives (LCCs) partner with outside agencies (federal and state), tribes, NGOs, and others to support applied conservation science.[147] There are six LCCs in Alaska. The Arctic LCC Science Plan articulates the goal to work with tribal governments and involve local communities in developing science priorities and participating in studies.[148] The other Alaska LCCs have similar plans, with the Western Alaska LCC including specific outreach tools in its policy document. These tools include conferences, webinars, reports, and education, along with a general strategy to engage during the research planning process.[149]
U.S. Geological Survey (USGS)	USGS researchers are directed to recognize the requirement and trust responsibility to work with Alaska Native governments to assure that rights are protected and concerns are addressed in bureau projects that may produce results on or adjacent to Alaska Native lands.[150] In addition, researchers should respect Alaska Native traditions, cultural values, and practices.[151] To that end, USGS has a tribal relations training course for employees.[152] During projects, USGS has an intern program that encourages tribal youth participation in research projects.[153] Field managers and personnel are expected to make government-to-government contacts with appropriate tribal leaders. These contacts can be made through federal liaisons. Field personnel should also be aware and respectful of cultural sites.[154] Whenever possible, USGS policies encourage the sharing of technical information by incorporating Alaska Natives into projects.[155] The USGS recognizes the value of incorporating TK with empirical studies to better understand the environment.[156] The USGS states that it is committed to providing unbiased scientific information to tribes, and is committed to funding educational initiatives and training sessions.[157]

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[147] Landscape Conservation Cooperatives for Alaska, U.S. FISH & WILDLIFE SERV., http://www.fws.gov/alaska/lcc/index.htm (last visited Dec. 29, 2013).

[148] ARCTIC LANDSCAPE CONSERVATION COOPERATIVE, DRAFT SCIENCE PLAN 20 (2012), *available at* http://arcticlcc.org/assets/about/scienceplan/ALCC_Strategic_Science_Plan_draft_Feb2013_fulltext.pdf at 20

[149] WESTERN ALASKA LANDSCAPE CONSERVATION COOPERATIVE, FY14-15 SCIENCE AND OPERATING PLAN FOR WESTERN ALASKA LCC 12 (2013), *available at* https://westernalaskalcc.org/about/LCC%20Document%20Library/WALCC%20Science%20and%20Operating%20Plan%20(FY14-15).pdf.

[150] U.S. Geological Survey, U.S. Geological Survey Manual § 500.4 (1995), *available at* http://www.usgs.gov/usgs-manual/500/500-4.html.

[151] *Id.*

[152] Training Information, U.S. GEOLOGICAL SURVEY OFFICE OF TRIBAL RELATIONS, http://www.usgs.gov/tribal/training/index.html (last visited Dec. 29, 2013).

[153] SISNAR Internship Program, USGS, http://www.usgs.gov/tribal/activities/index.html.

[154] U.S. Geological Survey, U.S. Geological Survey Manual § 500.6 (1997), *available at* http://www.usgs.gov/usgs-manual/500/500-6.html.

[155] *Id.* § 500.4 (1995), *available at* http://www.usgs.gov/usgs-manual/500/500-4.html.

[156] U.S. Geological Survey Office of Tribal Relations (OTR), U.S. GEOLOGICAL SURVEY, http://www.usgs.gov/tribal (last visited Dec. 29, 2013).

[157] *Id.*

Bureau of Ocean Energy Management (BOEM)	Before research, BOEM policies indicate that ideas for new studies should be driven by public meetings and program reviews. In Alaska, BOEM distributes the Alaska Studies Plan, which summarizes upcoming research and calls for new research ideas.[158] During projects, BOEM directs researchers to "coordinate directly with local communities to discuss their plans, seek advice and ensure that interested individuals learn about the project and its results."[159] BOEM attempts to incorporate TK in the preparation of study materials and dissemination of results.[160] The agency's program documents state that it is committed to open and transparent communication with tribal leaders.[161] After projects, BOEM publishes results of funded research online.[162]
NOAA	NOAA aspires to enable, inspire, and engage Arctic stakeholders, incorporating the value of TK.[163] This guiding principle includes formal and informal education and outreach efforts.[164]

Interviewees indicated that Alaska state agencies generally follow federal policies, and that Alaska-specific outreach and engagement policies are similar to those discussed above.

B. Alaska Native Policies:

Several organizations representing Alaska Native interests have research protocols or guidelines that encourage outreach and communication. The **Alaska Native Science Commission (ANSC)** was established in 1994 to bring together researchers and communities.[165] The ANSC has a template Code of Research Ethics, which provides forms for collaboration, co-authorship, and compensation, among other things.[166] One interviewee noted that ANSC's funding and staffing levels have decreased, leading to capacity challenges.

Multiple Alaska Native political subdivisions have passed research policies by ordinance. The **Northwest Arctic Borough (NWAB)** passed Ordinance 02-03 in February 2013, outlining 12 guidelines for

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[158] BOEM, *supra* note 84.

[159] *See id.*

[160] *Id.*

[161] Reaching Out to Alaska Communities, BUREAU OF OCEAN ENERGY MANAGEMENT, http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Community-Liaison/Index.aspx (last visited Dec. 29, 2013).

[162] BUREAU OF OCEAN ENERGY MANAGEMENT, *supra* note 84.

[163] NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NOAA'S ARCTIC VISION AND STRATEGY 5 (2011), *available at* http://www.arctic.noaa.gov/docs/NOAAArctic_V_S_2011.pdf.

[164] *Id.*

[165] Alaska Native Science Commission Homepage, http://www.nativescience.org (last visited Dec. 29, 2013).

[166] Ethics and Protocols, ALASKA NATIVE SCIENCE COMMISSION, http://www.nativescience.org/communities/code.htm (last visited Dec. 29, 2013).

researchers.[167] The guidelines apply to projects that require an NWAB permit.[168] They were summarized as follows in the April 2013 Workshop on Improving Local Participation in Research in Northwest Alaska:

> The ordinance requires written consent of project participants, written details about proposed research, reporting of research results in non-technical terms, a guarantee of anonymity for research participants, acknowledgement of intellectual property rights, and consultation with the borough and applicable city and tribal councils. In addition, the ordinance recommends that fair compensation be provided to those who disclose traditional knowledge.[169]

The NWAB guidelines parallel much of the data gathered in interviews—communication should be open and understandable, with compensation provided for TK, among other guidelines. The **Bristol Bay Native Association (BBNA)** has similar guidelines. They are summarized as follows:

> The guidelines require communication about the purpose, goals and timeline of the study, written consent of the village or tribal council, training and employment of local Native people, confidentially for sensitive information, fair compensation, respect for culture and traditions, use of translators, an opportunity to comment on draft reports, use of non-technical language, and provision of final results to the community and applicable organizations.[170]

Like the NWAB guidelines, BBNA focuses on engagement before, during, and after projects. The **Native Village of Kotzebue** and the **North Slope Borough** have similar guidelines, emphasizing communication, outreach, and collaboration.

The **Tanacross Tribal Council** has developed a Code titled Natural and Cultural Resources—Tanacross Tribal Government, which has the general purpose of providing guidelines for the "wise and continued use of the natural and cultural resources within the jurisdiction of the Tanacross Tribe, to reduce conflicts over natural resource use, and to preserve the cultural heritage of our Tribe."[171] It contains provisions specific to research, set out to protect the Tanacross Tribe's sacred knowledge, intellectual property, and cultural property.[172]

Pursuant to Chapter 6 of the Code, research activities conducted on Tanacross Tribe members and Tanacross Land require the express permission of the Tanacross Tribal Council. In addition, researchers must communicate data-gathering practices and the positive and negative effects of participating in projects; participants must be compensated; and Tanacross Tribe members must be involved in research

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[167] WORKSHOP ON IMPROVING LOCAL PARTICIPATION IN RESEARCH IN NORTHWEST ALASKA, *supra* note 69, at 8.
[168] *Id.*
[169] *Id.*
[170] *Id.*
[171] NATURAL AND CULTURAL RESOURCES - TANACROSS TRIBAL GOVERNMENT (adopted Sept. 3, 2013) (on file with author).
[172] *Id.* at CHAPTER 6: RESEARCH ON THE TANACROSS TRIBE AND LAND.

projects as employees or trainees "to the maximum extent feasible."[173] Further, the Tanacross Tribe members are to be involved in final research products by approving any research that is intended to be representative of Tribe members, in addition to having their perspectives included in final research outcomes.[174]

NSF worked with Alaska Native Organizations in 2004 to develop Guidelines for Improved Cooperation between Arctic Researchers and Northern Communities.[175] These Guidelines provide an overview of concerns from both the researcher and Alaska Native perspective but do not provide specific methods to overcome all of the concerns.

All of these policies align with the **Alaska Federation of Natives** Guidelines for Research, which were drafted in 1993, outlining principles of early communication, informed consent, compensation, participation, and understandable information dissemination.[176] Similar guidelines were drafted in 2000 by the **Alaska Native Knowledge Network**, which developed **Guidelines for Respecting Cultural Knowledge** to address issues of concern to Alaska Natives with respect to the use, documentation, and representation of traditional cultural knowledge. The document sets out specific guidelines for various groups with roles in the transmission of traditional cultural knowledge.[177]

C. Summary:

Research communication policies have the potential to structure community-researcher interactions in a way that is more productive, from creating more efficient research designs to spurring more effective research implementation and information dissemination. NSF has a strong policy on paper and has demonstrated a commitment to engagement with the Alaska Native community. Other research funding entities have some policies in place as well. However, interviewees consistently identify community-researcher linkages as a primary point of weakness in the Arctic research framework.

In some instances, the weakness may stem from the fact that there is no requirement for outreach written into the mechanism funding the research. Multiple agency researchers interviewed were not aware of applicable policies governing community engagement.

In other instances, even when there is an outreach requirement within proposals or agency guidelines, some interviewees noted that there was no requirement for meaningful engagement. According to one researcher, Native communities have very little to do with who gets funding. Rather, researchers can

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[173] *Id.*

[174] *Id.*

[175] NAT'L SCI. FOUND. & BARROW ARCTIC SCIENCE CONSORTIUM, GUIDELINES FOR IMPROVED COOPERATION BETWEEN ARCTIC RESEARCHERS AND NORTHERN COMMUNITIES (2004), *available at* http://www.arcus.org/guidelines/pdf.html

[176] Alaska Federation of Natives Guidelines for Research, ALASKA NATIVE KNOWLEDGE NETWORK, http://ankn.uaf.edu/IKS/AFNguide.html (last visited Dec. 29, 2013).

[177] ANKN, GUIDELINES FOR RESPECTING CULTURAL KNOWLEDGE (2000), *available at* http://ankn.uaf.edu/Publications/Knowledge.pdf

throw key words in the proposal to check a box. Then, at the review panel stage, the program manager might say something about community management, such as considering the relationship and needs of communities that the project concerns. In practice, however, some interviewees felt that the community commitments were not always fulfilled.

Several Alaska Native communities are passing ordinances detailing specific outreach requirements. Based on the research conducted for this report, the authors note that there is concern that funding entity policies and Alaska Native policies have not succeeded in ensuring accountable engagement practices with the funding and research process possibly not meaningfully considering the research needs and culture of Alaska Native communities. As discussed in the following section, there are many constraints that could hinder good policies from becoming effective practices, including funding limitations.

Interviews indicate that the communication policy framework has thus far failed to rectify the information flow problems related to climate change research. The next section of this report looks deeper at research communication, moving from the policies to the practices, in order to identify important issues and successful strategies that can inform meaningful engagement.

VII. RESEARCH COMMUNICATION PRACTICES

The first step in realizing meaningful communication and engagement is establishing robust policies. The second is ensuring they are implemented in practice.

The following section summarizes feedback received through individual and group interviews and meetings that shed light on which policies are being effectively implemented in practice, and which effective practices have developed despite a lack of mandatory or guiding policy. Discussants provided examples and insights that identify successful approaches and important considerations for strengthening the Arctic research communication framework.

Generally, the communication framework can be divided into four categories:

- Researcher to Community
- Community to Researcher
- Researcher to Researcher
- Community to Community

The section begins by identifying "key issues," defined here as practices that cut across all stages of the research process. It then presents general principles and specific examples for each of the four communication framework pathways.

Key Issues:

Overarching Key Issue: Funding	
Overview	Communication efforts require adequate resources, both financial investment and personnel time. At any time, but especially in light of today's tightly constrained budgets, resources for outreach and communication must be specifically incorporated into project funding if researchers and communities are to have the capacity to engage. Specific outreach and communication funding can occur through internal agency operations and policies or through external funding processes (e.g., agency or foundation funding of outside parties).
High Turnover and Travel Restrictions	One problem interviewees identified is turnover in the individuals involved, both in the field, at agency/funding entity headquarters, and in the community. Turnover can make it difficult to establish the relationships necessary for realizing meaningful communication, and can occur as in two separate situations. First, given short funding periods and challenges to obtaining funding altogether, some individuals do not have the ability to engage long-term in relationship-building. Second, even with constant funding streams, turnover occurs—in a place where long-term relationships are needed to ensure effective and meaningful

	engagement, such turnover can inhibit outreach and communication efforts. Similarly, travel restrictions and declining travel budgets can make it challenging to facilitate in-person interactions, identified as an important component of establishing relationships. Multiple researchers described personally paying for travel to conferences and meetings and/or attending on their own vacation time.
Lack of Proposal Requirements	According to one interviewee, until communication is explicitly written into funding requirements, there is no obligation to collaborate. Some interviewees explained that even when proposals require an outreach requirement, this does not necessarily translate into a requirement for meaningful engagement. One interviewee noted that the entity funding the research determines research priorities, including the importance and form of communication. Other interviewees said that any amount of communication is positive, regardless of funding source.

In addition to funding, conducting research in the U.S. Arctic is challenging due to the cultural differences between Alaska Native communities and many researchers coming from other parts of the region or outside the region entirely. Below are three general principles that cut across all community-researcher interactions, primarily focused on interpersonal and group communication strategies.

Key Issue #1: Trust and Respect

General Principles:

The foremost issue in most research-community interactions is trust. Interviewees emphasized that it is essential to be respectful and build trust. For many, the starting point to building trust in-person engagement. Over the long term, it is important to **establish ongoing relationships and two-way information sharing.** According to one interviewee, the heart of the issue is that a community does not have a particular reason to expect a research group to prioritize the community's interests. There can be a perceived power imbalance between communities and outsiders, based on past experience, which can lead to skepticism. It is important for outside researchers to be respectful of Alaska Natives as individuals and as a culture, including shedding preconceived notions and focusing on listening in both personal and group interactions.

Approaches to Obtain Trust and Act with Respect:

Interviewees identified several different general tactics for acting with respect and building trust. Multiple interviewees said that **it is important to engage in outreach and communication in a way that aligns with community practices.** This includes traditional practice, such as having the elders begin meetings. Some communities may want a community-wide meeting, with follow-up engagement. An open-minded approach is essential in outsider-community interactions. One researcher included a graduate student and a faculty member in meetings with a community. The researcher perceived that the community members felt more comfortable talking to a student. Another researcher noted the need to have research team members with the skills to engage—i.e. not all researchers possess the outreach and communication skills needed to work with Arctic communities.

Key Issue #2: Relationships

General Principles:

Building from the need for trust and respect, personal interactions are key to relationship-building. Interviewees emphasized that **the most successful engagement strategy is an ongoing connection with communities.** As described by one interviewee, Alaska Natives are living with subsistence resources and observing them year-round, and they are keenly aware that someone who comes for two weeks and leaves is only getting a snapshot.

Moreover, personal relationships are more important than organizational ones. **It is ideal to spend time in communities.** Communities are accustomed to researchers that have projects that are funded for three years, involving trips to the research site perhaps a half-dozen times during that period. During that time on-site, researchers are often frantically try to accomplish all of their objectives. According to interviewees, this makes it difficult to build relationships, which require proactive, sustained effort.

Approaches to Build Relationships:

Interviewees identified different ways to spend time in the community and build relationships, from basic to deeper interactions. One interviewee said that in some remote villages, something as simple as spending a morning in the grocery store can help facilitate social interaction. Others identified numerous methods before, during, and after the research process, including engaging Alaska Natives as researchers, speaking in schools, attending meetings, and making posters for public bulletin boards. These methods and others will be discussed in greater detail later in the report.

As described by one interviewee, the goal should be to build some trust, make some good friends, and then work together to complete projects. The way that happens can vary based on personalities and the issues involved. One interviewee emphasized that "community" is a key term—the villages and regions are often very distinct, and there is not necessarily a shared identity.

Key Issue #3: Communication Methods and Understanding

General Principles:

Many interviewees expressed that researchers are best served by interacting with communities in a way that can be understood by non-scientists. According to one interviewee, **the first thing researchers should think about is making information accessible to communities.** The presentation of information must come at multiple levels; however, there is more that can be done through written communication than is currently being accomplished. One interviewee emphasized the importance of successful models of written documents that capture and convey impacts of proposed research. It is important not to get caught up in tables and descriptive information, but rather to focus on what the research may mean for communities.

Other types of communication methods that may be appropriate in different circumstances were identified as well. In some situations, lectures and audio-visual presentations may be best. In others, websites and social media posts may provide the optimal opportunity for outreach. **The best approach**

may vary depending on the issue and the attributes of the audience generally. For example, elders may have different needs than younger members of the community.

Similarly, interviewees expressed **the importance of conveying how the research results will affect the communities in order to make it relevant to their experiences.** This element combines communication method with cultural understanding—one interviewee stated that it is the responsibility of researchers to think whether or not information is relevant to communities and then write it down in a way that is accessible to communities. It is important that communities have a point of reference that makes the issues being researched relevant to their experience.

Approaches to Successful Communication and Understanding:

Many interviewees stressed the importance of using communication methods that convey the research in an understandable manner. One method is to provide a short synopsis or summary, up to two pages, that is written in a way that speaks to community experiences. The North Pacific Research Board currently compiles summaries with visual aids for all of its Arctic projects.

In some communities, **it is important to understand language barriers and more traditional modes of communication.** In some instances, it may be helpful to make bilingual presentations. In other instances, it is important to recognize cultural differences. One interviewee provided an example of miscommunication when a teacher entered an Alaska Native classroom, asked a question, and then appeared offended by a student's raised eyebrow response – which was meant to convey "yes."

Another interviewee perceived Facebook posts to be an effective way of communicating. According to the interviewee, many community members use social media for communication, so it is useful to share research information and engage with communities using social media. Methods like reposting important websites and videos, keeping a blog, and focusing on visuals may make the information more accessible.

One researcher described how a community where research was being conducted likely did not share an innate appreciation for a particular basic science research topic. The researcher did not perceive the subject matter to be a focus of TK, due to the distance between the topic and subsistence resources. To engage the community, the researcher opted to forego a lecture-based approach and instead offer an audio-visual presentation modeled after a movie, followed by a discussion. The researcher noted that it is important to connect the communication to what the community members experience.

A. Researcher to Community

1. Before Projects

Engagement prior to the start of a project can make climate change research more effective by incorporating TK, which strengthens the information base, and subsistence community needs, which ensures the information gathered is useful and practical, into planning and design. In addition, early engagement can help prevent conflict throughout the rest of the research process.

Below are a set of strategies to facilitate engagement before research projects begin (from planning to the start of data collection). For each, specific examples and ideas are bolded.

Facilitating Communication Prior to Proposal Development
General Issue: As discussed previously, relationships and trust are key issues in collaborating with communities. Some interviewees highlighted that communication should begin well before the first day of the project.
Examples: One researcher interviewed described a project that selected four subsistence communities in Alaska for discussions regarding climate change, including two Arctic communities. The project leaders discussed the research project with the communities and asked community members if they were interested in collaborating. This request included providing an explanation, asking for permissions to conduct the research, and meeting with the tribal council. In addition, the researchers asked the community leaders to identify elders and active hunters who had substantial knowledge about climate change and communities. The researchers asked the community members to identify the effects of climate change on subsistence resources and used the interviews to develop a report. Once drafted, the researchers shared the report with the community for comments. Multiple interviewees emphasized that **it takes time and demonstrated commitment to build the relationships with Alaska Native communities necessary for true collaboration. Attending local and state meetings is one way that researchers engage with communities.** Meetings include the Alaska Forum on the Environment, Alaska Native Organization meetings, Bureau of Indian Affairs meetings, and Alaska Federation of Natives meetings, among others. One interviewee described the importance of education efforts. The interviewee described the Alaska Native Science & Engineering Program at the University of Alaska, Anchorage, which engages Alaska Native students by hiring them as interns with the goal of building relationships out early in the education process. Other interviewees and meeting attendees said that scholarship programs have the potential to facilitate researcher-community engagement.

Discussing Project Design Early in the Process
General Issue: Interviewees expressed that it is important to engage community members as early as possible in the research process. According to one interviewee, **interaction must occur early and often.**
Examples: The North Slope Borough Department of Wildlife Management is a local government entity that, among other activities, supports subsistence communities through Arctic research.[178] The Borough received a multi-million dollar grant from Shell to conduct research in the Arctic, primarily with the goal of filling

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[178] North Slope Borough, Dept. of Wildlife Management, http://www.north-slope.org/departments/wildlife (last visited Dec. 18, 2013).

gaps through baseline studies. The Borough formed a steering committee, with village representatives, that recommends science projects from the community perspective. Similarly, the Arctic LCC[179] has a steering committee and invites any tribe to help develop research priorities. According to interviewees, participation in the Arctic LCC steering committee may be constrained by lack of capacity and travel funding.

One researcher reached out to the regional tribal organizations to solicit ideas for research project design from communities. The researcher also went to the North Slope Borough to seek project design recommendations. In another instance, agency representatives went to a regional non-profit, the Council of Athabascan Tribal Governments, for ideas and input regarding project design. According to the researcher, **it is important to make sure the research process is consistent with community needs.**

In interacting with communities prior to project proposals, or between proposals and execution, **listening is essential.** One interviewee emphasized letting communities describe important subsistence resources and what factors affect those resources. The interviewee emphasized that it is essential to go into meetings without a pre-defined agenda—one must let the communities drive the process. According to the interviewee, failure to do this has been a constant source of tension between researchers and communities. Another interviewee suggested that researchers should engage communities a year before a proposed project begins.

When possible, interviewees expressed that it is good to make communities official collaborators on a research proposal, after engagement with the tribal government. That way, it is not a one-sided relationship with perceived power imbalances—researchers and communities are in the project together. Also, **developing RFPs with community partners can build long-term relationships.**

Multiple interviewees discussed how communities are interested in self-reliance. One of these interviewees stressed that communication should inform project designs that address self-reliance and the sustainability of a subsistence lifestyle in the face of climate change. This includes an understanding of community values.

One researcher described an innovative program that was developed in response to a challenge from an Alaska Native leader: given that university researchers had not historically had productive relationships with Alaska Native communities, what could be done to heal that relationship? In response, researchers met with a dozen communities, focusing on local priorities. Later, there was a participation session at the Alaska Forum on the Environment where community leaders discussed the results and project ideas were developed.

Multiple interviewees described **the importance of incorporating TK into project design.** One researcher is using TK to inform projects based on sea ice and potential oil spills. **Another interviewee said that communities should require a TK component in proposals if they are going to grant access to local research sites.**

A problem identified with meaningful, early, and ongoing engagement is timing and speed. Timing and speed concerns must be considered because community collaborators do not always feel empowered to make decisions at the table—they want to take things back to communities, tribal councils, and/or boards of non-profits. This can be a slow process to work through, which may not comply with research project timelines. A positive example that addresses this issue is the U.S. Fish and Wildlife Tribal Grant

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[179] *See supra* text surrounding note 147.

process, which funnels research ideas and grant opportunities to communities, allowing communities to control the timing from the RFP through project implementation.

One interviewee explained that there must be stronger local review of proposals to provide checks and balances on researchers and funding entities that aim to "check the box" of community involvement. To illustrate the problem, the interviewee described a researcher coming in to the community, having an informal conversation, and then citing that conversation as satisfying an outreach requirement. The interviewee's vision is that research should go through a local board for review, from the early stages of the process through project completion. A percentage of research project funds could support the community board, which would also facilitate idea generation, project proposals, and the issuance of RFPs, in addition to ensuring local control and oversight.

On one hand early engagement with communities is an important component of the research process in the Arctic as noted by many interviewees. On the other hand, researcher engagement with communities has the potential to overwhelm Arctic communities. **Multiple interviewees expressed concern over the demands placed on subsistence communities by the influx of researchers and others into the region.** The burden on communities has been increasing—one interviewee conveyed that some community members were at risk of **"participant burnout."** These problems are exacerbated if communities do not feel that engagement activities—whether in regional meetings or local interactions—are meaningfully influencing the research and management processes. Themes identified in interviews include issues surrounding limited capacity and resources in the face of increasing demands on communities.

Funding

General Issue:

Funding constrains engagement opportunities for both researchers and communities. Engagement takes time and costs money.

Examples:

One interviewee identified a model program—in the past, EPA provided "mini-grants" of $10,000 to communities, where communities could present an idea for a research project and solicit proposals from scientists to complete it. This mini-grant program allowed for engagement from a different perspective. An example project was research on potential contamination from a bulk fuel storage tank.

One interviewee identified opportunities in the co-management framework. The interviewee received funding for research cruises, and then invited co-management partners to nominate and suggest community members to participate.

The LCC framework seeks to fund projects of interest to communities through the development of community-focused RFPs. For example, one project developed a methodology for screening for disease in subsistence animals (which came from an Alaska Native Tribal Health Consortium RFP, demonstrating multi-institutional collaboration as well).

The North Pacific Research Board has an RFP category for TK and community involvement. The NPRB

specifically allocates funding for community involvement—usually $2,000 per project. The funds cannot be allocated for any other purpose and must be returned if they are unused.

Applications for funding are more likely to be selected with **letters of community support.** Another interviewee noted that these types of letters should be signed by the village council president.

One interviewee emphasized **the importance of coordination between funding agencies and tribal organizations.** The interviewee said that the key is to get funders to recognize that coordination matters, in order to start brainstorming together.

Training
General Issue: Understanding fundamentals of communication and the research process in the Arctic is essential. However, the fundamentals are neither simple nor self-evident.
Examples: One interviewee emphasized that **mentors matter.** Researchers should seek out others that have been successful working with communities in order to fully understand Arctic research dynamics and approaches. Intermediaries are also important. Before research commences, a network of researchers and community members could facilitate productive engagement. The Alaska Native Science Commission developed a **Code of Research Ethics and Cultural Guidelines** to aid researchers prior to engagement with communities. One interviewee recommended sensitivity training and certification, with a focus on basic human dignity and cultural understanding. The interviewee emphasized that training goes beyond ethics and culture, however, and should extend to real-life protocols of researching in Alaska. One researcher noted that **there is no substitute for spending time on the land.** The researcher shared that every outsider should go hunting with community members as an observer to understand the importance and wisdom of TK. One problem is that researchers are not trained on effective written or verbal communication with communities. An interviewee described that the Smithsonian evaluates researchers on outreach; most scientists, however, are not necessarily trained for that type of communication. One interviewee discussed that researchers can receive training via the Alaska Marine Science Symposium, which includes a half-day workshop on communication in the Arctic. Sample topics include how to write for a general audience, how to give a presentation, and how to make compelling video.

Communicating and Coordinating Prior to Field Work

General Issue:

Subsistence communities have a unique relationship to and are deeply interconnected with the environments where research occurs. Interviewees said that engagement is needed prior to project execution, as projects may be seen as infringing on subsistence rights.

Examples:

The LCC groups have a requirement that **researchers must contact landowners when collecting in the field**, especially when aircraft are involved.

Several interviewees expressed the need for **single points of contact.** The contact points could be related to agencies or tribes. An interviewee indicated that IARPC aims to develop single contact points on different issues: subsistence, native language, climate change, medical impacts, and others. An interviewee expressed that a database of contacts will allow for more efficient communication and engagement prior to research by ensuring that conversations are occurring with the right people. One interviewee discussed the problem that there seem to be more Arctic initiatives than people in the Arctic, saying it was **important to coordinate instead of proliferate.** Agencies and researchers should work together, and piggy-back off other meetings and outreach opportunities.

Multiple interviewees said that it was important to make initial contact ahead of time with communities and tribal governments. **To be successful in the Arctic, communities should be viewed as collaborators.**

One interviewee provided the example of the NOAA Shore Zone project as a successful outreach approach. It involved oblique, still photography of the coastline for a GIS database. The **researchers conducted in-person meetings with community members**—by the time the research was conducted, the community understood the reasoning and helped in the information generation process.

At one meeting, the importance of communicating research plans was discussed in the context of walrus tracking. By communicating such projects, researchers can be sure not to obstruct subsistence activities.

Databases of Research Concepts and Partners

General Issue:

Online, accessible information storage sites can allow communities and researchers to share information that may inform future or existing projects.

Examples:

Bio-Alaska is a collaboration between the Sea Life Center and the LCCs to allow citizen scientists to record unusual findings, and then put them in touch with relevant researchers.

One interviewee discussed the potential usefulness of a knowledge sharing hub to share information

with communities and research groups. This hub would allow both community members and researchers to offer their expertise and shop around to see existing research and research needs. Such a database would include research from state and federal agencies, NGOs, and others.

2. During Projects:

Once a project begins, interviewees described the need for ongoing engagement at the research site and in the community. Continued communication can prevent conflict, aid research execution, and build relationships. One interviewee described that a lack of relationships can undermine a project. In addition, information-sharing can prevent information-flow issues that would preclude subsistence communities from using climate change research.

Involving Community Members in Research
General Issue: Community knowledge can contribute to project success. In addition, individual community participants can build relationships between researchers and the community at large.
Examples: Multiple interviewees stressed the importance of **involving community members in the research process**, with the caveat that there must be funding for this type of engagement. One interviewee provided an example to demonstrate the importance of local hires: in 1996, a walrus data collection project had two agency staffers and 80% cooperation from community members. With an entirely local crew, there is now 100% cooperation. The interviewee recommended hiring through the tribal council. In addition, several researchers bring community members on research cruises and charter boats. Another researcher emphasized that it is impossible to work in the Arctic without local guides and TK. **Projects benefit from employing guides from the community.** In addition, by spending time together in a professional relationship, both sides are dependent upon each other to complete jobs; this establishes a personal relationship with the community. In one instance, an initial bad sampling site choice was rectified by local guides, who had a better understanding of the land and conditions that were desirable. One researcher described the importance of hiring a local subsistence community member as a technician, which helps the project while also facilitating positive word of mouth discussions to create relationships and share information. **The type of engagement with local communities during project implementation may depend on the type of project.** In some instances, when research is directly related to subsistence resources, for example, direct collaboration may be the most beneficial approach for researchers and community members. For example, one interviewee described that subsistence hunters are very good at capturing animals and are very experienced at getting close to the animals. One walrus project used hunters to harpoon tracking devices onto target animals, which enabled tracking the animals for an entire migration season. In other instances when a project does not have direct links to community members' interests or expertise, the level of engagement may focus more on working with communities to identify sampling sites, using guides to support working in the field in dangerous conditions, or other similar

project execution strategies.

One interviewee emphasized that many projects face the challenge of participant burnout. The Arctic Council's Best Practices in Ecosystem-based Oceans Management in the Arctic project describes how many Arctic indigenous communities aim to be involved in all aspects of resource management, from identifying problems to evaluating and implementing solutions to monitoring outcomes.[180] In many cases, however, companies and government agencies have more employees than some of the communities at issue, and community leaders and TK holders are already overtaxed with the demands of contributing to the management of vast areas.

Another interviewee said that collaboration is effective when there are two elements: a need and mutual benefit. Related to mutual benefit, an interviewee said that **it is important that community members are compensated for providing their TK**, and they cannot be expected to communicate freely without it.

Public Outreach During Research Process
General Issue:
Engaging with the communities, either directly or indirectly, can facilitate healthy personal and professional relationships, assisting climate change research goals.
Examples:
In Barrow, several researchers described weekly **public lectures** where scientists speak at the local school about their projects. In some instances, this method did not succeed because the lectures were mostly attended by researchers, rather than community members. An interviewee noted that during these lectures, it is important to present information in a way that is relevant to the community members and their experiences.

One interviewee described the value of **radio advertisements** and **commercials** regarding research projects. Putting up **museum-like signs** at field sites is another outreach method. **Lab days may also be helpful**, where community members are invited into the lab to see the project and meet the researchers. During lab days, researchers can welcome community members into the lab, demonstrate what they are doing, and provide an abbreviated summary of what they have found and conclusions they have drawn to date.

Multiple interviewees mentioned **social media and electronic outreach** as important facets of a communication plan. Some projects have traditional websites that interested community members can access. Others have Facebook pages (both personal and professional) that engage the community.

Real-time communication is important. One project involving extensive aerial surveys of the Bering Sea had a **daily email and fax campaign** to inform the communities of where they were flying. The goal was to minimize and avoid interactions with subsistence hunting activities. |

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[180] NORWEGIAN POLAR INST., BEST PRACTICES IN ECOSYSTEM-BASED OCEANS MANAGEMENT IN THE ARCTIC 110–12 (Alf Håkon Hoe ed. 2009).

A primary challenge identified was that researchers on boats and airplanes can remain at a distance, which can alienate local communities concerned about subsistence resources. For example, a bottom trawl to survey benthic communities near Nome had a miscommunication prior to the research that resulted in community discord. One interviewee noted that, at the very minimum, it is essential that communities are made aware of research activities in their vicinity, even when the community is not directly involved in the project.

Multiple interviewees identified the potential for classroom outreach. They noted that schools are receptive to developing projects and hosting researchers. One example is a collaboration called Students Monitoring Ocean Response to Eutrophication, which partners classrooms in Houston, Atlanta, and Barrow. The outreach effort involves student-led water quality measurements in different places, with class connections through Skype. Shorter-term, less broad efforts have been successful as well, including lectures and poster presentations. Another example is the work of a Scripps Institution of Oceanography Whale Acoustics Lab that partners with Mt. Edgecumbe High School in Sitka, Alaska—a high school that is 85% Alaska Native.[181] With support from the science team and high school teachers, the students are helping analyze data and are even involved in publishing the results.

3. After Projects:

After research is completed, efforts to disseminate results are essential to ensure information flow. A primary climate change research need identified was for research results to be shared with relevant communities. Effectively sharing information can lead to informed communities, which is important for climate change adaptation and for building relationships for future research efforts.

Outreach Methods—Flyers, Posters, and Summaries
General Issue:
After a researcher completes a project in a community or involving subsistence resources the community cares about, results can be shared through a variety of outreach strategies.
Examples:
Multiple interviewees emphasized that **preliminary results can be shared**, including when they are not up to publication standards. It is important to engage the community in a conversation as early as possible, and the publication process can be too slow to provide needed information. Several interviewees described the potential for **posters** as a method to share results. According to some interviewees, placing **visuals in common areas and schools** in the community can have lasting impact and improve relationships. Interviewees also noted that summary documents are important. Interviewees expressed that when communities are involved in the research, it is important to **share how community input or aid helped the research process**. This makes the research more relevant.

[181] Around the Pier: Profiles in Diversity: Call of the North, SCRIPPS INSTITUTION OF OCEANOGRAPHY (June 7, 2013), https://scripps.ucsd.edu/news/11109.

Concise (one- to two-page) flyers are another strategy discussed by interviewees. **Newsletters** can be useful as well. With all of these strategies, multiple interviewees expressed that it is important to share information in plain language, focusing on how the research is useful for subsistence communities. The North Pacific Research Board has published compilations of two-page synopses that are distributed to communities and libraries.

One interviewee said that a useful tool is quarterly reports to ANOs.

Outreach Methods—Presentations and Discussions

General Issue:

Personal interaction is a good way to build relationships and build better projects using community knowledge.

Examples:

Interviewees described several strategies that were similar to the "During Projects" examples. These include a **summer schoolyard lecture series** and **presentations at community meetings**. One researcher worked with local children to make a **video documentary**, with a stated goal of engaging elders as well. Another researcher illustrated a walrus project involving genetic recapture by using Hershey Kisses.

Presentations during state and regional meetings may be helpful. For example, one interviewee described a researcher who was at a regional meeting with a display of a repeating video showing collared tracking of seals as they migrated. The video showed multiple stages throughout the year, and was engaging and received well by meeting attendees. The researcher indicated that this approach got people talking and looking and excited about research. Notably, there was no plan or outcome in mind—the researcher was simply available, waiting for people to come by and engage.

Generally, state and regional meetings may be important venues for information dissemination when projects are not conducted in the community. A researcher described bowhead whale surveys operating out of Barrow as having numerous opportunities to share preliminary results. Meanwhile, an aerial survey did not have the same chance, thus the researcher engaged at regional meetings, including the annual AFN meeting.

In addition, interviewees discussed that it is important to allow communities to engage in a discussion regarding the research. A document sent to a funding agency may not engage a community member. Instead, some interviewees indicated that researchers should aim for **two-way information-sharing** with discussion and plenty of asking and listening. According to one interviewee, questions may include "How does this square with what you see in your communities? Is it consistent with your observations?" Then the researcher can elicit ideas from the community and possibly develop new projects or new applications of existing ideas.

One researcher described ideas for improving outreach if funding was available. One example was possibly making annual trips starting in Bristol Bay and taking puddle jumpers up along the coast, giving presentations along the way.

CLIMATE & COMMUNITIES

These outreach methods are challenging in smaller communities, which are difficult to reach on existing travel budgets. In general, these efforts must be funded. One interviewee said outreach may be most effective through the co-management bodies.

Outreach Methods—Electronic Communication
General Issue: As it is elsewhere, electronic communication is becoming a primary means of engagement in the Arctic.
Examples: Many interviewees described the importance of **email and other electronic communication campaigns, along with social media outreach**. Direct emails to community groups and members have had some success. In addition, newsletters (also discussed above) are useful. Multiple interviewees recognized the Local Environmental Observer (LEO) network[182] as having a significant impact. LEO uses internet-based interaction to create community information centers, in addition to sending newsletters on research updates that are relevant to subsistence communities. Webinars are another strategy. The Alaska Center for Climate Assessment and Policy, for example, has weekly webinars on various science topics, which are intended to be presented in a form that is accessible to both agencies and communities. Some interviewees identified real-time data sharing and data systems as important forms of communication. There have been efforts to gather information on researcher projects and interests, along with community interests, in order to facilitate communication throughout the research process. The Alaska Ocean Observing System, for example, compiles data on the ocean and coasts. The Coast Guard has developed ship-tracking technology that allows subsistence communities to monitor the paths of vessels that may interfere with activities. One interviewee emphasized the need for transparency, suggesting that everything should be shared publicly online, including datasets.

B. Community to Researcher:

Subsistence communities have a role in making their voice heard in order to support productive climate change research. Interviewees expressed that communication cannot be a one-way relationship, and that tribal members can take certain actions to develop healthy relationships with researchers. However, while many interviewees stressed that researchers have an affirmative responsibility to engage, community-to-researcher engagement is more focused on efficiency.

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[182] For more information about LEO, *see* Alaska Native Tribal Health Consortium, *Local Environmental Observer (LEO) Network*, *at* http://www.anthc.org/chs/ces/climate/leo/.

Communicating Needs and Interests
General Issue: In order for research projects to address the climate change research needs of subsistence communities, researchers and organizations must be aware of the concerns of community members.
Examples: In the past, the Alaska Native Science Commission had a data portal that allowed communities to input their concerns regarding adaptation of a subsistence lifestyle in the face of climate change. More recently, the Community Partnership for Self Reliance and Sustainability aims to provide an avenue for communities to voice their concerns regarding research needs. One interviewee expressed that it is important for community members to be patient with researchers who have good intentions. The interviewee said that the need for respectfulness applies to all parties involved. One interviewee described a general need for communities to be willing to train researchers on how to engage. Many researchers do not have experience working with Alaska Natives, and cross-cultural patience and respect is important in early interactions.

C. Researcher to Researcher:

Some interviewees expressed that coordination is needed within and across agencies as well as with outside research organizations. The LCCs and IARPC are two examples of this coordination effort. Alaska's LCCs aim to "provide a forum for States, Tribes, Federal agencies, non-governmental organizations, universities and other groups to work together" on landscape-scale conservation issues.[183] Similarly, IARPC "consists of fifteen-plus agencies, departments, and offices across the Federal government" dedicated to coordinated planning of Arctic research.[184] Moving forward, the LCCs and IARPC could provide a framework for researcher-to-researcher linkages.

Another example is found with the FWS, which has invited researchers to Gamble and Savoonga when the communities have walrus hunter meetings. Yet another example is the Alaska Department of Fish and Game, which has worked closely with researchers and the FWS on cross-cutting issues, including the potential disturbance of harbor seals by cruise ships.

In addition, interviewees discussed cross-agency collaboration at meetings and in outreach efforts. Given constrained resources, several interviewees expressed that each agency should avoid acting

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[183] Landscape Conservation Cooperatives, U.S. FISH & WILDLIFE SERVICE, http://www.fws.gov/landscape-conservation/lcc.html (last visited Dec. 18, 2013).
[184] Interagency Arctic Research Policy Committee, NATIONAL SCIENCE FOUNDATION, http://www.nsf.gov/geo/plr/arctic/iarpc/start.jsp (last visited Dec. 18, 2013).

separately when engaging with the Alaska Native community. This includes both formal consultation and co-management process,[185] along with informal outreach.

D. Community to Community:

Cross-community coordination can facilitate research engagement and ensure that the climate change research needs of subsistence communities are heard. Interviewees described how research needs vary across communities, thus there are inherent challenges with this type of coordination. However, meetings of Alaska Native Organizations and other groups may present an opportunity to discuss research needs. One interviewee described a need to communicate about climate change research, even if it is just engaging together.

In the past, the Alaska Native Science Commission convened regional meetings to develop the community perspective. They brought researchers with them as a form of cultural training, so that the researchers could learn communication that resonates with Alaska Native communities.

Presently, science presentations are a part of many meetings. One interviewee expressed that these meetings could be a good place to consolidate research needs to coordinate future projects.

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[185] For a discussion of this issue, *see* ENVIRONMENTAL LAW INSTITUTE, STRENGTHENING GOVERNMENT-TO-GOVERNMENT CONSULTATION RELATED TO MARINE SUBSISTENCE RESOURCES IN ALASKA (in press, 2014)

VIII. RECOMMENDATIONS

In this section, the authors identify potential options to improve the climate change research communication process. The options are categorized by issue, with each issue being a recurrent theme or concern in interviews. Each issue is grouped in the following categories: General Principles, Before Research, During Research, and After Research. The options to address that issue come both from the author's research and expertise, as well as from the interviewees.

A. General Principles:

Issue #1: Building Trust, Demonstrating Respect	
Overview	Many interviewees discussed cross-cultural and inter-personal differences between researchers and communities that have the potential to undermine effective communication. According to interviewees, researchers tend to be data-driven, while community members take a more holistic approach. As a practical matter, these differences in communication style can lead to reduced efficiency in written documents, oral discussions, and visual presentations—at worse, it can generate personal offense for both communities and researchers.
Options	(1) **Develop training programs, manuals, and/or fact-sheets that educate researchers on effective communication with Alaska Native communities.** One interviewee emphasized that the programs or manuals should focus on cross-cultural communication, cultural awareness, and cultural sensitivity. These programs can be used across agencies and funding entities (drafted by inside employees or outside groups).
	(2) **Gather examples of effective visual presentations and research summary documents.** Many interviewees identified posters and summaries as powerful engagement tools; however, they must be relevant and understandable. The examples can be provided by funding entities/agencies or outside groups.
	(3) **Establish a mentor program that provides new Arctic researchers with the option to contact researchers who have worked successfully in the region.** Interviewees said that the unique concerns of Arctic research make guidance necessary, and a mentor database could provide researchers with a tool to make projects more effective. Participating in a mentor program could be voluntary or a pre-condition of project approval.

Issue #2: Building Relationships and General Outreach	
Overview	Interviewees consistently highlighted the importance of personal interactions to building lasting relationships. There are practical hurdles to regular face-to-face communication, from a lack of funding to logistical issues such as where to go and who to talk to. However, communities and researchers both stressed that even small efforts count. The overarching goal is to realize long-term commitments to research and engagement in the region that builds trust and respect over time.
Options	(1) **When possible, researchers should attend meetings to make presentations and interact with community members.** Centralized gatherings like the Alaska Marine Science Symposium and the Alaska Forum on the Environment provide an opportunity to share results and develop relationships. Some researchers have had success with this strategy, and it allows resources to be used efficiently while providing points of contact for communities. (2) **Research projects (and researchers when appropriate) should establish a social media and traditional website presence**. Some interviewees expressed that Facebook may be the most widely used and effective outreach tool in the Arctic. Social media provides an avenue for more informal communication that is needed to build relationships. Projects could establish a Facebook page that allows for community members to interact with and receive updates from each project. Multiple interviewees identified personal pages as another tool. The general information available in a project Facebook page should be available via traditional websites as well. (3) **To the extent possible, researchers should strive to establish long-term research programs in the Arctic, rather than one-time projects.** Many interviewees expressed that mutual trust and consistent engagement is dependent on relationships and collaborations that build over months, years, and decades.

Issue #3: Coordination	
Overview	Many interviewees and meeting attendees expressed concern over broad communication about current projects, future projects, and research needs. Communication gaps can lead to misunderstandings and misguided projects.
Options	(1) **Develop a database that gathers and sorts proposed and approved projects in the region, with an option for researchers to submit projects at the pre-proposal stage as well.** Interviewees expressed a need for transparency throughout the research process. Entry of information into the database could be an RFP requirement or voluntary, and maintained by an independent group or an agency/community group. (2) **Communities and regions could develop research guidelines, which could be sorted into a similar database for community needs and research**

requirements. Some communities already have guidelines, ordinances, and policies that could serve as templates for additional communities to develop guidelines (e.g., Kotzebue and the Northwest Alaska Borough). Within the database, communities could include input on and ideas for projects. The database would provide a resource for researchers to understand the guidelines of each particular region. The effort can be modeled after the recommendations made in the Workshop on Improving Local Participation in Research in Northwest Alaska.

B. Before Projects:

Issue #4: Funding Entity Policy	
Overview	A primary concern of interviewees was funding. Lack of substantial communication and outreach funding can make it challenging to develop appropriate community-researcher linkages.
Options	(1) **Agencies and funding entities could include explicit outreach requirements before, during, and after projects in all RFPs or project descriptions, with an additional requirement that community-targeted outreach reports are returned back to communities after projects are completed.** Several funding entities (e.g., NPRB and NSF) have policies that can serve as a starting point for improving outreach and engagement requirements. (2) **Funding entities and agency budgeting could condition part of project funds on outreach, with a provision that the funds cannot be allocated for any other purpose.** NPRB currently requires that $2,000 be used for outreach for every project—otherwise, the research project forfeits the funds. Given that many projects are time- and money-constrained, allocating funds specifically for this purpose can prevent outreach funds being used to conduct research projects. (3) **Agencies and funding entities could require reports of outreach methods that detail positives and negatives of each approach, which can subsequently be communicated to communities and other researchers.** Evaluation of project success is a common requirement for many grants. Focused effort could be placed on developing appropriate evaluation criteria to better understand the successes and challenges with different types of outreach and engagement methods. (4) **Consider providing mini-grants to communities or researchers for small, community-oriented projects.** According to one interviewee, EPA had a successful mini-grant program that engaged communities that no longer exists. Small, $10,000-capped projects would allow communities to lead project design, and enable increased interaction of community members with the research process.

(5) **Allow grant recipients to use part of their funding to support community boards to review, provide input on, and solicit ideas for project design and implementation.** One interviewee suggested such boards could be supported by research project funds.

Issue #5: Designing Projects	
Overview	Interviewees expressed that projects should be designed with community input. Such an approach allows for integration of TK and community concerns into project development, which can increase the effectiveness and efficiency of implementation.
Options	(1) **Researchers should include community partners on RFPs and project plans.** Interviewees expressed that partnership is essential, akin to listening instead of telling. Several community-researcher partnerships discussed in the preceding section have been very successful. These partnerships demonstrate respect and trust while also increasing community member involvement and investment. (2) **When possible, researchers should include research partnerships with community members that facilitate the inclusion of Alaska Native co-authors.** Multiple interviewees expressed that co-authorship develops relationships and makes projects better due to the joint effort involved in completing the project. In all circumstances, the work and TK of community members should be properly credited. (3) **Researchers should strive to include a TK component in all proposals.** Many interviewees said that considering the traditional perspective, even when it is not directly applicable (as in some basic science projects), can benefit project design. (4) **Consider soliciting ideas and vetting existing ideas in communities and at meetings.** Engaging in a discussion demonstrates the type of effort that is needed to build relationships. Although such discussions may not substantively change every project, the engagement will make the ongoing research process more efficient.

Issue #6: Preparing for Research	
Overview	Interviewees expressed concerns about who to contact, when to contact them, and how to make contact before projects start. Community members described instances when a research vessel appeared offshore without warning. Researchers described entering communities after discussions, only to learn they were not communicating with the correct person. Lack of communication or miscommunication can lead to discord and distrust.

Options	(1) **Researchers should reach out early, a year in advance if possible, to the tribal council or other community representatives.** Interviewees said that outreach just before a project begins is not enough. While there is often not funding to support this type of early engagement, methods described above, from meeting attendance and presentations to social media outreach and direct calls, should be undertaken as soon as possible.
	(2) **Communities and agencies should consider developing a database of contacts.** Efforts to establish single points of contact or general lists have been segmented or ineffective. By providing all key actors with the same information, there will be increased transparency and accountability. If a contact person is unwilling to share information, general non-descript email accounts could be provided.

C. During Research:

Issue #7: Community Involvement	
Overview	Interviewees identified involvement in projects as a primary method of engaging the community. Through this method, community members can become personally invested in the success of the project, develop an understanding of the issues, and provide an avenue for broader community engagement.
Options	(1) **When possible, contact tribal councils or other community contacts to make local hires.** Interviewees said local hiring for technician positions or other roles is an optimal way to engage with the community.
	(2) **Researchers should compensate for TK, or make it clear at the beginning of a discussion when there is no compensation.** Interviewees expressed the value of TK. Given that value, obtaining TK and not paying can be viewed as strain relationships. Being open about expectations should decrease misunderstandings.

Issue #8: Ongoing Outreach/Engagement	
Overview	During projects, engaging the community requires consistent and meaningful discussions and information dissemination. Interviewees expressed that a project should not only involve a warning that researchers are coming and a report of what the researchers did.
Options	(1) **Researchers should provide understandable, plain language information related to project progress through posters, summaries, museum-like signs, and lectures, among other strategies.** Other options for ongoing outreach include Facebook, email, radio broadcasts, potlucks, and newsletters.

Issue #8: Ongoing Outreach/Engagement
(2) **When possible, researchers should make themselves available in the community.** Options can be simple (e.g., going to public places) or involve more planning (e.g., lab days where community members can participate in research). (3) **Researchers should capitalize on every opportunity to conduct ongoing outreach and engagement.** For example, when visiting new places to conduct new activities, researchers can share information from past projects.

D. After Research:

Issue #9: Sharing Results	
Overview	Climate change research needs of Alaska Native communities can only be addressed if information and results return to the communities.
Options	(1) **Researchers should provide summary documents, visual presentations and posters, and publish an online report that is relevant to communities.** Webinars, social media outreach/reports, meeting presentations, and newsletters are other options. Interviewees described the necessity of relevant, straight-forward information. (2) **Communities should be given an opportunity to review and comment on draft research reports.** Commenting opportunities will facilitate ongoing communication and make researchers aware of community concerns.

Issue #10: Transparency and Accountability	
Overview	Interviewees described frustration regarding the means of information-sharing. Two-way dialog is facilitated by ready access to information that rectifies any perceived power imbalance.
Options	(1) **Researchers should report back to communities and the relevant agency/funding entity with one document that describes methods of outreach used, the effectiveness of that outreach, and how community input influenced the project.** It is important that communities understand that communication is not merely checking-a-box, but part of a meaningful engagement process.

IX. CONCLUSION

The Arctic is changing rapidly. Subsistence communities that rely on the Arctic environment for survival have seen the change first-hand. Moreover, these communities possess a deep base of TK—stemming from sophisticated environmental observations over many generations—that provides context for current changes. In the research of and response to rapid Arctic change, then, TK has an indispensable role. TK and subsistence community perspectives can enhance climate change research before, during, and after projects, both by identifying research priorities and optimizing research implementation. However, to achieve the optimal outcome—where climate change research and TK are integrated, with trust and respect forming the basis for mutual understanding—communities and researchers must engage with one another. This report looks at aspects of that engagement, emphasizing the need for two-way information sharing to create effective climate change research projects. Moving forward, we hope that this report and other efforts to enhance cooperation in climate change research can facilitate dialogue to help both researchers and communities. Rapid Arctic change is a challenge, but it is a challenge that TK and climate change research—if working collaboratively—can address.

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