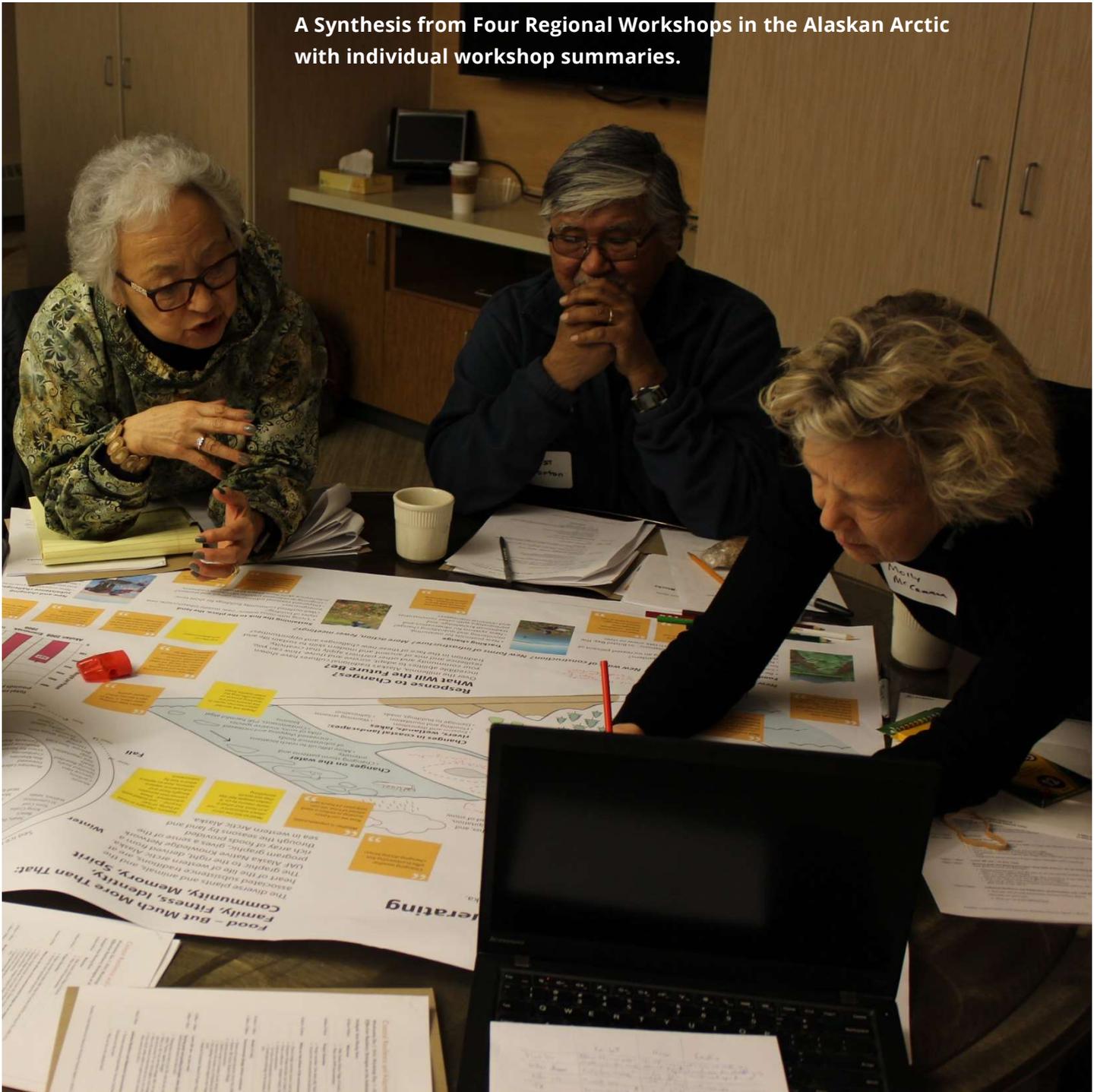


# Promoting Resilience *and* Adaptation *in* Coastal Arctic Alaska

A Synthesis from Four Regional Workshops in the Alaskan Arctic  
with individual workshop summaries.



# Acknowledgements

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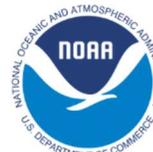
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# About the Project

*"We've been here for tens of thousands of years; we'll be here for tens of thousands more. We are people of the land – not of the office. We will be able to adapt." – King Salmon workshop participant*

*"As an agency, how can we stick to our mission and still be a positive agent for change? How can we understand the problem and solutions in a wholistic way, with wellness, mental health, economy, and subsistence all tied together? We can't take people and economics out of the environment, and we don't have great immediate answers. At the most basic level, we can build committed and sustained relationships with each other. We can talk and understand each other, and build trust. It is important that villages and tribes have a voice in how they want to adapt." – Kotzebue workshop participant*

The Promoting Resilience and Adaptation in Coastal Arctic Alaska project was led by the Aleutian Pribilof Islands Association and three of Alaska's three Landscape Conservation Cooperatives (LCCs). Funding was provided by the Bureau of Indian Affairs and the U.S. Fish and Wildlife Service. Agnew Beck Consulting, Inc. was contracted to lead a team of consultants to carry out this project.

This synthesis represents a summary of conversations during four workshops held in regional hub communities of Nome, Unalaska, King Salmon and Kotzebue. Over six months in 2016, almost 200 participants from 34 tribes, 14 state and federal agencies, local communities as well as several research institutions and nongovernmental organizations shared their insights on the most urgent risks and vulnerabilities for coastal communities and resources. They also identified key opportunities for collaboration between communities and agencies. Project partners, communities, and resource managers dialogued about what stakeholders are already doing to respond to coastal threats and help refine informational products and tools. By fostering effective partnerships and communication, these workshops and project products aim to better equip resource managers and communities to respond to the challenges and opportunities of climate change, supporting healthy habitats and resilient communities. The workshops were intended to help participants better understand regional changes, challenges and adaptation strategies, and to foster collaboration among communities, agencies and other stakeholders in the region.

**Follow the progress since these workshops at: [www.adaptalaska.org](http://www.adaptalaska.org)**



# Workshops

*"The folks here are really making connections and that really strengthens them. There are huge changes happening here – climate, migration, human impacts even greater. This is a great model for other areas of the state. These guys are connecting with the vessels that come in (international) – an eye opener that people are catching on to, building the network." – Aleutian Life Forum participant*



*"For me and the community I work for this has been a really great workshop because all the components talked about are in my [EPA IGAP] workplan. So now I can put faces to the people I'm going to have to be talking to in the future. This has been great for me and my community to do the work that I'm going to be doing. On top of that, not only are these topics in our environmental workplans, but there's more of a thread so sometimes my workplans seem scattered in pieces and parts but there's more of a thread to all of it. That helps me go back to my leadership and communicate what's going on better. This will help me do my work better. Thank you."*  
– King Salmon workshop participant

*"Very few discussions about the Arctic take place in the Arctic, and not many of those things seem to happen. I have not been sure what the purpose of those discussion was. But to have these conversations here, with people here, I think I have a little better sense of that here." – Kotzebue workshop participant*

Four workshops were conducted in 2016:

- Nome (May 11-12): approximately 75 attendees
- Unalaska (August 19-20): approximately 40 attendees
- King Salmon (September 21-22): approximately 50 attendees
- Kotzebue (December 7-8): approximately 50 attendees.

Each workshop follows the same structure: brief mini-presentations (of up to 10 minutes) followed by large or small group facilitated discussion on the drivers of environmental change moving to strategies and actions to respond to climate changes. The alternating presentation and discussion was designed to encourage participants to exchange information, ideas and consider working together in new ways, across agencies and local or regional organizations. The continuing dialogue helped participants process information, think creatively, positively, proactively about how to work together to better understand and respond to climate changes using both Western science and governmental mechanisms as well as local traditional environmental knowledge, observation and cultural approaches to producing information.

## Themes from Workshop Discussions

*“Environmental change has always been taking place. What’s happening now is much faster and on a larger scale than we’ve seen before. There’s a lot of uncertainty. Climate change is going to cause a lot of stress. It’s going to lead to food insecurity. We can already see how changes in caribou has caused conflicts between local and non-local people, and that might get worse. It’s not easy to pick up and move to someplace new. It’s not easy to learn new ways to obtain, process and prepare food. People are adaptable, and have adapted to environmental change. Rural Alaska has traditional knowledge, very strong and extensive family and social support networks, deeply rooted connections to land and cultural values.” – Kotzebue workshop participant*



Climate change is causing far-reaching impacts for resource management units and coastal communities. Resource managers emphasized changes in the timing, location and numbers of various species and the resulting management challenges. Community members focused on the interconnectedness of the state of the ecosystem and their ability to live in their home communities: they experience culture, identity and the health of local ecosystems as one and the same. All participants emphasized the desire and ability to adapt, to bridge differences, build upon shared values and work together to respond to climate change and associated challenges.

- “We are a whole different world. People don’t understand if they haven’t seen it.” (Nome workshop)
- “Communities are where we are because of access to important resources; this is particularly important to for folks from outside the region to understand.” (Kotzebue workshop)
- “Walrus are declining. What is happening to the ecosystem beneath the ice? They really depend upon the ice. Plankton, other organisms are also linked to sea ice. Ocean acidification may alter the food chain. The Y-K Delta King salmon example is chilling... Food security into the future is not just an Alaska issue; with the human population increasing, it is a global issue. Global changes will put more pressure on the Bristol Bay fish resources. Ocean Acidification is a big concern if it is going to impact salmon.” (King Salmon workshop)
- “The fact that seasonality is changing – for us, it’s like someone moved the calendar by a month and nobody told us. We wonder what it must be like for the animals, plants and fish.” (Nome workshop)
- “We have to go further away from the community to access resources such as walrus, and traveling further from the community in unpredictable weather is more dangerous. Now we can’t plan hunting activities a week ahead of time; we can only plan 24 hours out. We live it day by day.” (Nome workshop)
- “A river change causes a change in ‘the roads of our people.’ Our highways are our infrastructure; they are being re-routed around us.” (Kotzebue workshop)
- “We see less snow and more rain in August. Less snow means that the tundra is drier, so tundra fires are a larger concern. Snow and the watershed is what we watch for. We have never worried about Devils Lake drying up, but it has reduced three to four feet. This is extremely concerning because we don’t have another water source. The amount of money it would take to get more infrastructure built

is extensive. The entire watershed drains into the lake, so less snow means less water.” (Kotzebue workshop)

- “The importance of access to subsistence foods is not just a cultural thing; it’s a survival thing. You can save thousands of dollars a year and get good healthy food with access to subsistence resources. We’re concerned about PSP and other impacts to food. We’re also looking at new food sources all the time. For example, we are interested in the greenhouse.” (Aleutian Life Forum)
- “We’ve survived all these years because we’ve had some kind of comfort in the food. We’ve adapted over time. My parents have gone from sled dogs and snow machines to jets. They have seen huge changes in their lifetime. We can handle the change. We have a strong history and culture of folks that have adapted. Hopefully we don’t lose that resilience.” (Kotzebue workshop)
- “Because the economy is tougher here, parents are working multiple jobs and don’t have the time to spend with their kids like they used to. We are concerned about kids becoming screen-addicted and substance-addicted.” (King Salmon workshop)
- “What most at risk is our adaptability. In the larger society, our culture and our knowledge don’t seem to be valuable. Our adaptability to influences that are outside our control, it’s difficult to advocate for when it doesn’t appear that our Native Alaska traditions are valued. When we see these things and have no ability to voice our concerns, our very existence is at risk. There is so much that is out of our control.” (Nome workshop)
- “I don’t see anything up there about how it affects people physically, psychologically, spiritually, for security. I know some young people just think, “There’s nobody who’s going to help us. They don’t care about us. My life is going to end soon, so I’m just going to live the way I want to.” A lot of our people don’t care anymore. They don’t want to move from that island because that’s their home. They’re going to wash out to the ocean.” (Kotzebue workshop)
- “The sustainability of our communities is at risk. Big cultural changes have happened already, and climate change can amplify those negatively or positively, provided that our youth still have reason to be here. Climate change issues are going to be dependent upon the people who are here.” (King Salmon workshop)
- “Our essence is our culture, and that needs to be maintained. But culture is not a static thing; it is always evolving. We need to better maintain that way of thinking.” (Aleutian Life Forum)
- “If we get a small fish run or our moose/caribou population gets smaller, if we don’t get involved with agencies to make sure that subsistence is protected, it will get taken away from us. We need to protect our way of life for our kids. We get sport hunters in here. We get outside people who want to take the resources. If we are caretakers of the land, we have to fight to keep that. With social media, kids are on computers all the time. We have to make sure they get out to do subsistence and learn from Elders. We’re always in fight mode, we fight to keep what we have and to continuously tell agencies what we have, what it’s like to live here. They don’t live here; don’t know what it’s like. But we’ve been here for thousands of years.” (King Salmon workshop)
- “People know how ocean conditions affect the food web; animals have to eat. The animals are adapting and we are having to catch up.” (Nome workshop)
- “The more money put in infrastructure, the more it gives a false sense of security. Look at Venice and New Orleans. A thousand years ago, Eskimos were always living in sync with natural phenomena, moving with the seasons; that was the answer to all fluctuations then.” (Kotzebue workshop)
- “Our sense of security is in our sense of people, of community, that people will always come back, and that the land provides.” (Kotzebue workshop)

# Goals and Candidates for Action to Promote Climate Change Resilience and Adaptation

*"If we want to maintain our communities, some of us are going to have to do things in new ways, make those calls ourselves, do things for ourselves. We hope this might be a good way of encouraging people to think of their own collective and individual ways to do something, although if you want to stay as a community, collective." – Nome workshop participant*

## Communication and Leadership



*"We are working on getting fiber optic cable. Right now, we can't even connect or get Google to work. It's ironic that this is such a key international port and third-world countries have better internet access than we do." – Aleutian Life Forum participant*

**Goal: Maintain our ability to make choices and keep our options open.** *"What's worked for 12,000 years is people being able to make choices for themselves. How do we keep as many options as possible? Are there new options that we take advantage of? Who's making the choices?" (Kotzebue workshop)*

**Goal: Be proactive rather than reactive and crisis-driven.** *"Climate change is only one of several problems people in communities are working on, such as economic development. It's hard to talk about climate resilience without economic resilience. People tend to be reactionary because we have all these other things to deal with." (Aleutian Life Forum)*

- **Action:** Use community plans to identify and implement ways to reduce carbon emissions as a community.
- **Action:** Seek and implement alternatives and efficiencies in energy, transportation, etc.
- **Action:** Use the necessity of change as an opportunity to replace aging or damaged infrastructure with better alternatives. Use various local plans to set priorities and access resources, and use completed local plans and regional partnership entity(ies) to push as needed for external partner funding.
- **Action:** Establish a River Watershed Council.

**Goal: Build capacity and increase awareness.** *"Tell our story in a way that is simple and from the heart. Accept that things are rapidly changing. Inform the younger generation now so they can help prepare for change." (Nome workshop)*

- **Action:** Continue to have discussions with scientists, policy experts, local representatives, etc. and share the information throughout the region. Maintain consistent, frequent and effective communication among communities and agencies. The LCCs can help connect people in different agencies, researchers, and communities, including people who specialize in bridging science and the end-users of science.

- **Action:** Share traditional knowledge and information about adaptation responses with other communities, including how they can keep aspects of their culture with the adaptation responses.

**Goal: Cultivate more youth involvement in the tribe and community.** *“There are more scholarships and programs for young people to get involved, and the older generation is more willing to reach out to youth.” (Aleutian Life Forum)*

- **Action:** Provide mentorships and invest in people who can make a difference in our communities.

## Carry out the ‘Right Science’

*“Use existing science, bring it back to communities to use as tools to let people know what is happening and give them options to see what we can do to change ahead of time. We would like to see more community-driven projects, synthesize information and studies, and invest time into commonalities, not differences...Sometimes as a community member I am concerned about these things but unaware of the work that people are doing about it. I wish there were more ways for regular community members to learn about the work that is being done on this. It works both ways, if we can educate our communities, we will make better decisions; we will be wiser.”*

*– Aleutian Life Forum participant*

**Goal: Integrate traditional knowledge and science and increase communication with researchers and agencies.** Because models can under- or over-predict, local observations are important to help make scientific models more accurate. Community monitoring programs that adhere to scientific data-collection protocols give communities data they can use to document changes, contribute to science, and leverage additional resources. The Northwest Arctic Borough, Kotzebue IRA and their partners have done several research studies that integrate traditional and western science.

*“There is a need to listen to residents and fishermen, their understanding of dynamics and impacts. We couldn’t get industry to pay attention to the impacts they were having on subsistence. They wouldn’t allow our traditional knowledge. It was almost like they were saying, “I don’t believe you.” It was frustrating. That’s why it’s important for local leaders throughout coastal Alaska to have these conferences and get the right science to adapt. If you don’t have baseline data, where is your funding going to come from? Where is the funding for research integrated with adaptation? It’s competitive - a battle, sometimes repetitive. How to you funnel funding towards a common goal? It shows that we all have to work together. It doesn’t do any good to chop anyone off; it’s counterproductive. On a global knowledge perspective, what kind of model could be created to be able to share with other tribal communities to be able to have a response to an acknowledged baseline data system that is respected, so it doesn’t sound like we’re ranting and raving?” (Aleutian Life Forum)*

- **Action:** Prioritize research that fills the information gaps of greatest importance to communities and resource managers (e.g., coastal environment changes, changes in subsistence species, and in some areas – the nearshore environment). Attend subsistence meetings to get feedback about science and learn what information is useful to hunters.
- **Action:** Set a multi-year path for community/agency/business/NGO research partnerships (e.g., to study factors affecting stages in the lifecycle of salmon).
- **Action:** Bring together the right partners to set up an integrated regional monitoring and measurement system.
- **Action:** Better define the data to be collected, associated standardized collection protocols, and a system to connect local data collection with research institutions.

- Action:** Build a system that takes full advantage of local knowledge: communities, commercial fishing captains, etc. *“Not much has been done to harvest the knowledge of fishermen; there is a lot more room to work with fisheries skippers and other industry people, whether logistical help travelling to remote communities or collecting marine observations. I hear a lot from locals who are full of observations, such as algae blooms, whale dieoffs, whales in areas they normally wouldn’t be that time of year. We start to put things together and, for example, see that whales are about to swim into a toxic algae bloom.”* (Aleutian Life Forum)
- Action:** Maintain the security and integrity of data, for example by not publishing subsistence resource data, using MOUs to establish data ownership and privacy rights, or allowing local observers to select values. Traditional knowledge is difficult to share taken out of context, and it is difficult to know if it (and local input generally) is being used by state and federal agencies.



## Better Connect Agencies with Local Communities

*“The reason we are all here is because we want to do more. We need to work together. If we could have done it by ourselves we would have done it.” – King Salmon workshop participant*

**Goal: Work together for fair access and distribution of resources.** *“Working together is important. Fight for fair access to resources and biomass; we see these oceans used by Japanese, Canadians, etc. and want to see local communities get fair access... If we wait for agencies, we are not going to get there because agencies have limited funds and have to keep up with their individual missions.”* (Aleutian Life Forum)

**Goal: Build relationships and work together.** *“Before an agency comes into a region, they need to ask how they can be helpful, listen, and build a relationship. Regional organizations, like BBNA, can give help agencies understand how to work with tribes and communities in the region. The regional agency knows who to call for whatever issue needs to be solved, as well as how to work with people in smaller communities to do what needs to be done. It’s relationship building. It’s the historical trauma that has happened in each region...there are a lot of people who do not trust, so information is withheld. You have to build the relationship with people first. As agencies, you need to not tell us how to live here. We need to tell you how we live here, and then you can listen and tell us how you can help.”* (King Salmon workshop)

- Action:** Hire more USFWS Refuge Information Techs (RIT’s) and increase local hire among State and Federal land management units. Find ways for others to expand the agency local hire model. *“To have local people, people who have been here, grew up with us, managing our local agencies, who understand the rhythm of the people who live here – it goes such a long way. Giving people some level of comfort that at least at some levels they’re being understood. When you have somebody who has the highest level of respect for the people who are hunters, and based regulations on their recommendations – they earn that level of trust. Everyone has equal access according to the Constitution, but if somebody can be flown directly to the migration route, they have better access than those that have to wait along the river.”* (Kotzebue workshop) *“At subsistence meetings, people are saying that when the regulations were changed suddenly, people were criminalized for providing for their families.”* (Kotzebue workshop)

- **Action:** Clarify and simplify procedures for working with agencies (e.g., agency ecosystem map, integrated planning and grant opportunity programs); the multiplicity of agencies and associated processes present undue challenges, particularly for communities with small populations.

## Emergency Preparedness

*"The way things are going right now, it's not going well, not getting any better. Seriously, we need to consider with our own leadership, not just rely on government but prepare for disasters ourselves." – Nome workshop participant*

**Goal: Be prepared for natural disasters.** *"They take measurements and take their scientific counts of birds, fish, etc. and I'm thinking, 'Hello! I'll be gone by the time you're done counting the fish!' I'm starting to label the people of Kivalina as threatened or endangered species." (Kotzebue workshop)*

- **Action:** Take personal responsibility for seven days of post-disaster emergency preparedness. Get specific about what you would take with you and how much supplies you will need in an emergency evacuation situation. Nothing is more important than your own health and your own welfare, so that you can be strong enough to take care of children, people with disabilities, pets, etc.
- **Action:** Keep Small Community Emergency Response Plans (SCERPs) current.
- **Action:** Prepare community evacuation plans and methods.
- **Action:** Use local plans to set priorities for improved, adaptive infrastructure and work with regional partners to increase access to external partner funding.
- **Action:** Improve 'communications infrastructure' to better understand risks to the physical infrastructure. For example, work with the National Weather Service (NWS) to obtain and improve forecasts for various weather phenomena.

## Food Security and Culture

*"I hope one of the storyboards is about subsistence – not just food, but what it really means to us. For me, subsistence is commercial wellbeing. It makes people feel like they are worth something. The wellbeing that you get from sharing subsistence activities is priceless...knowing the language, as you have to know and speak the words for the traditional foods. It is important for us to express things correctly, what we're making, what the end product is. People who practice a subsistence way of life, the economics of it, sharing it, putting it away, processing, knowing what is the word or language that fits this [salmon/walrus/bowhead, etc.], what the process is, how special it is...I'm an*



*instructor. I must have a PhD in harvesting. With the social ills that our kids face, when they do subsistence, they have less time and need to wander off, get involved in drugs...They're filling that void of the things we've lost, things we've done for years and years and years. There's that disconnect, and we're now reconnecting with our land and our food, everything that we have as our people. We are healing that disconnect." – Nome workshop participant*

*"Passing on the culture is done through teaching our children to hunt. With risks to people's lives, we also risk losing the knowledge they carry. It isn't safe to go out and hunt, so these practices aren't being passed down.*

*My hope would be to enjoy the resources that our area has to offer, that we have the resources to enjoy them. The way we raise our children and grandchildren is to use the same high standards our elders showed you, not to accept low standards now.” – Kotzebue workshop participant*

**Goal: Protect food security and subsistence way of life.** *“It’s who we are, part of our livelihood.” (Kotzebue workshop)*

*“Land is not only part of our soul; it’s what literally feeds us: berries, caribou, fish. We must maintain the environment to we have those things. Our goal is to still be here. We eat the berries, the caribou, the moose, the fish – being able to conserve those resources, maintain clean water for fish habitat – that’s what we talk about is that we are still here. That’s our goal.” (King Salmon workshop)*

- **Action:** Improve safety for hunters, e.g. by providing real time ice data.
- **Action:** Broaden agency missions and increase the flexibility of land management policies to more quickly adapt to changing conditions on land management units (currently it takes 1-2 years to change federal regulations). Continue to focus on communication among land management agency field staff, state and federal agency leadership, and local residents to solve problems and facilitate adaptation strategies. It helps to have people working for land management agencies who have lived in the area for a long time, who know and understand the local way of life. Local people can also provide information about the land and resources that helps researchers and agencies do their work better. Can decision-making move to the community level in some way?
- **Action:** Increase communication about traditional hunting and fishing practices; teach young hunters and non-residents to follow traditional protocols (e.g., Kotzebue locals fly people into caribou hunting area and educate them, the Kiana Elders’ Council created a flyer on hunting protocols).
- **Action:** Establish and carry out programs and policies to eliminate contaminants in subsistence foods and ecosystems (soil, water, etc.).
- **Action:** Create Waterways Safety Committee(s).

**Goal: Maintain cultural identity.** Try to maintain a healthy and active way of life that will allow people to survive and adapt to changing climate conditions, and that balances modernity and cultural traditions. (Nome workshop) *“Our kids are Natives. We are trying to instill in them that they are a living culture and worthy of protection.” (King Salmon workshop)*

- **Action:** Use ‘food-bridging’ strategies (e.g., greenhouses, managed herds) to supplement traditional food sources.
- **Action:** Identify best practices to integrate agriculture into healthy existing ecosystems (e.g., grow agricultural foods without introducing invasive species).
- **Action:** Share traditional subsistence practices in new ways, e.g., film traditional knowledge holders demonstrating traditional knowledge, such as safe hunting practices, processing resources.

**Goal: Preserve local language(s).** *“Language is the blood of the culture. Once language is gone, the rest is easy to wash away.” (Aleutian Life Forum)*

*“The Inupiaq language is an environmental language. It’s tied directly to the land, the air, the oceans, the seasons. Place names are given for scientific reasons, Inupiaq scientific reasons, directly associated with our physical environment in some way or another. It’s a language that needs to be used. I was fortunate enough to learn how to speak Inupiaq growing up, but I wasn’t always a willing student. I learned enough to converse, but a lot of people never did learn. I learned something, so now what do I do with it? Well you talk. Use your skillset to some advantage, hopefully.” (Kotzebue workshop)*

- **Action:** Establish and carry out programs, projects and policies to promote the education and use of traditional language(s).

## Resilience and Adaptation Planning



*"We talked about increasing Refuge employees' connection to communities because it's not just our people; we need everyone in the community. We need more outreach to communities." – Aleutian Life Forum participant*

*"Many of the communities just aren't sure what they're going to do. It's hard to think 50 years from now when you have a crisis right now. People kind of glaze over." – Kotzebue workshop participant*

**Goal: Increase self-determination.** *"Develop power-sharing relationships. Strengthen our collective voice and get involved in planning; the community involvement and perspectives must be included. Increase protection and respect for subsistence... We have always been adaptive. We are resilient people. We are looking for better communities and communication solutions." (Nome workshop)*

*"We have to own our future by taking ownership of our problems, control what we keep and what we move toward, what our new communities look like, what is worth preserving." (Kotzebue workshop)*

- **Action:** Address climate change issues in various agency, community and regional plans. Try to find energetic staff who understand that the overall plan can increase successes and maintain the involvement of leadership (e.g., council, board).
- **Action:** Work with communities and agencies to clarify the benefits and necessity of different types of plans (e.g. EPA Tribal Environmental Plans, EPA Climate Action Plans; Hazard Mitigation Plans). Find ways to integrate similar planning processes or otherwise reduce planning redundancies.
- **Action:** Take greater advantage of the funding that is available to support planning and certain implementation programs (e.g. \$8 million was left unallocated for FEMA-funded Hazard Mitigation Plans in 2015 for Alaska communities).
- **Action:** Identify options for planning and grant-writing support services, possibly with regional coordination.

## Economic Development

*"It's hard to separate a conversation about climate change from economic stability. Economic stability is the foundation for cultural creativity; just considering climate change isn't enough." – King Salmon workshop participant*

**Goal: Maintain a clean environment** locally, for the country and the earth. *"We don't have a choice; we have to adapt. But we don't want to adapt more than we have to. We want to slow or stop climate change so we can keep our way of life and so that people in Lower 48 don't have to go through the changes we are going through now." (Kotzebue workshop)*

- **Action:** Recycle locally and use things that are biodegradable.
- **Action:** Reduce greenhouse gas emissions by changing to cleaner diesel and renewable energy (e.g., wind turbines, solar panels) alternatives that support self-sufficiency in energy, transportation.

**Goal: Improve economic development and connections between communities.** *"Snow and ice are how people get around. It is our means to get places. It powers our economy, and now our traditional routes are no longer safe with the rivers not freezing." (King Salmon workshop)*

Develop roads and other important infrastructure while protecting the land. Increase sustainable and renewable energy, and decrease dependence on non-renewable energy. Increase access to resources for relocation when and where necessary; communities used to move.

*"The marine environment is also important to the people of Interior Alaska because we share subsistence resources. We need to think about people, trading and sharing not just with coastal areas, but also with people throughout the state. People are really spread out, some gone to urban areas, but we still trade and share our subsistence foods." (Nome workshop)*

- **Action:** Invest in new infrastructure technologies or strategies for more mobile infrastructure. Does resilience mean becoming more mobile or learning to adapt where you are?
- **Action:** Lower energy costs and provide more housing options to alleviate overcrowding in remote communities.
- **Action:** Consider mineral resource development. At least participate in those decisions: How can we mitigate them, so our environment is protected and our people are part of the decisions? Can we influence them?
- **Action:** Aim to expand economic activities according to local values and harness the resulting wealth to carry out programs and projects currently beyond local means.

**Goal: Invest in education and innovation.** Provide future generations with a high-quality level of education. *"We are concerned that kids living in this community don't have a sense that there are jobs here or that there are highly valued jobs. We would like more place-based education, focused on our local environment so that students are learning trades available here and science, and teachers are more focused on place-based education. Kids are encouraged to go to university, but it is difficult to return and find jobs that match their skill set. With changes to subsistence resources, we need new policies to adapt but regulations are very static and difficult to change. We need more research into new emergent species and understanding regulations that need to be changed." (Aleutian Life Forum)*

- **Action:** Build a system of resilience classes through UAF campuses
- **Action:** Work with local schools to bring science into the classroom; e.g., teachers can invite visiting researchers to share their work with students; scientists and teachers can develop teaching modules for local schools based on current research; scientists, teachers and elders can develop culturally

appropriate teaching modules that blend traditional knowledge with current science research; communities could establish coastline monitoring stations at schools so that students can monitor things like erosion, weather, and learn to use GIS and remote sensing tools.

At each of the workshops, participants stressed the importance of economic development as a response to climate change. They envision concentrating on economic development strategies that are culturally appropriate, do not harm the environment, are scaled to the size of communities in each region and provide the stability to keep people in their home communities. For example, one King Salmon workshop participant stressed that *“as it becomes cheaper to process fish in a foreign country, we see processors here in Bristol Bay not coming together to work in Bristol Bay; we are seeing that economic contraction. But there is an opportunity for smaller, more specialized producers, processors and markets.”* Port Heiden residents created local jobs by taking over contaminant cleanup from a former military site: *“PCBs, petrochemicals, solvents, pesticides were all dumped where we harvest berries...we decided to do it ourselves because you never do as good a job in someone else’s backyard as you do your own. That’s the way of life.”* Other ideas included increasing local hire at National Wildlife Refuges and other agencies. At the Aleutian Life Forum, a participant spoke at length about this issue:



*“If tribes can create an economy, they could be a contributor to the region; that is something that hasn’t happened in Alaska. I can’t speak for other communities, but that is why we want more independence: we want to solve local problems ourselves rather than have someone else speaking for us. It’s an exciting way to look at it: How can we contribute to what we want to be involved with?”*

*“Tribal economic development is our major unmet need. It’s important to at least signify to Congress that Alaska tribes are without an economy and without land. When those two are able to be established, then you will see growth, health. Encourage discussion*

*among different regions: what could economic development mean for you? We looked at our community, at our shortfalls, how we could add to the health of our people. We are really liberating the power of the Tribe. It’s a socioeconomic need for tribal members; that’s where we have the most growth because the only place we have to go is up.*

*“This is an effort to redefine how we exist here, not on someone else’s terms. I think about everything that has failed this community; we have been silent for way too long. The way forward is for us to get healthy. We are really taking a serious look at our path, redefining and defining it. It’s all a unique arena when it comes to our communities. There are similarities, at least with the seed of working together; then it goes from there.”*

# Where do we go from here?

“We need to find a balance: up the value of people who have survived for millennia. Give ourselves a real bright future of opportunity instead of ‘woe-is-me.’ I’m sick and tired of our people being a ward of the government. If we’re going to save our language, we have to own it. How much are we willing to do the work? Some responsibilities we have to accept; we have to lead. For future generations, it’s our time to lead with blended knowledge.” – Kotzebue workshop participant

## Tell a better story.

“We are faced with lot of challenges and opportunities. I hope we use good sense in facing them both. In every challenge, there is a kernel of opportunity.” – Kotzebue workshop participant

A common theme that emerged from the workshops is the need to tell a better story about what is happening in Alaska’s coastal communities. One Kotzebue workshop participant explained it this way, “When it comes to the health and safety of the people, how can that really be expressed, so that no matter where this document goes, people will feel it? So that action can be taken before more lives are lost?” The people involved in these workshops repeatedly stressed that they are looking to use their power to leverage the assets they have and attract partnerships, collaboration, and resources from outside their communities that can be directed toward the health and welfare of the people and the physical environment we all depend on.

Workshop participants who had hosted the Obama Climate Change Commission noted that bringing people to the region and involving them in the work helps because when they are personally invested, they are more likely to do something about the situation. They also pointed out that Congressional staffers need things to be communicated to them in extremely simple and concise terms because they have to help make decisions on such a wide variety of public issues. Maniilaq produced a documentary video (shown at the workshop) that shows what environmental changes have been observed and how those changes are affecting several of their communities in the words of the community members themselves. The 20-minute long video was also separated into three- to five-minute segments for each community, so that each community could use it to tell their story when seeking support from outsiders. Interviews were also conducted with participants at each of the Resilience and Adaptation project workshops and will be shared through the LCC network at [www.facebook.com/northlatitudes](http://www.facebook.com/northlatitudes) and [www.northernlatitudes.org](http://www.northernlatitudes.org).

Ultimately, collaboration among a large number and diversity of people will produce the greatest likelihood of success. Collaboration allows people to share solutions (or potential solutions) across disciplines, perspectives and interests; it offers the potential for better coordination of research activities, funding and data collection; and with a louder voice and clearer message, gives the group more clout to affect public policy and funding decisions. To give that collaboration some structure, participants discussed how to build a regional dialogue and collaboration network.

## Building a Regional Dialogue and Collaboration Network

*"I think it's a waste of time if this is all that we do. If we don't move this forward, then it's a waste of our time." – King Salmon workshop participant*

Workshop participants have been enthusiastic about the value of the workshops and the overall project effort to understand and respond to climate changes as proactively and collaboratively as possible. Agency representatives in attendance at the Nome workshop reported having changed the way they think about working with coastal and Alaska Native communities to respond to climate changes based on their experiences at



the workshop. Regional leadership in Bristol Bay have begun to work more collaboratively on climate-change related efforts after the King Salmon workshop. At the Aleutian Life Forum, local and regional leadership asserted the desire to expand the reach of these efforts through the Alaska Federation of Natives (AFN) annual gathering: *"We want to take what we have learned here to AFN and try to get it on the agenda, at least to draw in a lot of the other Native communities because there are only a fraction that are involved. What do we do with this momentum? It would be a shame for it to all disband when we go back to our corners... this is the main focus of the world right now."*

Project partners and workshop participants have yet to create a formal structure for some form of regional collaboration at the time of writing. To move forward, a few questions must be addressed:

- What are the best ways to keep networking about climate change adaptation and resilience?
- What scale? Who might be involved?
- Are any existing organizations able to help keep the conversations and information exchange going?
- Are there funding sources available to support this effort? Are there any low-cost models to consider (e.g., piggy-backing on scheduled events)?
- What specific near-term actions might be the catalyst for expanded collaboration?

# Appendices

**Bering Strait Regional Workshop Summary**

**Aleutian Life Forum Workshop Summary**

**Bristol Bay Regional Workshop Summary**

**Northwest Arctic Regional Workshop Summary**

# Bering Strait Regional Workshop Summary

May 10-11 | Nome Mini-Convention Center | 9am-5pm

## About the Project

The project has been initiated by a growing group of partners, including the Aleutian Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), Western Alaska LCC, Arctic LCC, the Aleutian Pribilof Islands Association (APIA), Kawerak Inc., the Qawalangin Tribe of Unalaska, and the Bristol Bay Native Association (BBNA). The mission of the three coastal Alaska Landscape Conservation Cooperatives (LCCs) is to improve the quality and availability of data, information and tools that can help resource managers, local decision-makers and communities better respond to the changes and challenges facing coastal Alaska communities.

This project involves a series of conference appearances and workshops in four hub communities across Western Alaska where project partners, communities, and resource managers can dialogue about what stakeholders are already doing to respond to coastal threats and help refine informational products and tools. By fostering effective partnerships and communication, these workshops and project products aim to better equip resource managers and communities to respond to the challenges and opportunities of climate change, supporting healthy habitats and resilient communities. The Nome workshop was intended to help participants better understand regional changes, challenges and adaptation strategies, and to foster collaboration among communities, agencies and other stakeholders in the region.

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## Workshop Program

The workshop featured presentations and discussions about environmental change drivers that brought together recent science research findings, local observations, and traditional environmental knowledge to better understand regional trends in environment and human activity.

| Environmental Changes                     | Presentation and Discussion with  |
|---|---|
| <b>Ocean Characteristics</b>              | Nick Bond, University of Washington Joint Institute for the Study of Atmosphere and Ocean                               |
| <b>Weather Patterns</b>                   | John Walsh, International Arctic Research Center at the University of Alaska Fairbanks                                  |
| <b>Sea Ice</b>                            | John Walsh and Nick Bond  |
| <b>Permafrost and Onshore Changes</b>     | Jeremy Littell, US Geological Survey  |
| <b>Vessel Traffic and Oil Spill Risks</b> | Doug Burn, Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSI), and Austin Amahsuk, Kawerak, Inc. |

The workshop featured presentations and discussions about tools and case study examples of near and longer-term strategies and actions that can be done locally to respond to climate changes.

| <b>Tools and Case Studies</b>   | <b>Presentation and Discussion with</b>                          |
|---|--|
| <b>Assessment and Planning</b>  |  |
| <b>Community Inundation Maps</b>  | Jaci Overbeck, DGGs  |
| <b>Unified Oil Spill Contingency Planning</b>                             | Matthew Mitchell, US Coast Guard                                 |
| <b>Oil Spill Prevention and Response Preparedness</b>                     | Rhonda Sparks, Defenders of Wildlife                             |
| <b>Measuring Change</b>   |  |
| <b>Tracking Shoreline Changes</b>   | Jaci Overbeck, DGGs  |
| <b>Coastline Monitoring Tool</b>  | Joel Reynolds, Western Alaska Landscape Conservation Cooperative |
| <b>Bering Watch Citizen Sentinel Program</b>                              | Pamela Lestenkof, Aleut Community of St. Paul Island             |
| <b>Other Strategies and Actions</b>                                       |  |
| <b>Climate Change Planning</b>  | Mike Sloan and Jacob Martin, Nome Eskimo Community               |
| <b>Filing for Assistance if Erosion is Putting Infrastructure at Risk</b> | Sally Russell Cox  |
| <b>FEMA planning (FEMA Tribal pocket guide)</b>                           | Ramona VanCleve, FEMA  |
| <b>Adaptation Planning in Alaska</b>                                      | Davin Holen, Sea Grant Alaska                                    |

Participants found the information relevant, especially the tools for measuring coastline change, the inundation maps, spill response resources, local observation tools and ice information. Participants suggested future presentations or case studies to include: community risk assessments, food safety assessments/tools, the State emergency declaration process including FEMA plans and assistance, emergency response plans (e.g., SCERP) with training, oil spill preparedness and response, coastal monitoring, and integrated planning and monitoring (Unalakleet example).

Throughout the two-day workshop, participants discussed these environmental changes, their impacts and potential adaptation strategies and actions in small groups. The main themes of these discussions are summarized on the following pages.

## **What are environmental changes we are experiencing and their drivers?**

*“This region is changing rapidly; we have seen drastic differences in the last 10 years. Ten to 15 years ago, shorefast ice went 10 miles out around Savoonga. There has been less snow in winter the last two years. Water levels are lower; there have been water temperature changes to streams and rivers (for example around Golovin); changes in precipitation; algae in the ocean. It also affects berries.”*

Weather is unpredictable.

*"We have to go further away from the community to access resources such as walrus, and traveling further from the community in unpredictable weather is more dangerous. Now we can't plan hunting activities a week ahead of time; we can only plan 24 hours out. We live it day by day."*

Elders observed that the weather started changing in the 1980s. There has been an increase in the rate of change the last couple of years, and it has been more noticeable in the upper northern latitudes, suggesting a significant increase in all these interconnected environmental dynamics.

### Seasons are shifting.

*"The fact that seasonality is changing – for us, it's like someone moved the calendar by a month and nobody told us. We wonder what it must be like for the animals, plants and fish."*

There has been a lack of snow, spring break-up starts earlier, it freezes up later, and the warmer season has lasted longer in recent years. Inland, residents have seen heat waves on the tundra in summer. Although the predictions are for more precipitation, residents have observed less precipitation in the last several years. There has been a noticeable increase in midwinter rain, which changes the melt factor of nearshore ice, making it less stable for travel, and contributing to earlier spring breakup. Winter rain has caused icing on roads and flooding on frozen ground.

The last five years (2011-2016) have seen warmer temperatures (above -40 Fahrenheit) and ice being blown offshore. Although 2012 was a big ice year, since 2013 there has been far less ice and it has rained December through February. Ice is forming later and has been going out early. The lack of ice has prevented winter crabbing in the last few years. Residents have needed to shift to jet boats because melting and spring rain affects the movement of material downriver, plugging up lower rivers and estuaries. Less shorefast ice means greater storm surges and more impact on the environment as well as infrastructure.

### Permafrost thaw, changing wind patterns, and increasing storm intensity are accelerating erosion along the coast.

*"When the wind comes from the south in the summer it is warmer and more humid, which creates harder drying conditions."*

In recent years, residents have observed more severe storms later in the season, and more storms coming from the north or from Anchorage, rather than the normal Dutch Harbor path. A weather pattern has developed in which a straight west wind storm comes after a couple of days of rain (at 50 miles per hour, west winds have been of greatest concern). The south wind is associated with weather that is too humid in the summer to dry fish and too warm in the fall to dry moose.

Sea level rise has not been observed in the Bering Strait area, but permafrost thaw, wind and storm surges have been contributing to erosion along the sea coasts. Historic and archaeological sites, graves, barrier islands and spits are eroding. Erosion is affecting geese, beluga and hunting access near Stebbins. Wales now has wind erosion. Further inland, high-water events have increased in number and magnitude: with four to five 100-year events in the last 10 years, people are now calling them 20-year events. High water events also leave table size (or larger) ice cakes on the tundra, which make winter travel difficult. More water level monitoring and nearshore bathymetric data is needed for storm and inundation modeling, and more information is needed about wind patterns.

### River courses and water levels are changing; riverbanks are eroding.

*"We have to take lighter loads to camps up from Council in the spring due to low water levels."*

Changing river patterns have caused riverbank erosion. In river systems, freshwater input is causing the water to travel in different pathways, creating timing issues for travel and for fish. The river channel is changing often, and banks are eroding. Low water levels increase river transportation challenges, driving up the cost of goods that must be brought into the community. Increased freight costs exacerbate already high costs of living, particularly fuel for heating and transportation.

## Sea ice has been declining in area cover, thickness and composition.

*"We used to go 20 miles out of Elim to crab, six to seven feet thick. Now, you are lucky if you get ice for crabbing that is two feet thick. People do travel and go through the ice... Our hunting practices are also changing. We used to look for walrus where the walrus form their own breathing holes (which become like cones on the ice). This hunting method isn't available anymore."*

Participants repeatedly referred to the importance of sea ice and their concerns about the diminishing extent and quality of it. For example in Diomedes, which has had only seasonal ice runways, residents have had to use helicopters instead of airplanes for the past three years. Because the helicopters carry less cargo and fewer passengers, transportation on and off the island has become more expensive. To the extent that residents rely on hunting marine mammals and ice fishing or crabbing, diminishing ice has made accessing resources increasingly difficult. The ability of the ice to support travel is based on the ice thickness and salinity of the frozen water. Trace salts in sea ice provide more give; freshwater or river ice is much more brittle. The ice quality and thickness is no longer good enough to get to the walrus (or other species) to hunt them; the ice is too thin for travel on foot and too thick to skiff through.

## Water salinity, temperature and pH are changing.

*"Water temperature changes are also changing algal blooms, which impact salmon and whitefish. We don't have many studies to describe the different coastal systems, no baselines."*

In addition to the dynamics of ice formation, the salinity of the ocean and nearshore estuaries are changing, which affects the formation, duration and quality of the ice as well as the communities of species that can live in these environments, including king crab, capelin, herring and salmon. Rivers, estuaries and the ocean are warming. People are worried that warmer water in the oceans and the resulting growth of algae will negatively affect the lower trophic levels (at the bottom of the food chain), and that water temperature changes are negatively impacting salmon. Estuaries in lagoons and at the mouth of rivers are species-rich environments that are influenced by the salinity of water, but the impact of these changes on saltwater estuaries is not well understood. More research on climate change in these northern saltwater estuaries is desired. Participants also express concern that because freshwater has a greater capacity to absorb carbon dioxide, it may increase ocean acidification.

## Permafrost is thawing. Lakes and bogs are drying.

Participants discussed the effects of thawing permafrost. Residents are concerned that as the permafrost thaws, it might introduce toxins, existing metals, and residual mining toxins into the streams and environment. With the ground thawing in Diomedes, people have stopped using pits to ferment walrus because they are now worried about *E.coli*, and they are worried about landslides as the ground at higher elevations gives way.

On the mainland, lakes are drying, affecting migratory birds with specific habitat requirements that include lake size. Traditional hunting spots are changing because there are fewer birds at the shrinking lakes. On Diomedes, increasing numbers of birds are concentrating at the island community's single water source, contaminating

the water with their feces. Diomed residents surmise that the increase in birds could be caused by drying lakes and ponds on the mainland.

## The tundra is changing, and berry production has significantly declined.

*"Without the protection of the snow, berry stems freeze and break off in winter, and are exposed to the freezing rain. When the rain does come in the summer, it is hard; between the rain and heavy winds, it damages the leaves and flowers of the berries...Five to 10 percent of our diet is berries, and they need good water quality to grow and provide us with healthy food."*

Participants have observed the tundra receding and the appearance of new forest including white spruce, alder and dwarf birch, with a corresponding decline in blueberry patches. Berry production has been very low for the last 10 years, and berries are ripening noticeably earlier than normal. Participants discussed several possible causes for the berry decline, including: fresh and saltwater dynamics (i.e., salination from flooding), decrease in summer precipitation, unusually warm spring weather ("cooks the tundra"), forest crowding out blueberry bushes as tree species migrate into the tundra, lower snowfall and less snow pack in winter. Participants talked about black spruce and white spruce die off from bark beetles and two hot summers in some areas.

## The species that make up our ecosystem(s) – the food web – is changing.

*"People know how ocean conditions affect the food web; animals have to eat. The animals are adapting and we are having to catch up."*

Workshop discussions emphasized the productivity and richness of the many species in the Norton Sound and Bering Sea marine ecosystem, which is affected by the interactions of wind, currents, the salinity of the water and the presence of shorefast ice as well as polynyas (areas of open water surrounded by sea ice). Participants expressed concern about the food web as species' ranges and migration patterns change: will it be a simple or complex food web? Residents recognize potential gains with the introduction of new species, and are also concerned about mitigating invasive species. For example, (Japanese) Hanasaki crab have been found in Diomed with increasing frequency over time; Brevig Mission is seeing sea lions more frequently than before; sheefish have been caught in Teller (normally they are only in Kotzebue area); and other areas have seen grasshoppers and more tiny birds.

Residents are concerned about species die-off, disease, parasites, contaminants (PSP), lesions and radiation. Observations of these concerns include: seals with hair loss; belugas with sores (in Shaktoolik), avian cholera, tomcod die off (in Shaktoolik or Unalakleet where they are common along the shore and a staple of crab), silver salmon with sores on their backs and sides, and rumors that sea lion disease is transferring to belugas around the St. Lawrence Island. A number of different seals were found with lesions, bald spots, and/or weeping wounds in 2011. Although it was a low-ozone year and could have been sunburn, residents expressed concern about radiation from the Fukushima Daiichi nuclear disaster and the lack of scientifically-validated information about the extent of and nature of its effects on the Bering Sea ecosystem. Insects are also a concern: there has been a spruce bark beetle outbreak around Elim, and die-offs of insect species that are superfood for many other species (e.g., midges, chironomids) have been observed when exposed to higher salinity.

## People are part of the ecosystem.

*"The marine environment is also important to the people of Interior Alaska because we share subsistence resources. We need to add people, trading and sharing not just with coastal areas, but also with people throughout the state. People are really spread out, some gone to urban areas, but we still trade and share our subsistence foods."*

People are part of the Bering Sea region: as residents and hunters who live off the land, as resource managers, industry and as others whose actions affect the state of the ecosystem. Workshop participants highlighted international issues (i.e., balancing subsistence harvest, shipping, commercial fishing and other activities) with Russia and other countries with a presence in the area. Participants highlighted threats from human activity such as oil spills, large trawlers and bycatch, dumping at sea and solid waste, noise from power plants and other loud machinery disrupting the migration patterns of some species, and impacts from flushing ballast tanks. Residents talked about the development pressure they are experiencing (e.g., mining, deep water port, marine tour boats, shipping) and how economic development could be balanced with their social and environmental values.

## How will these changes affect us? What do we most want to protect?

### The essence of who we are as a community

*"I hope one of the storyboards is about subsistence – not just food, but what it really means to us. For me, subsistence is commercial wellbeing. It makes people feel like they are worth something. The wellbeing that you get from sharing subsistence activities is priceless...Knowing the language, as you have to know and speak the words for the traditional foods. It is important for us to express things correctly, what we're making, what the end product is. People who practice a subsistence way of life, the economics of it, sharing it, putting it away, processing, knowing what is the word or language that fits this [salmon/walrus/bowhead, etc.], what the process is, how special it is...I'm an instructor. I must have a PhD in harvesting. With the social ills that our kids face, when they do subsistence, they have less time and need to wander off, get involved in drugs...They're filling that void of the things we've lost, things we've done for years and years and years. There's that disconnect, and we're now reconnecting with our land and our food, everything that we have as our people. We are healing that disconnect."*

Residents articulated the essence of their communities in the region as including: traditional knowledge, sovereignty, oral history, culture, traditions, diet, way of life, and community cohesiveness. It is important for the people of this region to document traditional knowledge and pass it along to future generations, retain ownership of the land and their expertise as "professional harvesters," and protect connections and relationships, including the bonding relationships between communities, agencies, and others. Workshop participants also noted that Bering Strait is a very diverse region, and there is no one big regional economic driver or asset.

### What life in this region will be like in the future (say, 50 to 100 years from now)

*"Our Native lifestyle, people, languages, and traditional ways may diminish so much that we lose our unique identity and culture, developed over thousands of years."*

Workshop participants discussed their visions of the future, including environmental, social and political changes. "Environmental and climate changes will increase in magnitude faster. We will see more invasive species and fewer indigenous species. By the time the ecosystems re-stabilize, there will be different ocean flora and fauna in the area. Thawing permafrost will release viruses and create more marshy swampy land. Sea level will be higher, endangering villages. The water table will also rise, and more villages will have flooding and inundation problems. Storm surges will be more frequent or stronger, and there will be more coastal erosion, even within the next ten years. There will more archaeology, as erosion and permafrost thaw expose historic and/or traditional sites. Marine plastics will continue to be major issues, and the plasticizers in those plastics will threaten human health and wildlife.

“There will be population changes, as some villages grow and others decline. Some villages will have to move, as the sites we now know will be under water. We will still be living here, where we have been for 10,000 years. There will be more diversity, more people from different nationalities. We will bring together our cultures and find ways to maintain our sense of community, connections and relationships, despite having to become more political. There will be more access and more shipping, but also more risk of spills.

“To some extent, we will go back to old ways of surviving, and to some extent, we will have changed our subsistence harvest practices. There will be new hunting grounds. We envision changes in fishing regulations and opening local fisheries. We will choose technology and employ new uses of modern technology that is balanced with our cultural values. For example, we will have better transportation connections; clean, renewable energy in the villages; and less dependence on diesel, heating oil, and other non-renewable resources. Communities will feel empowered by their successful adaptation to change.”

## What is at risk and what we want to protect

*“What most at risk is our adaptability. In the larger society, our culture and our knowledge doesn't seem to be valuable. Our adaptability to influences that are outside our control – they are difficult to advocate for when it doesn't appear that our Native Alaska traditions are valued. When we see these things and have no ability to voice our concerns... our very existence is at risk. There is so much that is out of our control.”*

Participants identified the primary risks of climate change: clean water, clean land, our way of life, and family. Other concerns included high fuel costs and how communities will redistribute, if villages off barrier islands will necessarily have to move somewhere, probably resulting in fewer, larger communities.

Participants emphasized that the ability to adapt to climate change requires that we have some measure of control over our lives and environment: politically, economically, and culturally. Power sharing is essential. There is concern that outsiders are making decisions that affect locals without sharing full information or involvement, that other relevant groups are not involved in decision-making, that there is misrepresentation or lack of representation, and that actions and policy are done *to* the population rather than with their participation.

Workshop attendees highlighted the disconnect between the time scale at which conditions are changing (fast) and the time scale of adapting laws and policy (slow). They discussed ways to adapt the economy to keep pace with change, emphasizing small precise economic development tools that allow residents to retain local control: local fisheries, local family industry, supporting family and contributing year-round to the community. Participants also expressed concerns about being able to fund community projects and programs, since so many currently rely on grant funding.

## Our starting goals or guiding principles in this time of change

*“We have always been adaptive. We are resilient people. We are looking for better communities and communication solutions.”*

- **Prepare for natural disasters.**
- **Increase awareness.** Tell our story in a way that is simple and from the heart. Accept that things are rapidly changing. Inform the younger generation now so they can help prepare for change.
- **Increase self-determination.** Develop power-sharing relationships. Strengthen our collective voice and get involved in planning (community involvement and perspectives must be included). Increase protection and respect for subsistence.

- **Improve connections between communities.** Develop roads and other important infrastructure while protecting the land. Increase sustainable and renewable energy, and decrease dependence on non-renewable energy. Increase access to resources for relocation when and where necessary; communities used to move.
- **Integrate traditional knowledge and science and increase communication with researchers and agencies.** Traditional knowledge is difficult to share taken out of context, and it is difficult to know if it (and local input generally) is being used by state and federal agencies. More instrumentation research is also needed in this region.
- **Maintain cultural identity.** Try to maintain a healthy and active way of life that will allow people to survive and adapt to changing climate conditions, and that balances modernity and cultural traditions.

## Telling our story

*"We are a whole different world. People don't understand if they haven't seen it."*

Participants in the workshop expressed a strong desire to communicate their distinct way of life and how profoundly environmental changes are affecting residents' future in a way that outsiders can truly understand, while also acknowledging and communicating regional differences. Local residents talked about the importance of their connection to the land, water and natural resources to their identity and wellbeing. Participants were particularly concerned about ways to communicate with state and federal agencies and policy-makers.

Participants emphasized that traditional environmental knowledge (TEK), local observations and science research are all valuable in their respective ways and urged all of these sources to be available for use in understanding what is going on in the region and making decisions about how to navigate climate changes. Suggestions were made to increase and share research, widen audiences, and bring research back to those who are affected by it in a synthesized way, particularly for key species and ecosystem-level dynamics. Not only do most people (residents, land and resource managers alike) not have the time to look through all the studies and communicate their conclusions back to their colleagues and communities, but these dynamics and changes are happening on an ecosystem level, not as isolated phenomena. Participants also urged state and federal agency departments to work together as a team and coordinate on climate change resilience efforts, with the goal of creating a network(s) with fewer points of contact that could make it easier for small communities to successfully work with them.

## What can we do to navigate climate change and meet our starting goals at the individual, local and regional level?

*"If we want to maintain our communities, some of us are going to have to do things in new ways, make those calls ourselves, do things for ourselves. We hope that this might be a good way of encouraging people to think of their own collective and individual ways to do something, although if you want to stay as a community, collective."*

### Communication and Leadership

*"The way things are going right now, it's not going well, not getting any better. Seriously, we need to consider with our own leadership, not just rely on government but prepare for disasters ourselves."*

- Improve communication and integrate existing networks of information. Integrate assessments, mapping, monitoring tools and data collection, and create a centralized communication network or information hub that allows people to collect and share traditional indigenous knowledge, local community observations/data collection, and science research. Include scientific resources that help

communities better understand changes and threats that are occurring now as well as future forecasting so communities can think how best to adapt and plan.

- Standardize local observation /community data collection procedures to establish baseline data and allow comparability of data from different sources.
- Develop a list of recommended readings for researchers coming to communities that help them understand the context of local culture, knowledge systems, and how to communicate effectively with community members. Perhaps provide a pamphlet about community expectations for engagements and consultations.
- Increase community outreach and awareness, understanding, opportunities, representation, information and education. Restore the balance of power and cultivate a stronger shared voice to propel change. Get youth connected and involved in climate change.
- Maintain oral traditions. Document the local and traditional knowledge that we want to maintain. Engage and respect local knowledge, including what is currently good for our lives and culture.
- More Climate Change Adaptation Planning and prioritization to get communities on the same page.
- Technical assistance with grant writing (e.g., traveling grant writers), grants with technical support (i.e., workshops to get hands-on experience) and grant writer training.

## Land, Water, and Subsistence Management

- Improve communication among local communities, policy makers and managers. Build more flexibility into decision-making and government regulations and allow more input from local residents to address issues such as:
  - Disagreement about the appropriateness of subsistence quotas for certain species (e.g., walrus);
  - Disagreement about the appropriateness of fines for dumping at sea under extenuating circumstances (e.g., with less ice cover, hunters had to go farther into the ocean to hunt; bad weather forced them to dump some meat or risk capsizing the boat and the death of the hunters. Yet agencies expect trawlers to lose plastic nets at sea.)
  - The possibility that as residents must travel further from the community to hunt walrus and whales, there may be a need to allow them to cross the international border to follow a struck whale;
  - Existing regulations might not be keeping up with changes in the seasonality and migration patterns of subsistence resources. People used to be more selective about the animals they hunt; now animals are passing by before they can even get out hunting. Residents must hunt quickly whatever presents itself or miss out.
- Consider a voluntary community moratorium on hunting if an alternative food source is available to give the message to the world that we have a strong commitment to the future for our kids.
- Manage invasive species.

## Changing Subsistence Practices and Cultivation

*"People can't live without bearded seal oil."*

- Greenhouses and gardens may be one adaptation strategy but they don't work everywhere; you have to have time to tend them. "The land is our garden." That is what is preferred.
- Supplement wild berry patches with planted berries to get more varieties.
- Introduce new species in the area, like the reindeer herding.

- Develop new designs for things we already use (e.g., new technology or methods for drying fish or meat given changes in air temperature and humidity).
- Food safety outreach and testing, such as:
  - Rural Alaska Monitoring Program (RAMP): field test strips are used to see if there are certain harmful bacteria in a harvested animal's blood.
  - ANTHC and State of Alaska mercury testing: Women of childbearing age can submit a lock of hair to their local healthcare provider, who will send it in for mercury testing. Results are returned to the individual with personalized recommended guidelines.

## Community Services, Infrastructure and Utilities

*"It's hard to put things away for the future when you are barely making it today."*

- Promote local economic development and emphasize links between climate change, infrastructure and economic development.
- Allow more customary trade of resources between communities.
- Develop finfish and shellfish hatcheries.
- Address issues with transiting boat traffic (e.g., dumping, using the harbor for shelter but not communicating with the community).
- New types of vehicles might become necessary to get to subsistence, for transportation from village to village, as well as search and rescue.
- Continue to monitor vessel traffic in the Bering Strait region and provide access to communities.
- Keep drinking water clean and the landscape pristine.
- Every community should have a trash compactor and an adequate landfill. *For example, Unalakleet's school takes students out to the landfill to pick up trash before it reaches the ocean. They have a compactor and a bander. A few years ago, Kotzebue toured the landfill and got a grant to purchase its own equipment.*
- Adaptation could include more housing and better quality homes that are: energy neutral, built to withstand the weather, are mold-resistant and can be moved if necessary.
- Use alternative energy sources, more efficient energy systems, and cleaner burning engines. *For example, one community is now using the waste heat from the power plant to heat some community buildings.*

*"We are self-rescue community here so any risky activity on the water is even more risky."*

- More emergency/disaster preparedness, search and rescue, HAZWOPER and spill response tools, training and equipment. Education and training is also needed for planning (e.g. SCERP), tools (e.g., environmental change measurement tools), and how to interact with government.

## Inundation and Erosion

- Change the Stafford Act to enable FEMA to provide Federal relocation assistance.
- Give communities a stronger voice at the local level and be more flexible about land exchanges.
- Focus on easy-to-do, low-cost, high-benefit actions.
- Although not a "one size fits all" situation, help villages that hope to move determine what should be invested in. *For example, Shaktoolik created their own berms. Unalakleet has started migration to higher ground. Shaktoolik wants to stay, but needs evacuation routes.*

- Share ideas and technical expertise on natural infrastructure, working collaboratively with community members to identify specific workable solutions.
- Extend rock barriers (to slow/prevent erosion) from public lands into private property with owners' permission.
- Share technical assistance determining where to build homes and infrastructure with permafrost and flooding, keeping in mind that moving community buildings and infrastructure miles apart makes them more expensive to maintain, but communities do not receive more funding.
- Encourage inter-agency collaboration, such as using FEMA flood maps to inform the State DGGIS community inundation modeling, and together providing a tool for communities to see the different flood plain maps with the degrees of risk color-coded in different communities. *Note: New flood zone maps can have unintended consequences in terms of new requirements / mandates on communities.*

# Aleutian Life Forum Workshop Summary

August 18-20 | Grand Aleutian Hotel | Unalaska

## About the Project

*"I'm just a community member, but my takeaway is that I'm very heartened by the fact that I've met a lot of people who are out there doing this kind of work. Sometimes as a community member I am concerned about these things but unaware of the work that people are doing about it. I wish there were more ways for regular community members to learn about the work that is being done on this. It works both ways, if we can educate our communities, we will make better decisions; we will be wiser." – Aleutian Life Forum participant*

The project has been initiated by a growing group of partners, including the Aleutian Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), Western Alaska LCC, Arctic LCC, the Aleutian Pribilof Islands Association (APIA), Kawerak Inc., the Qawalangin Tribe of Unalaska, and the Bristol Bay Native Association (BBNA). The mission of the three coastal Alaska Landscape Conservation Cooperatives (LCCs) is to improve the quality and availability of data, information and tools that can help resource managers, local decision-makers and communities better respond to the changes and challenges facing coastal Alaska communities.

This project involves a series of conference appearances and workshops in four hub communities across Western Alaska where project partners, communities, and resource managers can dialogue about what stakeholders are already doing to respond to coastal threats and help refine informational products and tools. By fostering effective partnerships and communication, these workshops and project products aim to better equip resource managers and communities to respond to the challenges and opportunities of climate change, supporting healthy habitats and resilient communities. The Nome workshop was intended to help participants better understand regional changes, challenges and adaptation strategies, and to foster collaboration among communities, agencies and other stakeholders in the region.

Visit the facebook page [www.facebook.com/northernlatitudes](http://www.facebook.com/northernlatitudes)

## Workshop Program

The workshop featured presentations and discussions about tools and case study examples of near and longer-term strategies and actions that can be done individually, locally and regionally to respond to climate changes. Throughout the two-day workshop, participants discussed these environmental changes, their impacts and potential adaptation strategies and actions in small groups. The main themes of these discussions are summarized on the following pages.

| Topic   | Mini-Presentation and Discussion with  |
|---|--|
| <b>Individual Resilience + Adaptation</b>         | Ramona VanCleve, Federal Emergency Management Agency (FEMA)                          |
| <b>DGGS Programs and Resources</b>                | Jaci Overbeck, State of Alaska Division of Geological and Geophysical Surveys (DGGS) |
| <b>BeringWatch App + Citizen Sentinel Program</b> | Lauren Divine, Aleut Community of St. Paul Island                                    |
| <b>FEMA programs + resources</b>                  | Ken Murphy, FEMA   |

| Topic   | Mini-Presentation and Discussion with                                     |
|---|---|
| <b>Ocean primary production impacts</b>   | Jessica Cross, NOAA   |
| <b>“Food Bridging” Strategies</b>   | Karen Pletnikoff, Aleutian Pribilof Islands Association                   |
| <b>Changing Subsistence Regulations</b>   | Tom Robinson, Qawalangin Tribe of Unalaska                                |
| <b>Marine Vessel Traffic and Oil Spill Response</b>                             | Aaron Poe, Aleutian Bering Sea Islands Landscape Conservation Cooperative |
| <b>Climate Change Adaptation and Related Plans</b>                              | Heather Stewart, Planner, Agnew::Beck Consulting                          |
| <b>Climate Adaptation Planning</b>  | Neverley Shoemake, US Environmental Protection Agency                     |
| <b>The Study of Environmental Arctic Change (SEARCH) Programs and Resources</b> | Matt Druckenmiller, SEARCH  |
| <b>U.S. Army Corps of Engineers Programs and Resources</b>                      | Bruce Sexauer, U.S. Army Corps of Engineers                               |

## What are environmental changes we are experiencing and their drivers?

Shipping traffic is already impacting some species.

*“As the sea ice opens up and new sea routes open up, we are going to be at increased risk... We’ve had this concern for decades, but now it’s really kicking into gear.”*

Participants expressed concern about the cumulative impacts of changing migration patterns, noise pollution and ships not staying within designated shipping lanes. “We see a lot of entangled whales; there was a ship that came in with a humpback whale draped across its bow. I am also concerned about noise pollution: what does that mean? Whales are going to follow the herring; they’re going to follow the feed. We made an exclusive zone around the Aleutians. Plankton will factor in to the migratory path of the whale. Can we put all this information together? What is the normal pattern of navigation? Will it be one set pattern? Will it impact species from year to year? We know about what we find, but what are the numbers that we don’t find? I am concerned about an influx of traffic, with international shipping lanes just miles away. What are the impacts? There is a lot of freighter traffic out there. I’ve been fishing codfish out in front of Unalaska, Akutan, Akun, and seen whales more concentrated in-shore, along the shelf. With freighters coming through Unamak Pass, the majority will follow traffic lanes offshore 10-12 miles, but many take a shortcut: they come in short, go through the pot fishing gear in the shallow waters where the whales are. I would like to see something to enforce freighters using the shipping channels, so they stay offshore in the deep. They can’t see, can’t maneuver to get out of the way of the whales. There is more potential for whale strikes because of this.”

Invasive species are a concern.

*“If agencies have anything that could help us communicate about invasive species and the problems they can cause, that would help us a lot.”*

Attendees expressed concern about invasive species and their potential introduction into the area via ballast water. Dutch Harbor has the third greatest volume transfer in the world. Regulations dictate that discharge has to be 25 miles to the south, but some ships have been observed discharging close to shore, and the water is a

different color. Residents asked, "What impact does that have on our species, our biosystem? The water could have species that kill our species here (like Dungeness crab). We don't want to point a finger or see who is responsible, but it is a concern."

Erosion is affecting some areas.

*"We are losing information about and insights into past adaptation strategies. We are watching knowledge washing away."*

Attendees expressed concern about the loss of cultural resources (archeological sites) due to erosion. "I've seen a lot of erosion in Alaska. We have this real access to archaeology studies that show things have been happening for thousands of years, but erosion has been eroding archaeology sites. A lot of projects we rely on come out of development, but do we have a good plan for erosion and climate change?"

In some areas, changing water levels and tidal action is causing salinization in rivers and lakes.

*"Salmon are not mating in the water; they are waiting until the eleventh hour until they are nearly dead before spawning because of the salinity level."*

We are noticing locally the rise of the ocean into our rivers and lakes, greater salinization due to city wells drawing down the water table, causing greater susceptibility to surges closing rivers, natural fish passage barrier formation, and reduction of spawning habitat and access. "The salinity in the Iliuluk River is creating a low tide. The low level of water in the lake with the influx of high tide is influencing the salinity of the lake. The river is supposed to be full to allow the Coho to go up. Salmon are not mating in the water; they are waiting until the eleventh hour until they are nearly dead before spawning because of the salinity level. With our efforts to rebuild subsistence fish in our bays, it's one more problem. It's concerning."

Ocean acidification is a concern.

*"The only real 'solution' is to put less carbon dioxide into the atmosphere and reduce our carbon footprint."*

Attendees expressed concern about ocean acidification. The Aleutian chain currently has the highest levels of ocean acidification. Cold water is naturally more acidic; it can hold more acid. But that is also part of why the waters in the region are so productive (species rich). However, the less carbon dioxide that goes into the atmosphere, the less the oceans will have to absorb. Currently the focus of research is how things are going to change and what the challenges are to species, etc. With our current understanding of what is happening, some mitigation may be possible but responses to ocean acidification might be more adaptation (adjusting to new realities).

## **How will these changes affect us? What do we most want to protect?**

The essence of who we are as a community

*"Our essence is our culture, and that needs to be maintained. But culture is not a static thing; it is always evolving. We need to better maintain that way of thinking."*

Participants described community essence as "our culture, honoring our heritage, what we owe back to where we came from, being intact with our original resources, preservation of wildlife, basketball, and community identity. We are a fisheries and shipping community."

## What is at risk and what we want to protect

*“Simple changes can impact our lives very easily; for example, a route change for industrial marine traffic impacts our resources (e.g., sea lions). Our values and culture are at risk; Aleut language could be at risk of disappearing in the next few decades. We see a spectrum of exploitation and preservation.”*

Participants talked about preserving culture and resources through socioeconomic development, as well as protecting physical community infrastructure, e.g., the power plant, church, school and runway. The Dutch Harbor runway is predicted to be under water.

Discussions highlighted that big changes are happening fast. These include positive changes, such as more access to information, more technology, medicine, greater awareness of how those things are connected.

Negative changes included increasing risks to subsistence resource availability and economic opportunity, and disconnection of youth with traditional knowledge and culture. Erosion is making clam beds unharvestable, which kills seagulls. The seagulls and other animals have to adapt their diets. Kids are also adapting but by eating too much Western (processed) foods; kids have to adapt to healthy diets. There are risks for fishing licenses because the way the program is built up, it is no longer a family chain (retiring family members cannot pass licenses to young people). Job security is a risk but there are also risks of youth leaving their hometowns. There are new substances, bad lifestyle habits. Being low income is not a career for tribe members, so involvement in the Tribe is hard to attract. Look at our education systems; they are not funded as robustly as needed, and we have brain drain happening.

Young people do not get out as much and are less connected to the land; some have never been for a walk outside the school. When they do go camping, they have cabins with generators, TVs and games, so they are not really experiencing the wilderness or a connection to the land. Hunting knowledge is something that is critical to pass along, especially in Alaska Native cultures. However, it is challenging for Elders and more experienced hunters to share knowledge when things are changing so much so quickly; they are not sure what is happening or how or what to teach youth. Participants talked about the difference between dog sleds and snow machines: with dog sleds, the ‘driver’ must be skilled and know what (s)he is doing. With snow machines, it is not necessary to be that skilled, but if the person does not know what (s)he is doing, (s)he will scare off the caribou. People who know what they are doing harvest more caribou.

## Our starting goals or guiding principles in this time of change

*“If we had \$1million we would use it for partnerships, innovation, and leveraging that money to get more money. We would also have more coastal resilience workshops and put money to lobbying so communities have more voice in the world when decisions are made.”*

- **Invest in education and innovation.** We are concerned that kids living in this community don’t have a sense that there are jobs here or that there are highly valued jobs. We would like more place-based education, focused on our local environment so that students are learning trades available here and science, and teachers are more focused on place-based education. Kids are encouraged to go to university, but it is difficult to return and find jobs that match their skill set. With changes to subsistence resources, we need new policies to adapt but regulations are very static and difficult to change. We need more research into new emergent species and understanding regulations that need to be changed.
- **Cultivate more youth involvement in the tribe and community.** There are more scholarships and programs for young people to get involved, and the older generation is more willing to reach out to youth.

- **Work together for fair access and distribution of resources.** Working together is important. Fight for fair access to resources and biomass; we see these oceans used by Japanese, Canadians, etc. and want to see local communities get fair access.
- **Preserve our language(s).** Language is important to carry forward.

## What can we do to navigate climate change and meet our starting goals at the individual, local and regional level?

*“Tribal economic development is our major unmet need. It’s important to at least signify to Congress that Alaska tribes are without an economy and without land. When those two are able to be established, then you will see growth, health. Encourage discussion among different regions: what could economic development mean for you? We looked at our community, at our shortfalls, how we could add to the health of our people. We are really liberating the power of the Tribe. It’s a socioeconomic need for tribal members; that’s where we have the most growth because the only place we have to go is up. So this is an effort to redefine how we exist here, not on someone else’s terms. I think about everything that has failed this community; we have been silent for way too long. The way forward is for us to get healthy. We are really taking a serious look at our path, redefining and defining it. It’s all a unique arena when it comes to our communities. There are similarities, at least with the seed of working together; then it goes from there.”*

### Natural Systems

*“Use existing science, bring it back to communities to use as tools to let people know what is happening and give them options to see what we can do to change ahead of time. We would like to see more community-driven projects, synthesize information and studies, and invest time into commonalities, not differences.”*

- Individuals can join the new waterways safety committee.

*“Not much has been done to harvest the knowledge of fishermen; there is a lot more room to work with fisheries skippers and other industry people, whether logistical help travelling to remote communities or collecting marine observations. I hear a lot from locals who are full of observations, such as algae blooms, whale dieoffs, whales in areas they normally wouldn’t be that time of year. We start to put things together and, for example, see that whales are about to swim into a toxic algae bloom.”*

- Any effort to extend research to include nearshore and marine areas could be done via the commercial fishing fleet.
  - It’s a low-cost or no-cost relationship. Skippers are already out in remote places in Alaska making observations that are easy to formally record. For example, the National Weather Service asks us for certain kinds of weather observations.
  - Local observations from communities are shared with commercial fishermen, who move around a lot and are generally more in tune with the surroundings than the freighters. For example, St. Paul and King Cove have strong relationships with local fisherman; the environmental coordinator goes out and talks with local fleets.
  - Industry can also help with logistics, to help researchers get to remote places.
  - Capt. Rick Fehst has been working with the University of Iceland on a Skipper Science program. The fishermen all have log books. Researchers could work with them to create a new log book with a daily page that trains skippers to look for specific things and capture climate change notes. Captains would be responsive. Contact Capt. Rick Fehst: [captain.earlydawn@gmail.com](mailto:captain.earlydawn@gmail.com), 907-359-5171.

- Dan Magone (Marine Vessel Repair in Dutch Harbor) has had a close relationship with the Maritime Refuge doing invasive species and response training for rats and shipwrecks in remote places.
- Bering Watch has connections to local fishers already and is interested in connecting with more. Bering Watch is doing incidental observations of Steller eiders in and around Cold Bay (King Cove) and marine mammals through NPRB, tying in the observations of fishermen on the water.

*“A lot of people are just starting to have these kinds of programs. We are learning lessons the hard way because there is no way to reinvent the wheel.”*

- Look at options for creating a unified system for coordinating data collection into and sharing information from local observer networks.
  - Do we have a streamlined way of getting observations to the same place? How uniform does the protocol need to be? What are the quality requirements?
  - The purpose of an observation network is different from monitoring or baseline assessments with protocols. Data/information is gathered using different methods, at different time scales, and varying quality. Building this integration will require clarifying observation networks *versus* monitoring networks *versus* baseline assessments, and will require a clear recognition of the purpose of the research.
  - For coastal erosion, BeringWatch is trying to group several different measurement systems. How can we build that out to other communities, rather than start anew? Can we feed that into LEO and other observer programs to minimize duplication and user frustration?
  - The more local observer networks there are, the more fractured the community picture may be. How do we bring the picture together to bring the information back to communities?

*“It helps to have one place to look for most information in a regular place.”*

- An annual report could be one way to synthesize a consistent set of climate change information. Information from specific agencies could be compiled once a year, so people don't have to browse around different agencies and communities looking for information. We can more easily see observed changes all together throughout a large area, so that it starts to paint a picture of what is going on in the system. The NOAA observer network produces a synthesized report.

*“We can standardize measurement protocols; we need agency input and also local residents. Maybe this is a ways down the road yet, but it is a goal we should be working toward.”*

- The challenge is finding standardized measurement protocols. Even not standardized, ensure that the data are comparable.
  - Apps have made it much easier.
  - In Southern California, the US Army Corps of Engineers (USACE) has been asking local citizens to take pictures of local beaches when there is a storm. With basic guidelines on effective types and uses, photographs can make a big difference in the absence of everything else. Photos work well to gauge maximum storm surge height when the water line can be compared against a permanent visual reference. For example, one corner of a house is an effective fixed point that can be used for reference; we don't need super-precise measurement.
  - Alex Whiting is doing animal population monitoring with the National Park Service and the Fish and Wildlife Service in Kotzebue.

- There is value in standardizing but it needs to be flexible to the specific questions asked by the groups launching the effort. It's hard to standardize first until you know the questions that are of interest locally.
- If we are all on the same protocol then Tribes could apply together for BIA funding.
- Community-based research protocols need to be geared toward communities. Research agencies can provide regional 'services' (protocols, data infrastructure, QA/QC, simplified reporting back, etc.) to encourage local participation.
- Standardized protocols would be great, but might not be practical on the ground in some circumstances. Given that things are changing so fast, rather than waiting for the perfect data collection approach, it might be better to start with something and keep going from there.

*"If we wait for agencies, we are not going to get there because agencies have limited funds and have to keep up with their individual missions."*

- Perhaps we need a workshop among the groups doing local observer programs to figure out how this might be coordinated. *(The LCCs and the Alaska Climate Science Center could potentially fund something like this.)*
  - A statewide or regional observer coordination workshop could bring programs together to streamline and clarify data collection protocols, find better, more efficient ways forward, lessons learned, better information flow systems underlying all of this.
  - BeringWatch could be used as a model. It has been operating for 15 years; many of the kinks have been worked out. Right now, BeringWatch is being reformatted to take in more information. Through BeringWatch, people in False Pass and Sand Point are now collecting information on iPads and it downloads when they come home.
  - DGGs just did a workshop in Dillingham, working with a big group of people. We looked at data sheets, but the information was not relevant and didn't make sense to them. Now Jaci Overbeck has a list of ways to change the sheets and make them easier for people to understand.

*"SEARCH is trying to fill gaps in expertise to be more cross-disciplinary to address the societal implications of climate change. At the Arctic Encounters Conference, many state and federal level people pointed out that SEARCH needs to focus on particular issues rather than just sea ice."*

- The Study of Environmental Arctic Change (SEARCH) program provides science information on Arctic change through collaboration with the research community, funding agencies, and other stakeholders. The SEARCH program geographic area has been defined as arctic Alaska only. A few activities were highlighted:
  - The Sea Ice Matters website hosts science information on various topics (primers, science papers, graphics, videos etc. on key topics; data, tools, technical resources and literature) for use by media, public, congressional staffers, students, science journalists, scientists, etc.
  - The Alaska Observatory and Knowledge Hub (A-OK) provides a place for communities to share observations and knowledge co-production with a focus on how the seasonal cycle affects community activity and resources. The Alaska Observatory and Knowledge hub (A-OK) is not a portal. It is intended to be a way of improving upon practice and is connected to the Eloka project.
  - Sea Ice for Walrus Outlook (SIWO) provides weekly reports April through June on sea ice conditions relevant to walrus in the Northern Bering Sea and southern Chukchi Sea.

*"We need both a gap analysis to understand the questions we are not answering and a general synthesized picture of where we are right now in the Aleutian ecosystem."*

- NPRB had an RFP last year to "fund an Aleutian science synthesis" but they weren't able to get the kind of proposals they wanted because there are basic important things that are not known. It might be more effective for us to look at specific questions within the ecosystem, in other places along the Aleutian Chain. NPRB funded \$50million to understand the Bering Sea. There is not necessarily that kind of money today, but we could start with \$2-3 million on targeted research to answer specific questions.
  - If we're all focused on one thing we might be missing something else that is important to the equation. How does that impact scientific studies for the overall future?
  - A vulnerability assessment can help to shape those questions. The priorities from the vulnerability assessment become the priorities for research funding.

*"There is a need to listen to residents and fishermen, their understanding of dynamics and impacts. We couldn't get industry to pay attention to the impacts they were having on subsistence. They wouldn't allow our traditional knowledge. It was almost like they were saying, "I don't believe you." It was frustrating. That's why it's important for local leaders throughout coastal Alaska to have these conferences and get the right science to adapt. If you don't have baseline data, where is your funding going to come from? Where is the funding for research integrated with adaptation? It's competitive - a battle, sometimes repetitive. How do you funnel funding towards a common goal? It shows that we all have to work together. It doesn't do any good to chop anyone off; it's counterproductive. On a global knowledge perspective, what kind of model could be created to be able to share with other tribal communities to be able to have a response to an acknowledged baseline data system that is respected, so it doesn't sound like we're ranting and raving?"*

- Baseline data may be needed to substantiate local concerns about the loss of resources and resource habitat to entities such as the Board of Fish. Is there a role and a model for use of TEK to generate baseline data where quantitative data don't exist?
  - There may be a special role for TEK in the identification of key changes (and thus areas potentially requiring attention) that are 'off the current radar' of the science community. Much previous agency dismissal of TEK was based on the premise of a more or less static ecosystem, but in the absence of a Western baseline, if you can couch knowledge gaps and show evidence in a traditional sense, that knowledge can be better used in Western science. In a sense it matters much more what the future looks like than the past, so it's better to start now.
  - One challenge is how to share information when there are concerns about how the information will be used. From an agency perspective, it must be open and transparent knowledge. But local and traditional knowledge is proprietary information, to be used in a specific way; it tends to be closed or private unless there is a way to protect its use. The agency cannot use it broadly, only with specific permission for specific uses. Communities need scientists to explain how the research will support the community and how the results, implications and impact will be communicated back to the community.
  - What the information is going to be used for (e.g., reporting back to communities) affects the way it is communicated. Traditional knowledge is conveyed in stories, terms people can understand. Researchers and agencies can marry measurement-driven science with traditional knowledge (TEK) to communicate information: use TEK (or that style of description) to summarize and explain

the scientific data implications. Rely on human voices to tell stories. Use photographs and terms people understand.

- Hold more workshops on community monitoring.
- In the Puget Sound area, indicator species were used as a proxy for the state of the ecosystem. Salmon was used as the number one driver to show ecosystem health and as a common denominator to translate among various groups. Indicator species won't work for Aleutians or Bering Strait, but we do need a model that describes and brings all the sources together to consistently communicate about the research. A-OK [in SEARCH presentation] may be able to do that.

## Emergency Response

*"It's better to have an emergency preparedness kit and not need it, than to need it and not have it."*

- **Think ahead about how to be personally prepared for an emergency.** In an emergency, you are responsible for: yourself and others who need it (e.g., Elders, children, pets); children should know where to go and what to do in case of an emergency. Assemble an emergency preparedness kit; you want to have seven days minimum supplies ready for an emergency. Think about the practicality of traveling with your supplies. For example, what good is a 60lb fire extinguisher if I can only carry 30 lbs.?
  - The Red Cross offers free classes for dealing with emergencies.
  - The FEMA app (<https://www.fema.gov/mobile-app>) can be used to:
    - Receive alerts from the National Weather Service for up to five locations.
    - Get safety reminders, read tips to survive natural disasters, and customize your emergency checklist.
    - Locate open shelters and where to talk to FEMA in person (or on the phone).
    - Upload and share disaster photos to help first responders.

*"A drill is a drill, but are we really prepared?"*

- **Consider community emergency response and evacuation when planning for community infrastructure.** You have to look at the entire infrastructure system: how water, electricity system (generation, pipes, lines) are connected. Where are you going to house people if they need to be evacuated? How much food is there on the top of the hill? If there was a real tsunami, will that be enough? What if the cruise ship cannot leave? What if airlines are shut down for an extended time? What about disease (e.g., Zika virus)? What about if the internet failed?
  - Dutch Harbor/Unalaska: We have not had anyone live on the south side of the hill because of a tsunami some hundreds of years ago. The beginning and middle of every month we have an emergency warning sound, evacuation routes (from the school for youth and for elders to get to high ground), and a secure water source. There was an evacuation for an earthquake a few years ago. The Chief of Police advertises the survival kit for seven days. The runway is critical infrastructure, but it is projected to be under water in 70 years. We have a freshwater system 700 feet up. If the water gets that high, we probably have other problems.
  - King Cove has had a tsunami threat. Most public buildings are on higher grounds; they kept that in mind when they got funding for new structures. Funding for their new medical center included criteria that it had to be above the 50-ft tidal zone. Safe zones were identified on the island (Ballyhoo, Haystack, etc.).

## Public Infrastructure

- **As an individual, reduce carbon emissions** by taking shorter showers, turning off lights or appliances that are not being used, turning the heat down a little and bundling up.
- **As a community, reduce carbon emissions** by thinking about insulation as we're designing and constructing buildings (25 percent of energy is used for heating in rural Alaska).

*"If we had \$1 million to spend on climate resilience, we would use it as leverage to get \$10million to build a small boat harbor."*

- **Climate adaptive public infrastructure is important to economic development as well as climate change resilience.**

*"FEMA is there for the long term. During a disaster, FEMA will spend the money. How much could the agency get on a ship from Seattle to help a community? FEMA would bring a lot of stuff with them to help a community. Where will food and supplies come from if a Cascadia Earthquake hits and impairs Seattle's ports? FEMA depends on the fishing fleet along the coast; they have tools, internet, etc."*

- **Consider FEMA programs and resources.** FEMA has Homeland Security grants, mitigation grants, flooding grants, etc. FEMA has grant funding for Hazard Mitigation Planning for the whole community. The FEMA-approved Hazard Mitigation Plan comes out in March; it opens the door for Hazard Mitigation project funding. FEMA is also working with Lower 48 tribes on potential loss of subsistence: What if you lost all your berries? What about timber (as a harvestable crop) – will FEMA pay to plant new trees?
  - If using FEMA funding and/or doing FEMA Hazard Mitigation planning, think about to “bounce forward” if/when a disaster happens. Can the diesel power plant be replaced with renewable energy systems? Can buildings be relocated to sites farther upland/inland? For example, in St. George FEMA is being used to bring rock to refurbish and build up their jetty/harbor.
  - **Speaking only for FEMA,** Cost Share match for tribal entities is allowed using the PL 93-638 Self-Determination Funds. All of the criteria under 2 CFR §200.36 on cost share matching funds must be met. 2 CFR §200.36 subparagraph (5) “...(5) Are not paid by the Federal Government under another Federal award, except where the Federal statute authorizing a program specifically provides that Federal funds made available for such program can be applied to matching or cost sharing requirements of other Federal programs; ...”
  - FEMA contact for questions about a particular grant: Kathy J. Burke, Program Analyst - Grant Programs Division | FEMA, RX | 425 487 4650 (office) | 425 879-6987 (FEMA cell)
  - FEMA contact for legal questions: David Symington Smith, DHS/FEMA Office of Chief Counsel | Region X Counsel | Office 425-487-2099 | Cell 425-879-6989
- **Legal experts can help look for ways that federal legislation can better respond to current realities** (Barrett Ristroph has been looking at this for her PhD). The Stafford Act determines what FEMA can and cannot do. It currently only allows FEMA to respond to an event (e.g., storm, earthquake) that has been declared a disaster, so cannot be used for erosion or climate change because they are not isolated events. FEMA funds also cannot be used to relocate whole villages because the legislation is written to restore damaged property to pre-event conditions in the original location or to convert the land to park/green space after the event.

*“The U.S. Army Corps of Engineers can do watershed planning and ecosystem restoration projects. It might not be the perfect fit for all issues, but it never hurts to ask. It’s a large agency that focuses on large projects, but the Army Corps has some programs for smaller projects.”*

- **Consider programs and resources through the U.S. Army Corps of Engineers.** The Army Corps has a Civil Works Program that gets its own appropriations to provide solutions to water resource issues. ACE has a large Ecosystem and Watershed Program that can be used on projects to restore the environment, provide structures that enhance water systems or remove structures that impede water systems. ACE also has planning support programs with a 50-50 cost share that funds studies (typically \$40,000-\$1million). The ACE Floodplain Management and Silver Jackets Programs provides 100% funding for smaller projects (\$10,000-\$200,000). The Silver Jackets Program is used to leverage funding on collaborative projects, such as producing flood information posters. Call Bruce Sexauer at 907-753-5619.
  - For example, the Army Corps pulls information from NOAA and does modeling for the entire west coast of Alaska; it uses storm climate data from the last 50 years to predict storms approaching and can take specific bathymetry to model when the storm will come onshore. They did this model for Shaktoolik: every square kilometer is modeled (wave, wind figure) and how it interacts with the next kilometer.

*“We are working on getting fiber optic cable. Right now, we can’t even connect or get Google to work. It’s ironic that this is such a key international port and third-world counties have better internet access than we do.”*

- **Invest in communications infrastructure.** Dutch Harbor and other communities (Nikolski, Atkutan, etc.) weren’t included in the fiber optic cable project they just broke ground on up north. With limited communication, we don’t have a lot of representation from some of the Aleutian communities; they don’t know how to connect to the pipeline. We are working on getting fiber optic cable. We have about eight groups working on it, and they are not talking to each other.

## Health and Culture

*“The importance of access to subsistence foods is not just a cultural thing; it’s a survival thing. You can save thousands of dollars a year and get good healthy food with access to subsistence resources. We’re concerned about PSP and other impacts to food. We’re also looking at new food sources all the time. For example, we are interested in the greenhouse.”*

- **Protect subsistence.** How can we reduce controllable threats on subsistence resources? E.g., commercial fish issue, marine shipping.
  - Keep the momentum going for changing vessel traffic movement and better vessel traffic control. Make sure vessels transiting through areas are staying where they should be. With Proposal 194 to support Recommended Areas to be Avoided (ATBAs), the Qawalangin Tribe went through the regulatory process to change commercial fishing industry practices to apply to sustaining subsistence. Subsistence is an inherent right, and we saw commercial fisheries as impeding on our ‘local refrigerator’. As an ANILCA matter (State diving in to Federal issues), it has to be channeled through the appropriate people and the appropriate entities. It was difficult and complex, but progress was made and the Tribe was partially successful.
  - The Bering Sea Response Teaching Tool is designed to help communities, tribal environmental coordinators, and city or tribal administrators learn what to do for oil spill response.

- Science and agency partners could do an analysis to help people understand where their food is coming from and scenarios with possible alternatives if the food is unavailable. Include documentation of possible spill impacts on subsistence resources.
- Join the waterways safety committee to help local residents, industry, conservation organizations, etc.
- Given the priority for subsistence on federal land over sport or commercial harvest, agencies have a good opportunity to work with communities on subsistence with an eye toward collaboration and avoiding conflict.
- **Change the timing of harvest regulations.** Focus on the total amount harvested rather than daily limits. Target the harvest on what is available. Switching harvest species involves issues for resource managers if the subsistence harvest changes and they have no historical data on the new harvest species.

*“Everybody should have a high tunnel and a herd of some kind... It is usually too windy for high tunnels in the Aleutian-Pribilof area, but everyone wants a herd.”*

- **Consider some form of personal or community agriculture, including gardens, greenhouses and herding.** For example, Kotzebue has chickens and tomatoes. Port Heiden is raising pigs, chickens, and reindeer, and is now looking at how to set up a system to reuse herd waste. In Kamchatka everyone has greenhouses heated by geothermal systems. Tyonek uses a mix of modern agriculture (greenhouses and modern agriculture methods) and traditional subsistence practices. They formed a Tribal Conservation District (TCD), got funding for two high tunnels (USDA), found a lake nearby, got pumps and routed water onsite for irrigation. They had to fly in containers for compost to get that started. It had high up-front in costs, but since they started, it has provided food for Elders lunches, food for sale, summer employment for several high school students. It produces so many potatoes, they fly them to Anchorage and sell them there. In spring, the school does the starts and get kids interested in it. They have also done things to ameliorate stream environments and improve salmon habitat on cleaned up land once used for Cook Inlet oil and gas infrastructure, and are bringing back moose.
- **We could increase local food production capacity with greenhouses or growing large crops such as potatoes** that could sustain the carbohydrates needed, but we still need a protein source so fish will always be important. St. Paul is piloting a project to try cold-hardy thornless raspberries, strawberries and currants. On Unalaska, a greenhouse could be built in Summer Bay where natural hot springs are. It would also be good to have a community garden where you could deposit food into the building and it could be redistributed later.
- **The paradigm has been people and wildlife living in wild places; will that go away and shift to managed resources? How to label ‘managed traditional foods’?** Communities have not managed ungulate herds as well as they might. We can start harvesting ungulates to increase their productivity and expand our food sources. Herds are not just a Refuge management issue. Corporation lands are also being degraded by poorly managed herds. If they are not managing the resource well, that’s problematic. Corporations are not serving shareholders effectively if they want to benefit from these resources. Tribes could be part of the solution in managing their herds. With every herd, there needs to be a fence; there has been a containment issue because the land ownership patterns are complex. To the extent that they are novel or cross boundaries at will, there is a need to identify husbandry among a complex set of land uses that don’t incorporate that species (Specific examples: caribou, elk, cows). Joint ownership of land and/or land management

might be necessary. Joint ownership necessitates thinking creatively about land use in such cases. A management plan will be needed where ownership and impacts are complicated.

- **There are also social issues to address to promote healthy communities.** For example,
  - Having renewable energy sources, recycling programs.
  - Affordable housing is also important; we have a housing shortage and no real means to build affordable housing.
  - St. Paul promotes disc golf as a healthy past-time.

*“Language is the blood of the culture. Once language is gone, the rest is easy to wash away.”*

- **Support the maintenance and teaching of native language.** We would also love to see a curriculum for Aleut language. Put languages into pre-Kindergarten classes.
  - We need to connect elders and youth in different ways and ensure there is a forum for expressing concerns. AFN roundtable discussions were great. Sometimes the younger generation gets frustrated when the elders tell stories off topic, so find opportunities where the stories can be told. For example, Nome has Storytelling nights.
  - Pass on hunting knowledge; teach younger people who can share food. Elders are coaching youth in butchering harvests. St. Paul has a local subsistence freezer / foodbank where elders can come to get traditional foods.

## Other Economic Activities

*“Climate change is only one of several problems people in communities are working on, such as economic development. It’s hard to talk about climate resilience without economic resilience. People tend to be reactionary because we have all these other things to deal with.”*

- **More grant opportunities for various projects would help.** Is it possible to jointly fund a position to monitor and help with pursuing funding opportunities?

*“We talked about increasing Refuge employees’ connection to communities because it’s not just our people; we need everyone in the community. We need more outreach to communities.”*

- **The USFWS Refuge Information Technicians (RIT) program is one of the few programs that allows the FWS to specifically hire local community members.** RITs do many different things depending on where they are: they speak the local language, may live in the community, are often seasonal, do education and outreach, and conduct subsistence surveys.
  - RITs are funded from the individual Refuge base budget, so funding the position(s) can be an issue. The fishing industry, regional corporations, and CDQs, etc. might be able to help fund the positions. For example, BBNC partially funded an RIT position.
  - The Alaska Climate Science Center wants to do something similar to the RIT program with climate scientists, similar to Agricultural Cooperative Extension agents in the Lower 48.
- **Youth internships and programs.**
  - The Maritime Refuge has also had youth programs, interns.
  - St. Paul was interested in an RIT, but there was no funding at the Refuge, so the Tribe met with Mark Romano, Bering Sea unit biologist. They strategized and approached TDX (RNC) and the fishing association. The fishing association has been providing funding for youth hires and

- employing students/youth. They partnered and provided some of the youth with internships with natural science professionals (had a seabird youth intern for example).
- FEMA has the FEMA Corps program for youth 18-24 years old. It involves 10 months of education and service work; participants get \$5,500 towards college or skill development. The program operates on a five-year cycle, and participants work on emergency response.
- St. Paul has a program called Alaska King Crab Research and Biology (AKCRAB). It requires diving, so the Tribe is interested in starting a local diving program so they don't have to fly divers in from out of town. The fishing association is buying gear, and they are starting a diving locker, teaching kids swimming, snorkeling and diving.

*"If we had \$1million we would use it for scholarships for any major (environment, education, sociologists); all are important to community health. We would invest in education, to make a real campus here to focus on local jobs."*

- **Invest in education** to focus on local jobs, innovation in energy systems, the industry that is here now, and our local environment. For example, we have only one guy who can fix boilers in town. Let's have a class and get two guys who can fix boilers. We could do an energy resilience study, have a planned fundable project that we can take out and get more money to complete.

## Leadership and Communication

*"Everyone is excited about leveraging each other's resources. Federal agencies are very top down, but there is support for collaboration; it's trendy for everyone to cooperate with each other right now. If we were to gather the momentum to put something like that together, I think we'd be successful."*

- **Increase outreach, creating awareness and supporting people and leaders in communities.** You're not going to be perceived well in a community if you go in and tell them what they need to do. It is better to find leaders, support them, and help them communicate with their community about what is an issue and how to solve problems.
- **Increase youth engagement strategies.** We talked about using 'pizza parties' as a community engagement strategy. There is a theory that if you have pizza parties, you can engage the whole community starting with the youth. We are not really communicating in a lot of ways as a community. How are we going to communicate better? Maybe we need more pizza parties.
- **The EPA offers planning and capacity building assistance for responding to climate change.** The EPA is removing many actionable items from GAP program Tribal Work Plans. Tribes that have been doing GAP for a long time have done much of what they can do when it comes to managing landfills, dealing with recyclables, etc. EPA Climate Action Plans are a new option for Tribes to pursue. EPA Tribal Environmental Plans (ETEP) can also include climate change. GAP can also be used to do other types of planning. The EPA (Climate Change) Adaptation Resource Center has many resources: <http://intranet.epa.gov/arc/>

*"If tribes can create an economy, they could be a contributor to the region; that is something that hasn't happened in Alaska. I can't speak for other communities, but that is why we want more independence: we want to solve local problems ourselves rather than have someone else speaking for us. It's an exciting way to look at it: How can we contribute to what we want to be involved with?"*

- A newly formed U.S. Department of Interior (DOI) board could serve as a 'Regional Partnership Entity.' It is a 12-member, ethnicity specific board (Aleut, Inupiat, Athabaskan, Tlingit, Tsimshian, Alutiiq) with one member from each region representing all their tribal communities for Alaska. The Board reports to the DOI on each region's unmet needs, and that information is taken to Congress to agencies that

fund Indian Country, whether entitlement or non-entitlement. Studies have been done through DOI that found that between L48 and State of Alaska, there is shortfall of about \$66 billion (for housing, healthcare, etc.). The Board's current priority is to fund an education system in the State of Alaska, but additional unmet needs can be added to that list.

*"Those of us in the agencies and LCCs are used to making the case that Alaska is different. We're very good at it and we can help people understand how things are different here."*

- Landscape Conservation Cooperative (LCC) partners stressed their ability to work together with tribal entities, state and federal agencies to help identify additional resources and opportunities for collaboration.

# Bristol Bay Regional Workshop Summary

September 21-22 | King Salmon Lodge | King Salmon, Alaska

## About the Project

*"We've been here for tens of thousands of years; we'll be here for tens of thousands more. We are people of the land – not of the office. We will be able to adapt."*

The project has been initiated by a growing group of partners, including the Aleutian Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), Western Alaska LCC, Arctic LCC, the Aleutian Pribilof Islands Association (APIA), Kawerak Inc., the Qawalangin Tribe of Unalaska, and the Bristol Bay Native Association (BBNA). The mission of the three coastal Alaska Landscape Conservation Cooperatives (LCCs) is to improve the quality and availability of data, information and tools that can help resource managers, local decision-makers and communities better respond to the changes and challenges facing coastal Alaska communities.

This project involves a series of conference appearances and workshops in four hub communities across Western Alaska where project partners, communities, and resource managers can dialogue about what stakeholders are already doing to respond to coastal threats and help refine informational products and tools. By fostering effective partnerships and communication, these workshops and project products aim to better equip resource managers and communities to respond to the challenges and opportunities of climate change, supporting healthy habitats and resilient communities. The workshop was intended to help participants better understand regional changes, challenges and adaptation strategies, and to foster collaboration among communities, agencies and other stakeholders in the region.

Visit the facebook page [www.facebook.com/northernlatitudes](http://www.facebook.com/northernlatitudes)

## Workshop Program

The workshop featured presentations and discussions about environmental changes and their impacts, tools and examples of near and longer-term strategies and actions that can be done individually, locally and regionally to respond to climate changes. Throughout the two-day workshop, participants discussed these environmental changes, their impacts and potential adaptation strategies and actions in small groups. The main themes of these discussions are summarized on the following pages.

| Speaker                                | Topic                                    |
|--|--|
| Jeremy Littell (Alaska Climate Center) | Climate Change Overview                  |
| Natalie Monacci (UAF)                  | Ocean Chemistry Changes                  |
| Ellen Yasumiichi (NOAA)                | Salmon                                   |
| Todd Radenbaugh (UAF BB Campus)        | Erosion                                  |
| Gayla Hoseth (BBNA Natural Resources)  | Climate Change Impacts to Subsistence    |
| Mike Ottenweller (NWS Meteorologist)   | Storm Forecasting                        |
| Rich Buzard (UAF)                      | Tools for Flood Communication            |
| Sue Mauger (Cook Inletkeeper)          | Bristol Bay Water Temperature Monitoring |

|  |   |
|--|---|
| <b>Rich Buzard (UAF)</b>                                     | Stakes for Stakeholders Erosion Monitoring          |
| <b>Ramona VanCleve (FEMA)</b>                                | FEMA Tools for Communities                          |
| <b>Jon Isaacs (AECOM)</b>                                    | Community Relocation Strategies                     |
| <b>Keemuel Kenrud (FWS Arctic Youth Ambassador)</b>          | Food Security                                       |
| <b>Adrienne Christiansen (Native Village of Port Heiden)</b> | Meshik Farm and Food Initiatives                    |
| <b>Susan Alexander (FWS Becharof)</b>                        | Managing Habitat                                    |
| <b>Becky Savo (Bristol Bay Borough)</b>                      | Local Emergency Planning and Preparation            |
| <b>Verner Wilson (BBNA Natural Resources)</b>                | Flexibility in Subsistence Regulations              |
| <b>Cory Cole (State Soil Scientist)</b>                      | NRCS Soil Survey                                    |
| <b>Amy Holman (NOAA)</b>                                     | Oblique Aerial Image Mapping Product/Tool           |
| <b>Russell Phelps (BBNC Natural Resources)</b>               | Economic Development                                |
| <b>Annie Fritzie (BBNA Economic Development)</b>             | Climate Resilience in Regional Economic Development |
| <b>Verner Wilson (BBNA Natural Resources)</b>                | Regional Climate Change Plans and Projects          |

## What are environmental changes we are experiencing and their drivers?

The trend is for warming annual temperatures and increased precipitation in Southwest Alaska.

*"The last three years, the Naknek River hasn't frozen enough to drive across. Last year was the first year the Kvichak River didn't freeze. Ice is thinner in some spots and absent in some spots (where it used to be)...The past three winters have been snowless, just rain and ice. The winter subsistence lifestyle has been harder for us. And then the summers are warmer."*

The rate of warming is greater than the global average. More warming is anticipated later in the century (8-11 degrees warmer); less warming is anticipated in the middle of this century (5-8 degrees warmer). There are and will be impacts to stream temperature and salmon. The amount of greenhouse gases (CO<sub>2</sub>, methane, etc.) released into the atmosphere in the next several years will affect how much warming we experience later in the century. The warming we experience between now and the middle of this century is unlikely to be affected at this point.

It is projected to warm faster as we go into the future. Southwest Alaska is shifting from an annual average below freezing to an annual average above freezing. We expect a shift to many more days of above-freezing temperatures in November and April resulting in a longer summer. The shift from below-freezing to above-freezing could be dramatic; similar to a mountain environment, in which vegetation changes from lower to higher elevations, mostly because of a few degrees of temperature change.

Precipitation is anticipated to increase, with higher increases in August and September. Snowpack is anticipated to decrease, especially in coastally exposed areas in Southwest Alaska. At some of the highest elevations, snowpack might increase as precipitation increases, but at lower elevations the precipitation is anticipated to

fall as rain. Southwest Alaska is anticipated to become transitional (between snow-dominant and rain-dominant precipitation), but not rain-dominant (like Southeast Alaska).

Sea ice in the coastal Bering Sea is anticipated to decrease in the future. The models do not capture the dynamic nature and variability or show increases in winds/storminess. The ice-free season is lengthening; there is more potential for increased storm intensity, so the kinds of storms may be different. The Polar Jet will bring up more subtropical systems, so it will be more like England or Norway.

As the region becomes warmer and precipitation increases, water availability could be limited by increased evaporation. There is more potential for fog to form. With the loss of permafrost, the environment becomes more desert-like: infiltration makes less water available for plants.

In each river system, seasonal water level change depends on how much it is fed by glacial melt versus ground water. If the system is at least 20 percent glacial fed, then water temperature is likely to be fairly stable. Warmer weather will cause a longer period of glacial melt, which will offset the influences of air temperature on stream temperature.

## Ocean waters are becoming more acidic.

*“Walrus are declining. What is happening to the ecosystem beneath the ice? They really depend upon the ice. Plankton, other organisms are also linked to sea ice. Ocean acidification may alter the food chain. The Y-K Delta King salmon example is chilling... Food security into the future is not just an Alaska issue; with the human population increasing, it is a global issue. Global changes will put more pressure on the Bristol Bay fish resources. Ocean Acidification is a big concern if it is going to impact salmon.”*

The underlying cause of ocean acidification is the global increase of carbon dioxide (CO<sub>2</sub>) going into surface seawaters. More CO<sub>2</sub> in the water decreases the pH of the water, causing it to become more acidic. Globally, saturation states are extremely variable; there is no one global pH number. Alaska and Antarctica have the lowest pH levels because colder water naturally has lower pH values (i.e., higher acidity). There is some research globally that looks at ocean pH levels since the Industrial Revolution; it shows that ocean acidity is linked to the amount of CO<sub>2</sub> in the atmosphere and the industrial forms of carbon emissions.

The pH is naturally lower in Alaska waters, and Alaska will continue to have more CO<sub>2</sub> absorption because 1) colder water can hold more carbon dioxide; 2) because of Alaska's position on the global ocean circulation belt, Alaska has old water that is already holding a lot of CO<sub>2</sub>; and 3) there is a high degree of freshwater input into Alaska's marine environment.. It can change from year to year, over time. There are many different chemical variables linked to other variables (e.g., temperature, salinity, nutrients, oxygen, biologic presence, freshwater input), all of which affect the level of ocean acidification, locally.

Species and populations living in Alaska waters have already been exposed to many of the pH values that have not been seen in more temperate waters, so they are already adapted to harsh conditions relative to more temperate regions. Biologists have determined that the effects of the ocean chemistry on species depends where they are in the water column and where they are in their life cycle. Species at depth (mostly below 100 meters but varies by location) have been exposed to lower values for some time (pH is lower the deeper you go). The values are changing more near the surface, so there is some shoaling, moving higher into the water column. The implications of ocean acidification could be huge for small organisms at the base of the food pyramid (e.g., krill and Copepods), affecting the whole ecosystem.

Looking into the future, the Beaufort Sea is already below the pH threshold for certain species to build shells and reproduce; the Chukchi Sea is close at this time, and in the Bering Sea, the species that need to build shells may be unable to survive ocean conditions around the year 2020. However, different species will have different

thresholds. There are likely to be some species die off where the organisms can't survive. Many species will have a harder time living. There may also be species shifts if the species can move to new areas, or if they are outcompeted in their current environment.

Sea ice is a barrier for salmon to move north, and during cold years fewer fatter salmon and warmer years have more but skinny salmon.

"I've noticed in the last two years a significant change in the quality of the fish. Early fish coming back are small. Subsistence fish have a lot more worms in the belly. This year, took a count, when we took our subsistence fish, the bellies of the smaller sockeye didn't have as many worms in the belly. Last year's fish were significantly poor, to the point where we were discarding them because they weren't acceptable."

Salmon are highly migratory and prefer a range of temperatures. Research is now finding that sea ice is a barrier for salmon to move north. There is a pool of cold water in the ocean formed by melting sea ice. The southern extent of the cold pool changes from year to year depending on the amount of sea ice (less sea ice means a smaller cold pool). With the exception of salmon, fish at the bottom of the ocean (halibut, cod, Pollock) and midwater fish avoid the cold pool of water. Salmon in surface waters are less limited by the cold pool in their movement north.

In warm years, salmon move farther north (but still south of the cold pool). Salmon from Oregon and Washington are migrating up to the Bering Sea at different life stages, and juveniles of all five species of salmon have been found as far north as the Chukchi Sea. This was the first year there has been a salmon fry observation in the Chukchi area, Mackenzie River system. It is possible for salmon to migrate further north in the marine environment, but Sockeye salmon need big lakes for freshwater, and there are not many systems that have that large lake structure. With climate warming, river water in the northern landscape may be lost by infiltration through thawing permafrost. There might be enough mosquitoes to sustain the salmon but will there be enough prey for them to eat? Research also shows that the timing of the ice retreat affects the quality of salmon prey, and therefore the quality of the salmon. During cold years, salmon are fatter and have better meat than in warm years.

Erosion along rivers and coastlines is accelerating and causing problems.

"We have seen stronger storms with destructive winds, but haven't had bad floods for a couple of years. Our natural seawall of ice is no longer there to protect the shore. In winter time, there has been less nearshore ice or ice in the Bay to protect the land from storms, so we see more erosion."

The coastal erosion observed in northern regions of Alaska is caused by large tides and changes in sea ice formation and duration. In Bristol Bay, erosion occurs primarily through "slump blocking," in which unconsolidated sediments (earth that is not stuck together well) made of windblown glacial deposits are eroding from river water cutting into riverbanks and from seepage (groundwater flowing through the land to the river and sea coasts). The top layer of ground sediment is also strongly wind eroded.

Erosion is accelerating; more as been observed in the last few years than in the last 15 years. Three years ago the ground was frozen; during spring melt, the water went into the rivers and did not get into the groundwater system. The last three years, the Bristol Bay region has had warm winters, rain in the winter and little ice, so the water table has risen. With the added water flow, the land starts sliding around (called 'mass wasting'). Seepage can be observed along coastal bluffs; orange sediments (rust) reveal where groundwater is seeping out of the land and that the water table is above sea level. Freeze-thaw cycles cause mini-landslides, which erode sediments further, then tides wash them away. Erosion can carry trees and other debris with it (called 'woodcutting'). The bluffs are moving back more rapidly than the lower areas, and coastline erosion is causing

turbidity in the Nushagak and Kvichak Rivers. The deposit of eroded sediment is changing the marine ecology where it is being deposited, but how it is changing is complex. There are dunes and flats building up off the Bay.

## Climate change is impacting subsistence, industry and Refuge management.

*“At the Refuge, we have been monitoring tree swallows. This year they arrived so early (everything was shifting up by about a week) that we almost need to change our monitoring schedule.”*

Species have been shifting in timing and location, causing a mismatch in resource management regulations and the timing of the harvest. Birds are arriving and nesting earlier, leaving later, flying higher, continuing on their journey rather than stopping in some places. Plants have been blooming earlier (three weeks early this year). Caribou herds used to be far more numerous and go through the middle of villages; now they are smaller and their range has shifted. Anglers in the Refuge noticed blackfish die-off in some of the warmer lakes, which were warmer this summer than ever measured. New species are showing up in greater numbers in some areas, such as salmon sharks in Togiak.

Berry production has been highly variable over the last few years. All berries this year were ripe at the same time; usually, the salmon berries are ripe first, then other kinds of berries, and cranberries ripen last. In Levelock, cranberries and blueberries were everywhere this year, but there were no salmonberries. The amount of snowpack and rainfall significantly affects berries. In snowier winters, berry production is much higher.

Species are shifting in the Bering Sea and Gulf of Alaska. In warm years, we see juvenile pacific cod and sable fish from the Gulf of Alaska into the Bering Sea. This year we saw more predators (e.g., Humboldt squid) in the Gulf of Alaska. Halibut are such long-lived species, growth rates have dropped off significantly relative to what they used to be. Halibut have not been growing as large as they used to, which reduces overall reproductive success. Larger females have larger and better eggs; bigger fish make more money for fishermen.

The arrival of the sockeye salmon has been late by about a week for the past two years, but three years ago they came early. The Bristol Bay fishery is one of the most studied fisheries, but run variability is too much to predict with great accuracy. That unpredictability adds costs to commercial fishing. Processors are losing money without being able to predict the timing of species in fisheries; either they are waiting too long or out but missing the run. That cost affects how much fisherman get back and the shelf price of the fish. Every temperature degree means more ice for packing fish, which adds costs.

## How will these changes affect us? What do we most want to protect?

### The essence of who we are as a community

*“The loss of sea ice means a loss of opportunity to go out on the ice and hunt for seal, to pass along the knowledge of how to hunt seal, and of the opportunity for the seal to pass along spirit to your family...It’s a big deal as a young man in your culture; getting your first moose or caribou is a profound event in a young man’s life and that opportunity is going away.”*

Participants described the essence of community as family, food and togetherness. They talked about the resilience of being together: “We do as much together as possible – I think that’s really important. Family togetherness is resilience. How we maintain who we are and where we’re from. Kids go to work with us, everyone has meals together, hunts, steam baths, together every day. We encourage others to guide and chide our kids.”

## What is at risk and what we want to protect

“The sustainability of our communities is at risk. Big cultural changes have happened already, and climate change can amplify those negatively or positively, provided that our youth still have reason to be here. Climate change issues are going to be dependent upon the people who are here.”

Participants talked about the need to protect their culture, self-reliance, traditional knowledge and skills in the face of climate and technological change. Cultural losses include language, traditional foods and harvest techniques, and certain kinds of traditional knowledge (e.g., weather predictions). Environmental changes are happening so fast that traditional knowledge is becoming less effective as predictive information, and is being lost. Cultural and subsistence traditions are being lost to the cash economy and the lifestyle it brings. Subsistence practitioners do not always earn enough to support their subsistence activities; people are not always sharing anymore. Some people get an education, work jobs, but there can be a sense of working to survive with a subsequent loss of culture because of time restrictions (job requirements do not allow employees to be away on the land for long time to do their subsistence activities). “Because the economy is tougher here, parents are working multiple jobs and don’t have the time to spend with their kids like they used to.” Communities are concerned about kids becoming screen-addicted and substance-addicted.

“As it becomes cheaper to process fish in a foreign country, we see processors here in Bristol Bay not coming together to work in Bristol Bay; we are seeing that economic contraction. But there is an opportunity for smaller, specialized more producers, processors and markets.”

Economic development and the creation of sustainable, locally-based job opportunities are also important to residents to keep people in communities. Retaining local ownership of fishing permits and increasing local access to storage infrastructure could help locals distribute the harvest locally/regionally. Local permit holders used to gift a portion of their catch locally and were successful in both the cash economy and traditional economy. Participants talked about needing less heating fuel in warmer winter weather, so at least those costs might go down. With sky-high prices, grocery store foods are not feasible for many families. People are able to grow more food in gardens with the warmer temperatures. More people are gardening and building greenhouses, but making the change in lifestyle from subsistence to agriculture brings cultural challenges.

*“If we get a small fish run or our moose/caribou population gets smaller, if we don’t get involved with agencies to make sure that subsistence is protected, it will get taken away from us. We need to protect our way of life for our kids. We get sport hunters in here; we get outside people who want to take the resources. If we are caretakers of the land, we have to fight to keep that. With social media, kids are on computers all the time. We have to make sure they get out to do subsistence and learn from Elders. We’re always in fight mode, we fight to keep what we have and to continuously tell agencies what we have, what it’s like to live here. They don’t live here; don’t know what it’s like. But we’ve been here for thousands of years.”*

Some are concerned about threats to subsistence resources (e.g., salmon, caribou, walrus), which are the bedrock of culture, economy and ecosystems in the area. Subsistence resources and the timing of when they are available for harvest is changing. There is concern that fire hazards might affect migration patterns. Regulations are not always keeping up with changes in habitat, wildlife species or the necessary adjustments in subsistence activities. Agencies are struggling with challenges related to the timing of their surveys. Subsistence users are sometimes in situations of weighing eating against complying with regulations. Harvest technology is changing. With less snow and ice, hunters have to go out with boats and four-wheelers more often, instead of snow machines. “Snow and ice are how people get around. It is our means to get places. It powers our economy, and now our traditional routes are no longer safe with the rivers not freezing.” Residents are concerned about damage to the tundra and other landscapes as people use new technology or are forced to

use four wheelers to access resources that are now further away or that can no longer be accessed on snow. Families with transportation have more options to move up- or down-river to harvest seasonal greens, berries, etc. For game hunting, it is often necessary to go further away from the village (i.e., caribou herds used to come through the villages but stay farther away now). Subsistence now requires snow machines, four-wheelers, boats, gas and other equipment that must be paid for from the cash economy.

Participants discussed erosion and coastal flooding threats to village sites, public infrastructure, and harvest areas. The river bank in Naknek has receded 30 feet in 40 years. Several communities talked about the need to move infrastructure such as a runway, wastewater lagoon, roads, homes and camps, etc. "In Dillingham, erosion at Snag Point has started to threaten the sewer. They estimated 100 years before erosion would significantly impact the wastewater lagoons at Cape Seweroff, but we might have to relocate the lagoons in the next 10 years. Building a seawall might slow it down with sheet pile walls, but that is an Army Corps of Engineers project." Participants are also concerned about soil contamination from development. The proposed (open pit) Pebble Mine is a threat to the health of the land and subsistence resources, "I had to become an expert in all aspects of being a miner just to know the possible impacts to that way of life." In Port Heiden, residents have chosen to take over contaminant cleanup from a former military site in addition to outside-sponsored cleanup, "PCBs, petrochemicals, solvents, pesticides were all dumped where we harvest berries. But we decided to do it ourselves because you never do as good a job in someone else's backyard as you do your own – that's the way of life."

## Our starting goals or guiding principles in this time of change

"Our kids are Natives; we are trying to instill in them that they are a living culture and worthy of protection."

- **Maintain the environment and our culture.** "Land is not only part of our soul; it's what literally feeds us: berries, caribou, fish. We must maintain the environment to we have those things. Our goal is to still be here. We eat the berries, the caribou, the moose, the fish – being able to conserve those resources, maintain clean water for fish habitat – that's what we talk about is that we are still here. That's our goal."
- **Be proactive rather than reactive and crisis-driven.** "It's relationship building. It's the historical trauma that has happened in each region...there's a lot of people who do not trust, so information is withheld. You have to build the relationship with people first. You need to not tell us how to live here. We need to tell you how we live here and then you can listen and tell us how you can help."
- **Build relationships and work together.** Before an agency comes into a region, they need to ask how they can be helpful, listen, and build a relationship. Regional organizations, like BBNA, can give help agencies understand how to work with tribes and communities in the region. The regional agency knows who to call for whatever issue needs to be solved, as well as how to work with people in smaller communities to do what needs to be done.

## What can we do to navigate climate change and meet our starting goals at the individual, local and regional level?

### Priorities for Addressing Climate Change

"If there is not enough money to take care of these problems, then funding isn't the solution."

Participants discussed their priorities for addressing climate change, which included community infrastructure and services, economic development, as well as education and research.

- Reinforce the sea wall In Togiak.
- Develop a micro-grid based on renewable energy. Partner with the UAF campus in Dillingham and Naknek to extract salmon oil to burn for energy and reduce dependence on diesel.
- Improve airport security to keep drugs and alcohol out of our villages. Substance abuse is linked to environmental/climate change and disruption of our culture.
- Provide education about what the climate and environment might be like in this region in 10-20 years. Bring in people who currently live in an environment like that who can offer information about the species they live on (i.e., teach how to trap and cook beaver).
- Conduct more research to understand how stocks might be impacted by climate changes, in order to figure out how to address changes. Is there a way to enhance habitat and change natural variability through technology?
- Keep our youth in Bristol Bay: provide training, jobs and local hiring. Build capacity towards getting our youth into research, monitoring, and get youth involved with management agencies.
- Provide education and internships or similar opportunities to involve young people in understanding and adapting to climate change, (e.g., Alaska Youth for Environmental Action (AYEA), FEMA emergency response internship program. Youth (grades 7-10) are often the primary subsistence providers for their families.
- Provide cultural education so kids can understand and maintain the lifestyle of their ancestors and where they came from. Keep the oral history and make it available to people.

## Natural Systems

*“No matter where you come from – that land where you come from describes who you are.”*

- Local observations for Storm Forecasting. Storm forecasting is sketchy in much of Alaska due to lack of data. The National Weather Service (NWS) is taking steps to improve the data available, including providing ways for local observers to submit a storm report of wind, high surf, coastal inundation/flooding, or damage on the NWS website: [www.weather.gov/anchorage](http://www.weather.gov/anchorage)
- Tools for Flood Communication. The State of Alaska is creating color-indexed maps of communities to show where floods would reach at different surge levels. Data are being collected to create new maps and improve existing maps. Local observations can be submitted for the maps using the LEO app. The ANTHC LEO network is on Apple and Google Play. View a webinar and protocol for the tool at: <http://diggs.alaska.gov/sections/engineering/profiles/coastal hazards.html>
- Erosion Monitoring. Stakes for Stakeholders provides community-based tools to measure coastlines by looking at the topography of the beach. A baseline measurement is done to determine the seasonal envelope of beach change. The State gives a two-day training, helps participants collect baseline data, and gives communities tools to measure and upload their data on an ongoing basis. Measuring coastline changes allows researchers to estimate when erosion will affect community infrastructure and provides baseline data that can be used to get funding for disaster/hazard mitigation projects. Tools include:
  - The Emery Rod uses two rods, a marker and a compass to take measurements; it is as effective as a GPS system.
  - Stake ranging and time-lapse photography is also used to measure the distance between the stake and the coastline/bluff edge. Cameras provide good storm imagery.

- DGGs is working on: 1) building a baseline archive of where shorelines have been, adding baseline datasets to their tools; 2) adding post-storm datasets; and 3) establishing more community-based observation sites.

“This year was our largest halibut harvest since 2006. I don’t know if it’s correlated to a change in water temperature. BBEDC recently purchased small devices that could attach to gear and monitor water temperature. This year we did it on a voluntary basis but we are talking about making it mandatory in future.”

- Bristol Bay Water Temperature Monitoring. Cold-water species do not fare well when water temperatures are warmer than 55 degrees Fahrenheit. Better water temperature data for the Bristol Bay region will help us manage our salmon better. WALCC, BBNA, BB Heritage Land Trust were all partners in building a water temperature data set through community-based capacity-building projects to collect and report data. Community partners are doing their own monitoring in areas where there are data gaps; fishing lodges were added as partners this year. Monitoring protocols have been developed and the water quality program is now an occupational endorsement through UAF. Training is available with little to no cost.
  - The data reveal a great deal of variation in fish habitat in Cook Inlet and Bristol Bay. The healthier and more diverse the habitat for salmon, the better their chances are for survival. Specific locations have been identified as more vulnerable to climate change than others.
  - Adaptation strategies to increase resilience for salmon habitat:
    - Collect local information
    - Identify sensitive areas for conservation
    - Reduce non-climate related habitat stress: improve stream-side vegetation for shade; maintain groundwater connections; maintain wetlands for water storage; maintain/restore fish passage to thermal refugia
  - Next steps: better manage the data collected on a regional level, work together better with all partners, and better understand regional patterns to identify the vulnerabilities and strategic actions.
- Carry out the ‘Right Science’
  - Be clear about research questions/objectives. Focus on research that supports regional or local control of resources. Acknowledge the value of services, not just dollars.
  - At the local level, identify common goals and community questions. Include Traditional Environmental Knowledge (TEK). Start by listening. Trust is key. At the regional level, report on trends, identify and respond to common needs and goals.
  - Regularly report research back to community members in terms of what it means to them. Use layman’s terms and include elders. “I just went to a genetics workshop, and I wanted to talk back to them in Yup’ik!” Present science research findings at community meetings or other conferences where there is a mix of scientists and laypeople (e.g. ACTEM, AFE, WAISC).
- Potential research priorities:
  - Science that supports the vulnerability assessment of key subsistence resources; identifying highly productive areas; local involvement is crucial to identify priorities. (BBNA, LCCs)

- Local information about systems that support subsistence salmon streams. Measure/monitor water quality elements that would affect salmon, e.g., temperature, flow, high sediments. If the river waters are warm, will the salmon that come or try to come be affected by the heat?
- Integrated understanding of salmon behavior in salt water and in fresh water. Researchers also do not have very good juvenile escapement data, which will tell us how many fish are leaving our rivers.
- Establish baseline measures and structure for water temperature monitoring throughout Alaska.
- Investigate whether there is acidification within freshwater river systems, similar to what is observed in ocean water.
- Nearshore sensors are needed to establish a baseline and document change in the pH of the water. Could pH sensors be put on marine mammal collars (e.g. seals, whales)?
- It would be helpful to find/develop a way to get community feedback on storm events that is faster than the LEO network.
- Community index maps would be very helpful for planning. If you don't monitor you don't get on the "radar map" for possible funding.
- As Refuge management plans are updated, managers are prioritizing the monitoring and research needed to better understand climate changes on the Refuge, which changes Refuge managers have some control over, and how to deal with them.
- Standardize to get baseline measurements across the state. Continuity, consistency and standardization are needed to be able to compare with other data. Develop transferable protocols that can be standard for tribes, agencies, etc. Offer incentives to follow protocols. Provide training, use consistent protocols that include community outreach and feedback. Regional networks are an opportunity to standardize measurements, consolidate protocols, and feed in to management questions that a Refuge might have or that an IGAP program needs.
- Connect community knowledge with scientific community:
  - Get youth involved in research projects; talk to science teachers. Kids will share what they've heard from their parents and grandparents, and ask great questions. Integrate measurement and community observation programs into the school curriculum; work with local college representatives, school districts, science/culture camps, the Junior Ranger Program.
  - Involve elders in scientific observations; they know local knowledge, traditional weather patterns and can accurately predict weather. In the Bristol Bay region, work with the Bering Sea Elders Group about ice seals and BBNA for TEK in general.
  - Make sure citizen researchers: 1) clearly understand that protocols and consistency for using equipment is important to ensure the data can be compared to other data, 2) which data are being collected and why, because 3) data collection requirements depend on how the information will be used.
  - The Local Environmental Observer (LEO) network was developed to help record TEK reports of changes from normal environmental phenomena. The data coming out of LEO needs to be managed; not all of the observations are unusual sightings. The US EPA created the LEO app, which can be set to upload observations whenever it connects or starts up.
  - Improve cellular service in the Bristol Bay region. Bandwidth is too limited in many places to use these apps (2G instead of 3G).

## Emergency Response

*“Sometimes it’s hard to get people to take it seriously because we are resilient Alaskans and we want to just do it ourselves. But we haven’t had the kind of storms that we are starting to see.”*

- Put together a personal emergency preparedness kit with items such as: cash, computer, kids, pets, water, food, camping gear, survival gear, water, boots, socks, raingear, rifles.
- Download FEMA App (weather advisories, emergency preparedness resources, etc.) (each person)
- Improve the rural community communication network for emergency response and information sharing (GCI, BBNC)
- Increase regulatory and funding flexibility in preparing for rapid responses to natural hazards and emergencies (FEMA, Denali Commission, military affairs)
- Utilize tools for communities to anticipate and respond to emergencies and natural disasters:
  - Small Community Emergency Response Plan (SCERP) (p19 of Toolbox 3 in the handouts)
  - FEMA has free training and assistance and **many** tools to help communities be better prepared; some specifically for Federally-recognized tribal entities (e.g., tribes will be able to go directly to FEMA for a disaster declaration if it is specific to the tribal area and not part of a larger region for which the State of Alaska would request a disaster declaration). Contact Ramona VanCleve, FEMA Tribal Liaison for more information.
  - BBNA is completing Hazard Mitigation Planning for all BBNA tribes for access to FEMA funding. There is a cost-share, which can include 638 funding and in-kind services.
  - IGAP can be used to support this type of planning.
- Rely on local foods for food security.

## Public Infrastructure

*“It would be way less expensive for us to bring the whole village to Mexico for the winter and just come back in the summer. A charter for the 747 is nothing compared to keeping a village alive for eight months in the winter.”*

- Carry out coastal erosion mitigation activities such as erecting enforced walls or other measures in erosion-sensitive places (e.g., Naknek is on the edge of a bank, right next to the river is a Russian Orthodox gravesite) (US Army Corps of Engineers, BBNC, FEMA, BBNA, tribes)
- Move tank farms away from the coastline. Make this a priority in FEMA Hazard Mitigation Plans; it is eligible for competitive funding from FEMA. Frame the funding application narrative to replace with improved/diversified infrastructure. Work with tank farm owners: FEMA will ask who owns it, and it is important for owners to understand their responsibilities in case of a spill.
- Identify new/alternative technology or approaches to providing physical infrastructure and utility services that might provide needed services with less cost and more mobility, such as:
  - Innovative solutions for clean water that require less funding, equipment, energy, required training; e.g., treating wastewater at the house with a simple UV-treatment instead of expensive and difficult to maintain water plant (from EPA or ANTHC). (Village Safe Water Challenge)
  - Investigate ways to utilize salmon oil to produce energy. (BBC, BBNA, tribes, US DOE).
  - Microgrids for energy security and lower costs.
  - Grow Alder brush for biomass pellets; would require pellet stoves. (villages)
  - Work toward 100% green energy and use the local waste stream to generate electricity and heat; e.g., instead of burning shipping pallets (from the processing plant) at the landfill; hook up a wood burner to the school and use them for heat and hot water. Peter Pan converted their plant to use

- fish oil to offset electricity costs. Dillingham could use wind generators, solar panels, and biomass to power the local grid with diesel as backup. (REAP = Renewable Energy Alaska Project)
  - Increase building efficiency (e.g., super-insulated demonstration home in Dillingham).
- Community Relocation in Alaska communities due to erosion and flooding is complex, with differences in the nature of the problems communities are facing and in the culture and responses of the individual communities. There is no standardized approach that will work for every situation, but leadership and community cohesion is crucial for success. The general approach has been to 1) understand the situation in a particular community; 2) document response actions taken to date; 3) identify next steps. In Alaska, response has been slow and challenging because planning takes a long time, agency collaboration has been slow and complicated by the mission/procedural limitations of each agency, and response options are very expensive, particularly for the small populations relative to Lower 48 communities. Response options may include:
  - Moving buildings and infrastructure in a threatened area of the community away from the threat
  - Protect in place by building protective infrastructure (e.g., sea wall)
  - Partial or total community relocation. Choosing a new village site can be challenging: the least expensive, most physically secure site may not be viable for the community due to cultural reasons, traditional use, or transportation costs.
- Some communities/people consider seasonal relocation (during winter) a viable strategy.

## Health and Culture

*“In 1,000 years we want to still be here, with these same values, same culture. For us that’s a sustainable food system, an economy. Anchorage has 72 hours’ worth of food. King Salmon has about 72 hours’ worth of food. Port Heiden has about two weeks’ worth of food. If the planes stopped flying, where would we be? We need sustainable local food systems adaptable to our local environment.”*

- Provide local food-sharing options.
- Create a wildfoods app to help get more people out on the land.
- Meshik Farm and Food Initiatives. As a response to high shipping costs, a changing climate, and the need to make more healthy food available, the Native Village of Port Heiden started a farm (2014); they are now cultivating a garden and raising reindeer, pigs, chickens and rabbits. A salmon processing plant is also in development. “Everyone contributes: elders watch the reindeer, kids get food for the reindeer and bottle feed piglets; everyone is helping. We put all our stuff on Facebook, websites, Instagram, and created a food movement for our people. Our kids are really excited about it. We’re remembering our subsistence practices. A woman from Africa told us how she harvests fireweed...helped us remember that.”

*“We are making a huge effort to talk to people about this because it’s empowering, and we have so many community benefits from it. But agriculture is not easier than subsistence or buying food shipped in from outside. It’s a lot of work and a lot of personal work. People have to believe in it. If they’re not going to believe in it, they’re not going to help, and it’s not going to work.”*

- Community gardens, farms and farmer’s markets may help meet local food needs, but agriculture also involves challenges:

- Marrying agriculture and subsistence means managing a major agro-ecosystem to maintain genetic diversity. Agriculture could introduce invasive species, disease, blight, other challenges (i.e., how to keep shrubs out of critical berry producing habitats?)
- Agriculture and herding is hard work and requires a time commitment; people might not be interested in doing it. Experimentation and training required to see what grows and how best to manage herds in local environment.
- Agriculture and herding requires financial commitment: High tunnels can extend the growing season for crops but have a cost to build and may require heating or ventilation. Animal husbandry requires veterinarian services, possible fencing and other equipment that must be maintained. In production-level farming, workers have to be paid a competitive wage. A community garden requires volunteers, equipment, and grant funding.
- Agriculture reduces the mobility of a village, which could present challenges to subsistence and culture (villages used to be nomadic, mobile, had fish camps).
- Utilize resources to learn about community gardens, farms and farmer's markets in this region:
  - NRCS can do soil testing and help plan for gardening/farming
  - Someone at UAF is looking at winter wheat.
  - USDA paid for two classes (on mushrooms and gardening) in Dillingham in 2016.
  - Talk to others who are already doing it:
    - High tunnels are starting in Levelock.
    - Igiugik is already growing their own vegetables and chickens. They use waste from the salmon plant for fertilizer, and sell their produce to the lodges.
    - Dillingham is growing vegetables. A gentleman in Dillingham grows vegetables in a high tunnel in the summer. During the harvest, he lets people come in and take what they want.
    - Tyonek used grants to fund high tunnel community gardens and grow enough surplus produce to send it to CIRI in Anchorage.
    - Nikolski has a year-round greenhouse.
    - A farmer in Dillingham flies his produce to Manakotak and Togiak in his cub.
    - A gentleman sells berries from Dillingham on the Togiak airstrip.
    - The Bristol Bay Borough land held for public use (mostly around Naknek and King Salmon, reserved for infrastructure). The school has a new greenhouse, which could create jobs. Naknek has a commercial greenhouse that hires residents in the spring and will be expanding food production. Many residents get CSA shipments; some have greenhouses.
- Reindeer herding may help meet local food needs, but domestic reindeer mixing with caribou is a concern for the FWS because of threats to wildlife from diseases from animal husbandry. Keeping caribou populations in check requires aggressive management. The FWS might help with herd management to protect sensitive areas. Caribou harvest requires being able to migrate with them, and getting to the herds is challenging, especially in winter with low snow cover. Regional corporations could support better reindeer herd management. Association of World Reindeer Herders/International Centre for Reindeer Husbandry: <http://reindeerherding.org/>

“Today's technology is making kids unable to live off the land like we used to. Kids are less aware of their surroundings, and they are not participating in subsistence. Kids are eating more grocery foods rather than subsistence foods. The subsistence harvest takes money to do (snow machines, access etc.). The motivation for working becomes more materialistic – to earn money. It used to be to create a better life; now we use all

the money for transportation. Today there are assistance programs, exposure to other culture, but it's through the Internet so they are playing games... Adults that were sent out of the communities also don't know about culture."

- Maintain our subsistence:
  - Provide training for individuals in fixing equipment used for subsistence.
  - Utilize traditional and other resources that are not currently being used, e.g., ground squirrels, raspberries (unclear how indigenous they are to the Bristol Bay region, but they grow well).
  - Work with the BBNA Natural Resource Department Subsistence Program, which helps residents work with the Resource Advisory Council, Board of Fish, and Board of Game, and a variety of councils to improve policy regarding subsistence. BBNA does not have all the answers but knows who to call to get the answers.
    - The Alaska Migratory Bird Council (AMBCC) is working on changing season dates for birds; it is difficult because bird season dates are tied to four treaties that must be modified as birds come earlier and leave later. this. The Bristol Bay Region Migratory Bird Council, YKC (Yaquillrit Keutisti or "Keeper of the Birds") gathers to talk about migration patterns, caribou, moose, freeze-up, etc.
    - BBNA is working on how to change subsistence hunt season dates to recognize the fall hunt as subsistence harvest (currently the subsistence hunt is in spring and summer, September hunting is considered sport). Because it is a dual management area with both State and Federal rules, it is more complex with special actions and emergency orders, putting in requests to State and/or Federal subsistence boards. Usually requests are granted based on the needs of the people.
    - The USFWS In-Season Manager can extend the season within the Refuge, but must follow procedures that take time and obtaining various approvals. The Refuges have some degree of control over Federal season dates and bag limits, but there is also a State system; both State and Federal systems require time and getting approval from various people. Other resources for changes to season dates and bag limits: BBNA, USFWS subsistence biologist, RAC.
  - Get involved in local boards and advisory committees; attend meetings and talk about regulatory changes to resolve fish and game issues.
    - Bristol Bay Regional Advisory Committee (RAC) for federal regulations
    - Department of Fish and Game (ADF&G) and local Advisory Committees (e.g., Nushagak, Kvichak, Togiak, King Salmon, Naknek) for state regulations.
- Adjust hunting and fishing seasons, bag limits and resource access regulations as needed to allow the subsistence harvest to adjust to changing resource distribution and timing. Work with the appropriate agencies to give local managers more authority to adjust regulations to respond to changes and local management needs. (USFWS, ADF&G, BBNA Natural Resources, Subsistence Regional Advisory Council (RAC), Denali Commission)
  - For example, variability in winter snowfall has affected hunting access and berry production; allowing greater harvests in high snow years (if the populations can cope with it) will help meet local food needs.
  - Community quotas to allow designated hunters rather than individual harvests for subsistence would be more effective; not everyone has the equipment or opportunity to hunt anymore.

- To respond to caribou overpopulation, BBNA talked with stakeholders, went to the Federal Subsistence Board and worked with the Nushagak Peninsula Advisory Council and the Togiak National Wildlife Refuge Manager to increase the harvest for locals. This example can be applied to other species.
- Utilize BBEDC programs to help local people fill out loan and grant applications, purchase permits, equipment and training.

## Other Economic Activities

*"It's hard to separate a conversation about climate change from economic stability. Economic stability is the foundation for cultural creativity; just considering climate change isn't enough."*

- NRCS Soil Survey. USDA NRCS does soil analysis and mapping for the state. Soil maps provide composite baseline data of physical and chemical soil properties. The NRCS State and Transition Model can be used to understand what will happen to existing vegetation with different management practices. These can be used to understand how suitable land is for septic, farming, roads, landfills, village expansion or relocation, and any other engineering projects; permafrost sensitivity; susceptibility to erosion and possible remediation; the likelihood of finding gravel or sand; vegetation and water availability. [www.websoilsurvey.nrcs.usda.gov/app/HomePage.htm](http://www.websoilsurvey.nrcs.usda.gov/app/HomePage.htm)
- State Soil Scientist Cory Cole produced a documentary called "Between Earth and Sky" about how climate change is impacting soils on the North Slope.
- NOAA Oblique Aerial Image Mapping Product/Tool. In May 2016, NOAA took 39 photos of coastline around Red Dog Mine's port, the from Wales to midway down the western side of the Alaska Peninsula, and the western side of the Kenai Peninsula. The photos can be viewed using the [NOAA Coastal Imagery Viewer](#). NOAA encourages everyone to take a look at the photos and send feedback on the utility of the images and where additional imagery should be collected in 2017 if resources are available.
  - General Information: Nicole Kinsman, Alaska Regional Advisor, NOAA NGS, [nicole.kinsman@noaa.gov](mailto:nicole.kinsman@noaa.gov), 202-306-5736
  - Technical Questions: Chris Sloan, RSD Chief, Requirements Branch, [chris.sloan@noaa.gov](mailto:chris.sloan@noaa.gov), 301-713-2670 x176
- BBNC Economic Development Strategies. As an ANCSA Corporation, BBNC has been directed to make money from the resources we have. BBNC's role is to partner with village corporations and tribes to revolve issues in the region together, rather than curing problems. The BBNC Board has a 'fish first' policy, so that whenever we look at economic development we think about how it would affect fish first. Current BBNC projects include:
  - Quarry development in Dillingham (with Choggiung, Ltd.) and possibly in Chignik Bay area.
  - New drone technology with K2 Dronotics: testing its effectiveness as a land survey tool. K2 surveyed King Salmon using drones; they cut survey time in half at a cost equal to a surveyor.
  - BBNC will acquire native allotments so they are not sold to non-Natives if the allotment has land development potential (e.g., tourism), resource development potential, or would be valuable for conservation purposes (e.g., presence of unique salmon species). BBNC has no policy yet for shareholder lot acquisition programs (e.g., if land is going underwater) but they are looking at it.

- Working with the US FWS: Igiugig Village approached BBNC about selling some of their land to a Heritage Trust within Katmai NWR. The USFWS only buys land from willing sellers and is interested in acquiring native allotments only within Refuge boundaries. BBNC also bought the concession in Katmai NWR, allowing shareholders to get back to their traditional territory and work with Federal government in managing and preserving that land.
- BBNA is using economic development, transportation and energy planning to address economic and climate resilience.
  - BBNA recognizes that climate change will affect subsistence, commercial fishing, tourism, and other economic activities in the region, so is developing a climate mitigation strategy as part of the Regional Comprehensive Economic Development Strategies (CEDS): <http://www.bbna.com/our-programs/economic-development/>
  - BBNA does energy benchmarking for non-residential facilities in communities and partners with the BBNA Transportation program to do FEMA pre-mitigation planning (the most common transportation issue affected by climate change is road erosion).
  - BBNA works with the Small Business Administration (SBA) to help people start businesses and prepare for potential disaster.
- Diversify the economy to address outmigration to areas with more education and job opportunities. If new jobs require more than a high school education, improve educational opportunities for residents. Economic diversification could include: fishing industry, tourism, schools, healthcare, federal and state agencies, building a regional jail, new uses for the closed U.S. Air Force base in King Salmon. Local hire in federal and state management's science programs. Internship opportunities. Accepting TEK experience as analogue/substitute for formal/education in agency hiring (USFWS, NPS)
- Because of the Molly Hooch Act, village schools are closing; families are moving away. It is less of an issue in Dillingham because the regional entities provide jobs. Naknek/King Salmon lost the Air Force base, but the infrastructure around it brought more people. Some suggested providing more housing to encourage people to live in the region, and subsidizing the costs to equal Anchorage housing prices.

## Leadership and Communication

*"The reason we are all here is because we want to do more. We need to work together. If we could have done it by ourselves we would have done it."*

- Individual and small community-level action is important for making change:
  - Involve everyone and give examples of progress and success, "There aren't people who are going to believe in what you're doing, not at first. But get started, use social media, talk to people and everyone jumps in... Nothing seems to build momentum like a few successes."
  - Coastal resilience classes through college.
  - Public safety training: firefighting equipment, medical, etc.
  - Involve youth in planning discussions (village corporation, local schools, FEMA)
- Work through the BB regional partnership at the regional level: Bristol Bay Area Health Corporation, Bristol Bay Housing Authority, Bristol Bay Native Corporation, Bristol Bay Native Association, Bristol Bay Economic Development Corporation, UAF Bristol Bay Campus)

*"We've planned projects and ideas to death, to the point where the Board of Directors told us to quit planning and go do something with all these plans."*

- Use the Bristol Bay Vision listening and visioning project, which laid out a long-term regional plan from each one of the villages. It has been used in other planning documents (e.g., BBNA CEDS, Lake and Peninsula Borough Comprehensive Plan). It was a very powerful way for people to express what they want for their future rather than somebody else coming into their community telling them how their village is going to look in 20 years.
- Effectively communicating information will require a number of methods; e.g. a Bristol Bay-specific listserv for climate change issues; Facebook group; website; mailings
- Regional climate resilience activities through BBNA:
  - Marine Mammal Traditional Ecological Knowledge (TEK) Study uses GIS mapping to help understand different migration patterns and how elders have seen them in the past.
  - BBNA also provides regional IGAP network coordination and assistance. About 25 communities work with Sue Flensburg, BBNA Environmental Manager on projects like water temperature monitoring and erosion.
  - BBNA received BIA funding for 16 village leaders to attend the Northwest Climate Conference in November in Washington, which brings together people with the USEPA and other agencies to talk about climate change, start a regional dialogue.
  - BBNA is working with the US FWS to bring elders and youth together to talk about climate change issues at a Regional Natural Resources Summit in 2017. The summit may be held during RAC or another meeting where youth are able to see the processes in place. It would be a weeklong discussion of different topics that would culminate in a regional strategy.
  - BBNA plans to apply for BIA funding to create a regional climate adaptation plan.
- Develop a Waterway Safety Committee (LCCs, LEPC's, nonprofits, industry (incl. fishing), coastal communities, AKMX)
  - Draft vision statement: WSC works to promote safety for all: maritime industry, coastal communities, and all other waterway users by enhancing collaboration and improving understanding among all parties.
  - Resources needed: host for teleconferences, funds for AIS data, travel funds, trainings, funds for coordinator, office/meeting space, Federal Agencies for trainings (USCG).
  - Activities: 1) Updated marine vessel traffic maps. 2) Vessel of Opportunity / Local Response capacity, supporting local capacity development. Giving local residents the training so they help their own communities. Hazwoper training. Begin developing routing recommendations, standards of care. 3) Enhance collaboration between maritime operators and local communities
  - 2016-2017: expect an introductory phone call between the region and the USCG to initiate the discussion of the WSC at minimum. 2017-2018: Develop a five year plan; Identify membership and lead/coordinator (and funding for a coordinator); Identify geography for the WSC. (Bering Strait – Shumigans and out the chain); Identify partner agencies who could support the WSC
- Create Tribal Conservation Districts (TCD's)
- Work with the Bristol Bay Heritage Land Trust to conserve resources.  
<http://www.bristolbaylandtrust.org/>

- Provide culture camps/ environmental education for stewardship of the environment: Involve Village councils, Cities, regional entities (e.g., BBNC), State and Federal Agencies, others. Offer educational credit (e.g., high school students receive two college credits). Include topics like:
  - Air/breath
  - Food (subsistence + others)
  - Environmental awareness (water cycles, etc.) bring out camping, subsistence hunting
  - How to produce weapons and fully utilize resources (e.g., Kodiak shot a trouble bear then used the guts etc. to make a rain coat).
  - Culture and language; e.g., Igiugig has a Yup'ik language immersion program in their school and created a book on traditional plants and remedies (Naut Cungcaun – Ila Igyaraamek: select indigenous plants and their uses in Igiugig, Alaska). Through these projects, they are trying to record and pass on all the knowledge from the two living elders left in Igiugig.
  - Leadership and communication skills
  - Water and waste, including infrastructure
  - Regulations and standards; involve State and Federal Agencies and clarify who has what responsibility (e.g., ADEC, US EPA).
  - Environmental science; involve FWS, NWRS, NPS, communities, etc.
- Improve communication among professionals, researchers, community managers, etc. (ATCA, BBNA, UAF-BBC, Other BBs?)
  - Build trust. Provide ongoing/cyclical, back and forth communication.
  - Listen to hunters and elders as well as regional leaders. Communications with elders who are not bilingual may require translation services (concern about mistranslations).
  - Researchers and agencies can leave a little space in their funding requests for a community meeting or even a whole day to talk with people, explain what the project is, the data being collected and why. Often this doesn't happen because of a lack of time/budget for it.
- More regulatory flexibility and co-management of land and resources among agencies and local/regional organizations. Provide flexible response and a forum for addressing changing wildlife availability and hunting access (ADF&G, BOG, USFWS, NPS, tribes, BBNA)
- Create a frequently updated directory/guide to which agencies are responsible for what (standards, implementation, operation, regulations, grant funding, partners for different topics, etc.). For example, every community is dealing with waste treatment in its own way. There are various levels of compliance requirements. Often people don't see the larger picture of the roles of all entities and how they interact. Meeting compliance requirements may also be a financial problem, which requires more grants.
- Increase funding and access to resources for climate change response.
  - Designate an entity or group to bring these discussions and specific asks to our leadership in Western Government. (tribe, BBNA, BBNC, BB Assembly, municipalities, LP Assembly)
  - Pursue funding to continue efforts (local leadership, any entity, VOAD, NGO, state/government agency)
  - Hire a lobbyist.
- Develop a way to keep this work and these discussions going, e.g.,

- LCC model: define narrow enough issues under the umbrella of climate change to allow individuals/entities to do their specific thing; use meetings to make sure all are moving in the right direction.
- Champion model: Designate one individual, entity, or a steering committee that takes responsibility for communication and coordinating efforts.

# Northwest Arctic Regional Workshop Summary

December 7-8, 2016 | Nullagvik Hotel | Kotzebue, Alaska

## About the Project

"We are faced with lot of challenges and opportunities. I hope we use good sense in facing them both. In every challenge, there is a kernel of opportunity."

The project has been initiated by a growing group of partners, including the Aleutian Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), Western Alaska LCC, Arctic LCC, the Aleutian Pribilof Islands Association (APIA), Kawerak Inc., Maniilaq, the Qawalangin Tribe of Unalaska, and the Bristol Bay Native Association (BBNA). The mission of the three coastal Alaska Landscape Conservation Cooperatives (LCCs) is to improve the quality and availability of data, information and tools that can help resource managers, local decision-makers and communities better respond to the changes and challenges facing coastal Alaska communities.

This project involves a series of conference appearances and workshops in four hub communities across Western Alaska where project partners, communities, and resource managers can dialogue about what stakeholders are already doing to respond to coastal threats and help refine informational products and tools. By fostering effective partnerships and communication, these workshops and project products aim to better equip resource managers and communities to respond to the challenges and opportunities of climate change, supporting healthy habitats and resilient communities. The workshop was intended to help participants better understand regional changes, challenges and adaptation strategies, and to foster collaboration among communities, agencies and other stakeholders in the region.

Visit the facebook page [www.facebook.com/northernlatitudes](http://www.facebook.com/northernlatitudes)

## Workshop Program

"Environmental change has always been taking place. What's happening now is much faster and on a larger scale than we've seen before. There's a lot of uncertainty. Climate change is going to cause a lot of stress. It's going to lead to food insecurity. We can already see how changes in caribou has caused conflicts between local and non-local people, and that might get worse. It's not easy to pick up and move to someplace new. It's not easy to learn new ways to obtain, process and prepare food. People are adaptable, and have adapted to environmental change. Rural Alaska has traditional knowledge, very strong and extensive family and social support networks, deeply rooted connections to land and cultural values."

The workshop featured presentations and discussions about environmental changes and their impacts, tools and examples of near and longer-term strategies and actions that can be done individually, locally and regionally to respond to climate changes. Throughout the two-day workshop, participants discussed these environmental changes, their impacts and potential adaptation strategies and actions in small groups. The main themes of these discussions are summarized on the following pages.

| Speaker                                       | Topic                                  |
|---|--|
| <b>Jeremy Littell (Alaska Climate Center)</b> | Climate Change Overview                |
| <b>Lee Cooper (University of Maryland)</b>    | Ecosystems and Climate Change Overview |

| Speaker  | Topic   |
|--|---|
| <b>Natalie Monacci (University of Alaska Fairbanks)</b>                              | Ocean Acidification and its Biological Impacts                              |
| <b>Yuri Gorokhovich (City University of New York)</b>                                | Coastal Geomorphology of the Kotzebue Sound Shoreline                       |
| <b>Seth Danielson (University of Alaska Fairbanks)</b>                               | Currents and Oceanography in Kotzebue Sound, Erosion and Coastal Dynamics   |
| <b>Bill Carter (Selawik National Wildlife Refuge)</b>                                | Fisheries Research at Selawik National Wildlife Refuge                      |
| <b>Henry Huntington (HPH Consulting)</b>   | Integrated Ecosystem Research, Sea Ice for Walrus Outlook, A-OK, and SEARCH |
| <b>Adrian Gall (ABR, Inc.)</b>   | Seabird Surveys in Kotzebue Sound   |
| <b>John Seigle (ABR, Inc.)</b>   | Nearshore Fish Studies in Kotzebue  |
| <b>Trevor Haynes (Wildlife Conservation Society, University of Alaska Fairbanks)</b> | Fish Sampling in Nearshore Lagoons working with the National Park Service   |
| <b>Ramona VanCleve (FEMA)</b>  | Personal Preparedness, FEMA Tools for Communities                           |
| <b>Edward Plumb (National Weather Service)</b>                                       | Storm Forecasting and Monitoring, DGGs Inundation Maps Tool                 |
| <b>Lauren Divine (Aleut Community of St. Paul Island)</b>                            | BeringWatch Citizen Sentinel Program, DGGs Stakes for Stakeholders Tool     |
| <b>Alex Whiting (Native Village of Kotzebue   Kotzebue IRA)</b>                      | Ice Seal Research and Subsistence Impacts                                   |
| <b>Macy Kenworthy (Kotzebue Arctic Youth Ambassador)</b>                             | Arctic Youth Ambassadors Program  |
| <b>Millie Hawley (President, Native Village of Kivalina)</b>                         | Subsistence Regulations   |
| <b>Susan Georgette (Selawik National Wildlife Refuge)</b>                            | Subsistence Policy Flexibility  |
| <b>Maija Katak Lukin (former Maniilaq, now Park Service)</b>                         | Shared video ' <i>Silavut Atlanuuraqtuq: Our Changing Weather</i> '         |
| <b>Hanna Atkinson (National Park Service)</b>  | Inupiaq Place Names Project   |
| <b>Sally Russell Cox (State of AK, DCCED)</b>  | Alaska Climate Change Impact Mitigation Program                             |
| <b>Heather Stewart (Agnew::Beck)</b>   | Planning and Agencies   |
| <b>Davin Holen (Alaska SeaGrant)</b>   | Implementing Resilience and Adaptation Plans                                |

## What are environmental changes we are experiencing and their drivers?

"What we learn over the centuries is from nature. What do the animals eat? We eat that. I think about relocating. I don't want to move to where the snow is. I want to stay here. Nature tells what it's going to be, and that's the way it is."

“You really can’t count on things being the same anymore. This year it’s cold; three years before that it was really warm. In cold weather, it is safer to travel on the ice, but piped ground water systems might freeze.”

### Temperatures are increasing, with the potential for dramatic changes in the Arctic.

Northwest Alaska has already warmed 2.5 times faster than the average for the whole planet. If that continues, by the 2080s, most of the daily high temperatures from April through September will be above freezing. This is about two months’ increase of the warm/growing season. These are very big changes, very fast. Sea ice responds quickly: by the 2090s, sea ice coverage will decrease by 50 percent or more. Less ice means more warming, means less ice. Ice with snow on it reflects most of the light. It becomes a positive feedback loop; even if we stop carbon emissions, there will still be warming.

What does it mean for this region? These changes are the difference between deep Ice Age conditions and not being in an ice age. Trees could grow. Each of the species that we depend on will have different responses; some may do better, others worse. Scientists try to use models to predict the consequences of these changes, but models are not enough. Reality is more complex; local observations and input are key to testing the models. Scientists want to hear about changes and why they matter, so they can think about the science in terms of things that matter to people.

### Ecosystems are changing, but much is unknown about how they are changing.

This year, the ice over the Arctic was the second lowest ice extent on record. Much less is known about what is happening with the ecology and biological changes. In the Chukchi Sea along the continental shelf, scientists anticipate shifts because there is increased carbon dioxide (CO<sub>2</sub>) in the water. Currently, there is a lot of algae growing under the ice, and because the ice is shallow along the continental shelf, that algae falls to the seafloor and feeds a rich community of organisms. In the future we anticipate less algae, fewer bottom (benthic) species, and other species changes. Species that depend on the benthic species will decrease; some others will increase. Some species migration has been observed in the Arctic. There have been documented northward migrations of populations in the Bering Sea, but it is not uniform across all species. Some species are physiologically limited and will not move. Sometimes species have been in a place already, but it was never documented.

### Ocean acidification is causing biological impacts, particularly to shellfish.

Excess carbon dioxide (CO<sub>2</sub>) is absorbed by the ocean, resulting in ocean acidification (the pH is rising). Scientists have been measuring acidity in ocean areas around Alaska. Shellfish are affected by the increase in pH; it is also affecting finfish. Models can help predict when the pH levels are harmful for various species. If the pH is too high, shellfish put too much energy into maintaining their shells and do not have enough energy for growing, reproduction, sustaining life, etc. Ocean acidification is one stressor affecting species, along with changes in temperature, salinity, nutrients, oxygen, photosynthesis, respiration, freshwater content. Alaska Ocean Acidification Network: <http://www.aos.org/alaska-ocean-acidification-network/>.

### Erosion and coastal processes are altering the Kotzebue Sound shoreline.

Erosion and coastal processes are altering coastlines through wind, wave, storm surge, coastal flooding, ice run-up, and sediment transport. In some places sediment is being carried away; in others it is being deposited. A storm surge model factoring only the wind shows that over the course of about four days, a 15-mile per hour wind in the Bering Sea generates about six to seven inches of storm surge along the Chukchi coast, 500 miles north. Adding tidal action and other factors, the storm surge could be more or less. The storm surge drives ice run-up and flooding.

Erosion processes are effected by several ongoing changes. Temperatures are warming and permafrost is thawing. The sea level is rising an anticipated 1.5 to 2 feet by the end of this century. There is reduced sea ice cover and a longer season of waves and increased fetch, meaning that the amount of open water between ice and shore is greater, so waves can get larger and more powerful. There are more storms in the Arctic (increased storminess) and changes in wind direction, which can have a greater impact than a change in wind speed because different wind directions may have different wind strengths. Hydrological cycles (the flow of freshwater) is also changing; stream flows are potentially less peak discharged, with a longer discharge spread out over a longer period of time.

### Permafrost thaw may be affecting freshwater species.

A permafrost thaw slump happened in 2004 on the Selawik River about 25-30 miles upriver from sheefish spawning ground. The 2010 estimate of sediment was equivalent to 35-story building (the size of a football field). In 2012, about the equivalent of a 20-story building slumped into the river. In 2016, it has started to stabilize. Permafrost thaw slumps have happened in the past: there is evidence of previous slumps in the area 200 years ago and 1,000 years ago, but they may be increasing now. The Selawik River permafrost thaw slump is currently the only major slump, but a much smaller one has been noticed on the Tag River.

Selawik National Wildlife Refuge has been studying the Selawik River slump to determine whether it impacts sheefish. The youngest sheefish males come back to spawn when they are 10 years old. Researchers started collecting data in 2011, and are now starting to get data on the sheefish spawning in the river. Sheefish spawn in freshwater, but spend their lives in Kotzebue Sound; freshwater and saltwater systems are related. Differential snowpack and rain events are also affecting the timing of spawning and food availability.

A similar situation is being studied with the Alaska Department of Fish and Game (ADF&G) on the Kobuk River to see if impacts are localized or regional. The Refuge is studying the influence of nutrients resulting from permafrost thaw, e.g., algal blooms. As permafrost thaws, it releases more and different nutrients into the system, and the temperatures of the past few years have been warm enough to support harmful algal blooms. In the Kobuk, salmon dieoff from harmful algal blooms has been observed. Permafrost thaw may allow saltwater intrusion into Selawik or Kobuk Lakes, which would change those systems. Also, if the water melts faster, it changes the way it erodes.

### Integrated Traditional and Western Science in the Northwest Arctic Borough

"These projects bring together some of the 'right science.' These are the kind of projects people want."

Participants shared examples of integrating local research, traditional knowledge and research projects being done by the scientific community. For example, the Northwest Arctic Borough subsistence mapping project collects aggregated data (so it is not possible to see where individual subsistence hunters and their areas are) that could be used to plan shipping routes around subsistence areas by incorporating it with local community knowledge and agency-collected data.

"Last year the ocean didn't freeze until January; we didn't get any bearded seal because of the ice conditions. This year, it only just started covering over in December. We got some bearded seal, but we only had a small window to go and catch them. We usually get 80-100 bearded seal in our community. That's what we rely on. Every home is never without seal oil. If you don't practice it every year, the uncertainty and insecurity of not being able to harvest the bearded seal – it's very unsettling, and it causes a lot of anxiety. So this year when we caught it, I was elated when they brought one home."

**Seal studies:** The Native Village of Kotzebue has done several studies of seals in partnership with research institutions. Kotzebue IRA has studied bearded seals and ring seals, and learned previously unknown

information. These projects were the first to live-capture bearded seals and tag them. With the tags, we can see how deep they dive, how long they spend at depth, what they were doing there, the time of day, and the differences in these things between males and females. The studies show that some of the seals move up to 5,000-6,000 miles (the same as going from Kotzebue to Washington DC). Adult ring seals were staying up north; young seals were going to the ice edge of the Bering Sea. Seals would go to the same place in the Bering Sea during the winter. Kotzebue IRA partnered with the University of Fairbanks (UAF) Wildlife Toxicology Lab to study nutrients and contaminants in seals donated by subsistence hunters. This was a good way to train graduate students to work with communities. Kotzebue IRA partnered with the University of California (UC) Santa Cruz to research bearded seal hearing and response to noise (from seismic mapping, pounding rigs, etc.). Kotzebue IRA collected samples to study the genetics of seals, trained dogs to find seal dens, and continues to work on harmful algae blooms and their relationship to marine mammals.

**Integrated research of Kotzebue Sound:** The Northwest Arctic Borough (NWAB) commissioned a group of scientists to look deeper at what is going on in Kotzebue Sound. The Borough talked to communities to understand what kinds of things they want to know, and will do an integrated research project, mostly offshore, to understand what is going on with the whole system. What is it that matters to communities and how? How do environmental changes affect the people who are here, what they are doing and why? How do we do research without interfering with community activities? Involving people in data collection is one way.

“Communities are where we are because of access to important resources; this is particularly important to for folks from outside the region to understand.”

**The Kotzebue Sound coastline:** Yuri Gorokhovich (City University of New York) led a study of the coastal geomorphology of the Kotzebue Sound shoreline. Based on a comparison of coastline changes since the 1950s, the study found that erosion is slow in the area and that the Kotzebue Sound coast is about 50 percent wetlands and 35 percent gravel/beaches. Most areas of human habitation are where the most subsistence resources/species are. The study also revealed that coastal protection measures can also create vulnerabilities. A 2009 Army Corps of Engineers project moved sand from a nearby beach to protect another area in front of a school. The beach where the sand was taken from became more vulnerable to erosion after the sand was removed.

**Currents and ocean dynamics:** Seth Danielson (University of Alaska Fairbanks) led a study of currents and oceanography in Kotzebue Sound. Satellite-tracked drifters were used to understand the trajectory that, for example oil might go if spilled, or boat wreckage if a ship wrecked at sea. The data were used to create a model that takes into account wind speed and direction, currents, temperature, and salinity.

**Nearshore fish:** John Seigle (ABR, Inc.) and Alex Whiting (Kotzebue IRA) led a series of nearshore fish studies in Kotzebue. The goal of the project was to get an inexpensive nearshore survey that anyone could do locally, annually, in communities around Kotzebue Sound. The team wanted to describe nearshore fishes in the area and the environment in which they were doing the sampling. In August and September 2015, the research team did beach seine fish sampling and collected data on water temperature and salinity. The surveys filled a data gap on nearshore fishes in Kotzebue Sound. The nearshore environment is important to fish breeding and the invertebrates that the fish live on. The survey produced a lot of data using a seine net (a lot of ‘bang for the buck’), and the team found that as the fish got older their diet changed.

**Coastal lagoon systems:** Trevor Haynes (Wildlife Conservation Society, University of Alaska Fairbanks) conducted fish sampling in nearshore lagoons working with the National Park Service. The last naturally functioning coastal lagoons in the world are in the Arctic, but they have not been studied much by scientists. Lagoons are important culturally, as places where both freshwater and saltwater fish go to grow, and are home

to many different species of birds and marine mammals. Lagoon systems are highly variable and represent over one-third of the Arctic coastline. Because the coast is also important for shipping, there is a desire to understand how the coastal lagoon systems function, as well as how they can be resilient to some of these changes. The study uses scientist research and traditional knowledge to understand the baseline and how future changes might impact the lagoon systems. The research team talks with people as much as possible to help guide their research. Local traditional knowledge provides a time scale for the data that is collected, which is especially important as lagoons have not been studied by scientists for long. Traditional knowledge also provides an understanding of how the research can be valuable to communities.

**Kotzebue Sound seabirds:** In 2016, Adrian Gall (ABR, Inc.) led a pilot project of boat-based seabird surveys of Kotzebue Sound. The research team worked with local vessels, local people, and used local knowledge to survey birds, marine mammals and oceanography. The research team measured temperature and salinity using hand-held meters and assessed the feasibility of using mooring data. This data was compared to satellite data, historical data for the region, and what the team learned from talking to people in the region. Findings from these data sources were similar, but there were some differences in the findings and measurements. There is also a temporal mismatch: the research team did surveys in June and July to observe marine mammals as well as birds, but the historical data is from September and October. In future, the team would like to collect additional data in September and October to compare it with the historical data. The surveys found that there are more birds along the capes in June, and more birds everywhere in July. There is a greater concentration of birds out where oceanic water interacts with the Sound.

## How will these changes affect us? What do we most want to protect?

“We’ve survived all these years because we’ve had some kind of comfort in the food. We’ve adapted over time. My parents have gone from sled dogs and snow machines to jets. They have seen huge changes in their lifetime. We can handle the change. We have a strong history and culture of folks that have adapted. Hopefully we don’t lose that resilience.”

### The essence of who we are as a community

“Our sense of security is in our sense of people, of community, that people will always come back, and that the land provides.”

Participants described the essence of community as “a sense of support, that you belong; you can’t buy it.” They talked about the security and cultural sustainability that comes from harvesting subsistence foods, as well as the need to adapt to changing conditions while sustaining the essence of Inupiat culture.

### What is at risk and what we want to protect

“There are a lot of things I want to see the same, but the identity of the Arctic is changing, and our values are at risk... Sustaining our ability to live off the land, it defines the Inupiaq people. But maintain the values that sustain us, carry that respect for the environment. That same value will be there, the style of teaching and learning is doing-based, and sharing of stories, physically getting out there and walking like they did, being mobile like they did and sharing openly like our elders do.”

Participants are concerned about the cumulative effects of climate change, including threats to freshwater access, infrastructure, and access to species as their timing and distribution changes, as well as the impacts of international policies that affect the Arctic.

"I think we identify our culture – what we do and what we hunt – and adapt it to a different source of food. Keeping our identity – how we hunt – regardless of what we hunt. We still want to share, cooperate, avoid conflict, those kinds of things. The idea of identifying our culture as specific to a certain type of animal is limiting."

Participants talked about the risks and opportunities of changing species, as some resources become more plentiful and others diminish. For example, an increase in crab would be welcome, but life without seal oil is unimaginable to many residents. Moose and beavers have come into the area recently, but culturally, these new species do not necessarily replace the resources that people are used to: in Bristol Bay, moose is preferred over caribou, but it is the opposite in the Northwest Arctic. People are adapting anyway: while the caribou were down, people harvested salmon and beaver, which were abundant. In Barrow they started fall whaling quite a few years ago, which they never did before.

"The beach grass we use for baskets and mats are not the same as the new ones coming in. We don't know how to work with these new grasses."

Residents are already seeing changes in plants, such as new grasses and different insects. Berry production has been highly variable and unpredictable in terms of where, when and how much. Where marshy areas are drying, cloudberries have been in decline. Unusually warm weather increased the availability of blueberries in some areas, and other areas have had an abundance of salmonberries. Participants noted that larger birds (e.g., woodpeckers and seagulls) are now coming to the area, and that other species are in decline or less available for harvest. Tomcod do not come to the villages anymore; changing ocean water temperatures might be delaying the freezing of the lagoon so much that the tomcod are already out of the lagoon by the time it freezes. Participants also noted that caribou and sheep have been in decline because of an increase in ground ice (freezing rain and rain on snow) events. Participants also expressed concerns about invasive species, such as non-native plants that are seeded following airport construction and at mining sites, as well as potential impacts to resources and marine ecosystems from increased shipping traffic.

"Passing on the culture is done through teaching our children to hunt. With risks to people's lives, we also risk losing the knowledge they carry. It isn't safe to go out and hunt, so these practices aren't being passed down. The urgency to go out and get caribou as quickly as possible because of declining herds means we don't take the children out. Passing along traditions of hunting uguruk is increasingly unavailable when you can't go out onto the ice. This means that my children or grandchildren won't necessarily get this knowledge passed to them."

Participants' primary concerns revolved around uncertainty: in resource availability, timing, and ability to access the resources. They talked about the increasing difficulty of planning subsistence leave and the logistics associated with hunting and harvesting in advance, having to take advantage of very small windows of time to harvest the foods they rely on all winter, and how harvest seasons may need to change. Some environmental changes are affecting residents' ability to process resources once harvested; e.g., rain makes it harder to dry meat. Residents are also concerned about their ability to pass their cultural traditions to future generations, as hunting practices, technology and other aspects of lifestyle change in addition to environmental changes. Participants also talked about the risk of life; some people in the region have died in recent years because of unsafe conditions like thin ice.

"The price of gasoline and the economy interact in this way: when the price of gasoline was high, many people did not go out to harvest wolves and bears. Now we have high predator numbers, which are impacting the sheep, caribou, and moose. Nothing is impacting the predators. There hasn't been a reaction by regulators in that arena. It's all been towards humans. People need to think a little differently about that."

With the unpredictable weather patterns, accessing hunting grounds and harvesting areas is getting harder. Uncertainty increases the need for more scouting and more constant communication; people have to take more risks to go further and to new locations to access resources. Thin sea ice means that it is not safe for seal hunters to go out; it also means they have to go farther to find the seals. Changes in caribou migration routes that require longer travel combined with high gas prices significantly increase the cost of caribou hunting. Although warmer temperatures might benefit residents by lowering the amount of heating oil needed to get them through the winter, many villages have few jobs relative to the number of people who live there: "In a village of 600 there are only 30 or 40 jobs, and this is a huge challenge as well."

"We see less snow and more rain in August. Less snow means that the tundra is drier, so tundra fires are a larger concern. Snow and the watershed is what we watch for. We have never worried about Devils Lake drying up, but it has reduced three to four feet. This is extremely concerning because we don't have another water source. The amount of money it would take to get more infrastructure built is extensive. The entire watershed drains into the lake, so less snow means less water."

Participants expressed concern about threats to infrastructure from permafrost thaw, wildfire, sea level rise, storm surges, and erosion. Warmer summers and warming prior to the rainy season have created dry grass and increased the danger of wildfires. Ice breakup, fast currents, and ice can cause erosion in a short amount of time. However, when the ice breaks onshore it does less damage than it used to because the ice is thinner and weaker. Participants are concerned about extreme rain and wind upriver, as well as when it comes downriver. River system changes are also affecting fresh water access because most villages are pumping river water for drinking. Participants were also concerned about losing archaeological sites to erosion: "Erosion is washing away 10,000 years of history."

"The more money put in infrastructure, the more it gives a false sense of security. Look at Venice and New Orleans. A thousand years ago, Eskimos were always living in sync with natural phenomena, moving with the seasons; that was the answer to all fluctuations then. Now you don't move, you have the schools."

Discussions included talk about the options of remaining in existing locations where resources have been most abundant and infrastructure exists, in some cases moving to a new village site, or using modern technology to become more mobile. But because processes such as erosion and permafrost degradation are not included as hazards under the Stafford Act, a presidential disaster declaration cannot be made to access FEMA disaster relief funding to address them.

"At the end of the airstrip, about 200 feet over, the island [Kivalina] is threatening to become a little 500-foot island because of erosion on the lagoon and ocean side so close together; it's going to become two islands. We live and breathe the evacuation road as a community and trying to work with whoever is willing to help us."

"I don't see anything up there about how it affects people physically, psychologically, spiritually, for security. I know some young people just think, "There's nobody who's going to help us. They don't care about us. My life is going to end soon, so I'm just going to live the way I want to." A lot of our people don't care anymore. They don't want to move from that island because that's their home. They're going to wash out to the ocean."

Community clinics are essential infrastructure that residents want to protect, as well as freshwater supplies, sewer and water lines, landfills, fuel facilities, roads and other means of accessing community facilities. Participants noted that each place has its own specific challenges. For example, In Kotzebue, bridge and airport flooding, reduced snow for fresh (drinking) water, and storm surge threats are major concerns. In Selawik, primary concerns are threats to bridges and potential saltwater intrusion into freshwater sources. Buckland is concerned about floods and storms, and in Deering, the road to the airport is washing out. In Kivalina, much of

the village, the airport and other infrastructure is at risk from storm surge and erosion. Participants discussed the need for evacuation routes.

“A river change causes a change in ‘the roads of our people.’ Our highways are our infrastructure; they are being re-routed around us.”

Participants are concerned about changes in the rivers, as some channels are filled in or re-routed because of erosion or beaver dams. As rivers become shallower, barges and skiffs have difficulty navigating them. During summer, these changes in the rivers disrupt access hunting grounds and other subsistence areas, transportation, trade, and may also impact fishing. Making improvements to physical infrastructure in a community becomes difficult to impossible if barges cannot get to the community. Even small channels and estuaries disrupt coastal ATV routes: Kivalina could not access berries for two years because of this situation. In winter, lack of snow and ice makes travel conditions even worse for snow machines on the tundra and other vehicles on the ice roads.

## Our starting goals or guiding principles in this time of change

“We don’t have a choice; we have to adapt. But we don’t want to adapt more than we have to. We want to slow or stop climate change so we can keep our way of life and so that people in Lower 48 don’t have to go through the changes we are going through now.”

- **A clean environment** locally, for the country and the earth; the ability to recycle locally and use things that are biodegradable. Sustainable energy to reduce carbon emissions.

“My hope would be to enjoy the resources that our area has to offer, that we have the resources to enjoy them. The way we raise our children and grandchildren is to use the same high standards our elders showed you, not to accept low standards now.”

- **Food security and subsistence way of life** is a goal and a concern. It’s who we are, part of our livelihood.

“We want our children to want to stay.”

- **Maintain our ability to make choices and keep our options open.** What’s worked for 12,000 years is people being able to make choices for themselves. How do we keep as many options as possible? Are there new options that we take advantage of? Who’s making the choices?

## What can we do to navigate climate change and meet our starting goals at the individual, local and regional level?

“Many of the communities just aren’t sure what they’re going to do. It’s hard to think 50 years from now when you have a crisis right now. People kind of glaze over.”

### Priorities for Addressing Climate Change

“Change has been constant in this area. Resilience has to do with adaptation to that change.”

Participants discussed their priorities for addressing climate change, which included preparing for evacuation in communities facing imminent danger of natural disaster, building capacity locally and regionally, using modern technology to sustain culture and respond to climate change, lowering energy costs and providing additional housing in overcrowded communities.

## Natural Systems

“We are seeing more erosion, more intense storms, and more frequent storms. Now we have the mechanism to put a number on that change; we have been able to measure how much erosion has occurred where. That measurement has enabled us to get emergency relief funding to mitigate the road system after a storm.”

- Use local observation and community monitoring programs to measure and monitor environmental changes. Because models can under- or over-predict, local observations are important to help make scientific models more accurate. Community monitoring programs that adhere to scientific data-collection protocols give communities data they can use to document changes, contribute to science, and leverage additional resources.
  - **The BeringWatch Citizen Sentinel Program:** provides a framework for a local community environmental monitoring program that is entirely community- or tribally-driven. Detailed observations are made on specific species or phenomena using words and/or photos. As the observer encounters the targets, (s)he makes a consistent detailed observation using smart phone apps (iOS and Android, the same as ANTHC’s Local Environmental Observer (LEO) program). Data are uploaded to the BeringWatch online database. Users can log in to view their community’s data as well as data shared by other users, and can network with other researchers in the BeringWatch network to look at trends/patterns and share information. BeringWatch provides training and a handbook with standardized data collection protocols for various species and phenomena. Each community chooses what is important to them to know and the protocols that will get that information. The community owns their data and has authority over them. BeringWatch is developing an app and field guide for skippers to collect data, and adds protocols from other programs to the handbook; agency support is needed to get more protocols into the system. When a new protocol is added to BeringWatch, all member communities are contacted and BeringWatch offers to share and train them in using the new protocol. Until there is a statewide standardized protocol system, BeringWatch offers a ready-made framework that is flexible enough to meet the needs of various communities, with training and potential pay or volunteer collection. <http://www.beringwatch.net/site/>
  - **Stakes for Stakeholders:** Alaska Division of Geological and Geophysical Surveys (DGGs) Stakes for Stakeholders tools measure and monitor shoreline change. They require three people (two people to measure and one to take notes) and two rulers with a string attached to them; tools cost about \$100. Two people hold each of the rulers so that the string is perpendicular to the waterline. Once the string is level, the note-taker records the numbers on each ruler. The difference between the two numbers (on each ruler) is the distance of elevation change. St. Paul does the two cross-shore profiles once a month on two beaches, and when a big storm is coming to monitor long-term erosion versus storm erosion. The DGGs data sheet is incorporated into BeringWatch, so we collect all the data in BeringWatch, export the data in an Excel spreadsheet and send that to Jaci Overbeck at DGGs, who maps them.
  - **Community Camera Project:** As part of the Local Environmental Observer (LEO) program, the Alaska Native Tribal Health Consortium’s (ANTHC) Community Camera Project uses a time-lapse cameras to show changes in local environmental phenomena. Communities can choose what they monitor (e.g., coastal erosion, marine mammals). St. Paul Island uses the program to monitor areas with high amounts of erosion. They mounted cameras perpendicular to two stakes to show changes between the two stakes; staff read and record the change in number on the stakes. Data

- are uploaded directly to BeringWatch. The cameras are free for participating communities; otherwise they cost \$190.
- **The Army Corps of Engineers** (USACE) provides technical assistance with measuring erosion. Buckland measured erosion with the USACE on the east side of the Buckland River.
  - **Weather Ready Nation Ambassador Program:** allows collaboration between the National Weather Service (NWS) and community government or business organizations to fill data gaps. NWS seeks real time tidal/buoy data and community-based observations to help improve flood forecasts. <http://www.nws.noaa.gov/com/weatherreadynation/ambassadors.html>.
- Work with schools:
    - Scientists can talk to school teachers about coming to their classes and share their work.
    - Incorporate climate change into educational programs, e.g., the scientists attending the workshop are submitting a proposal to the North Pacific Research Board to develop a module on the arctic cod lifecycle that can be taught at schools. A 2016 increase in Federal funding for culturally appropriate educational programs in tribal communities could be used.
    - Establish coastline monitoring stations at schools. Students can monitor erosion, weather, use GIS and remote sensing tools.
  - Maintain the security of data. For example:
    - When the scientists did community-based mapping in Kotzebue, they agreed not to put any data about subsistence resources in the publications where the article would be presented.
    - BeringWatch signs an MOU with every community that spells out the data ownership and privacy rights. The community chooses to keep their data private or share it. The Aleut Community of St. Paul shares their data with NOAA because it serves a co-management agreement with the agency.
    - Some apps can help protect data by allowing users to select values.
  - Continue to focus research initiatives on meeting community knowledge needs, e.g.,
    - Sea Ice for Walrus Outlook: was created to provide to walrus hunters with information about wind conditions and ice conditions on a local scale.
    - A-OK: is a program run out of the University of Alaska Fairbanks (UAF) to connect scientists and people in communities to address things that matter, e.g., with permafrost thaw filling ice cellars, scientists help figure out what people should do if they are looking to build or maintain ice cellars.
    - SEARCH (the Study of Environmental Arctic Change): was created to look at sea ice, land ice and permafrost change, adding coastal dynamics and community concerns. SEARCH is currently focusing on better communicating what is known about sea ice, rather than doing more research.
  - Continue to focus research on filling knowledge gaps, e.g., inshore data collection.

## Emergency Response

“They take measurements and take their scientific counts of birds, fish, etc. and I’m thinking, ‘Hello! I’ll be gone by the time you’re done counting the fish!’ I’m starting to label the people of Kivalina as threatened or endangered species.”

- Personal preparedness: Get specific about what you would take with you and how much supplies you will need in an emergency evacuation situation. Nothing is more important than your own health and your own welfare, so that you can be strong enough to take care of children, people with disabilities, pets, etc.

- Keep Small Community Emergency Response Plans (SCERPs) current; they outline what to do in the first few hours before help arrives in an emergency. The State provides the SCERPs for FEMA. SCERPs can also be helpful for agencies seeking local emergency management contacts. More information: Alaska Division of Homeland Security and Emergency Management [www.ready.alaska.gov](http://www.ready.alaska.gov)
- Prepare evacuation methods to respond to coastal erosion.
- FEMA Resources: FEMA is a planning, preparing, and recovering agency for specific weather events (does not include coastal erosion). For response assistance, call the Borough or the State (800-478-2337). *(Note: until April, FEMA cannot spend money without permission; it is unclear which resources are available until then.)*
  - Emergency management training: FEMA will reimburse travel and give free training in emergency management specifically for tribes.
  - FEMA disaster declaration programs: Apply for a grant (released in March/April) to write a hazard mitigation plan. If FEMA considers a project cost effective, grants are available to implement projects in the FEMA-approved hazard mitigation plan, e.g. revetments, moving tribally-owned fuel tanks away from a river edge, moving houses, elevating buildings. Tribes can get a disaster declaration without having to go through the State of Alaska. After a disaster declaration, FEMA can help fix roads and homes, provide disaster unemployment, etc.
  - FEMA jobs: Full- or part-time jobs are available to work on disaster recovery (usajobs.com).
  - FEMA Corps: Young adults 18-24 years old are hired, trained, housed, fed, and all travel paid for. They work for 10 months, learn skills, decide which skills to expand on, then get funding for further education or vocational training.
- Work with the National Weather Service (NWS) to obtain and improve weather forecasts, marine forecasts, flooding forecasts, aviation, fire, high surf advisories, sea ice forecasts and warnings. The NWS can provide information about wind strength velocity, direction, etc. to help prepare for storms. The NWS operates 24 hours a day, seven days per week; you can talk to a live forecaster anytime.

## Public Infrastructure

“There are some good things that have come out of this: new creative ways of thinking about how to do things, better technology for people and the environment, alternatives to large hard-to-move infrastructure systems.”

- Mitigate negative impacts to physical infrastructure. Collect local observations and data, and develop an updated set of strategies for communities in the region, e.g. FEMA Hazard Mitigation Plan. Projects identified in the plan will have better access to funding. Potential projects:
  - Mitigate roads at the airport and post office in Buckland that are washed out every year.
  - Evacuation road in Kivalina.
  - Moving infrastructure, although it is costly (e.g., Kivalina moved their tank farm).
- Invest in technology for more mobile infrastructure. Does resilience mean becoming more mobile or learning to adapt where you are?
- Pursue new infrastructure technologies or strategies, e.g.,
  - ANTHC has a new building and water system project in Kivalina.
  - The State of Alaska Water and Sewer Challenge is funding innovation in decentralized water/sewer systems for rural Alaska communities.
  - The Canadians recycle water.

- Energy efficiency and weatherization improvements.
- The Cold Climate Housing Research Center (CCHRC) has been testing building design and technology for affordable, energy efficient Arctic homes.
- Homes built on skids or skis.
- Improve 'communications infrastructure' to better understand these risks to the physical infrastructure, e.g.
  - Working with each community and the National Weather Service, the Alaska Division of Geological and Geophysical Surveys (DGGs) is producing color-indexed maps that show elevation above sea level within the community. A '50-year flood event' or other meteorologist term might not mean much to a person in the community, but these maps easily show the areas that would be flooded at different levels of storm surge or sea level rise.

## Health and Culture

"The Inupiaq language is an environmental language. It's tied directly to the land, the air, the oceans, the seasons. Place names are given for scientific reasons, Inupiaq scientific reasons, directly associated with our physical environment in some way or another. It's a language that needs to be used. I was fortunate enough to learn how to speak Inupiaq growing up, but I wasn't always a willing student. I learned enough to converse, but a lot of people never did learn. I learned something, so now what do I do with it? Well you talk. Use your skillset to some advantage, hopefully."

- Inupiaq Place Names Project: Place names are more than a point on a map; they include knowledge of the weather, plants and animals in that area. When people go out on the land, they are reading the land like it is their book, and they remember what they were taught about how to live on it. Place names can be used to catalog information about places, like how to travel at that place. For example, one place name means 'the place that has thin ice in March and April,' so we know it's dangerous to travel there at that time. Recording place names involves a lot of contextual information. The National Park Service has been documenting Inupiaq place names recorded in the 1950s, the 1970s, and more recently in a GIS storymap that will be made accessible to the public. We are adapting to these changes in part by keeping the place names tradition alive. We want these to be added to and spoken on the land. If a place is unnamed, we can name it for future generations.

"As an agency, how can we stick to our mission and still be a positive agent for change? How can we understand the problem and solutions in a wholistic way, with wellness, mental health, economy, and subsistence all tied together? We can't take people and economics out of the environment, and we don't have great immediate answers. At the most basic level, we can build committed and sustained relationships with each other. We can talk and understand each other, and build trust. It is important that villages and tribes have a voice in how they want to adapt."

- Broaden agency missions and increase the flexibility of land management policies to more quickly adapt to changing conditions on land management units; currently it takes 1-2 years to change federal regulations. Can decision-making move to the community level in some way?
  - Continue to focus on communication among land management agency field staff, state and federal agency leadership, and local residents to solve problems and facilitate adaptation strategies.
  - Work together to solve issues with game management regulations. It helps to have people working for land management agencies who have lived in the area for a long time, who know and

understand the local way of life. Local people can also provide information about the land and resources that helps researchers and agencies do their work better.

- Increase communication about traditional hunting and fishing practices; encourage people (including young hunters and non-residents) to follow traditional protocols. For example, locals have been working to fly people into a caribou hunting area near Kotzebue and educate them. The Kiana Elders' Council put together a flyer about hunting protocols.

"At subsistence meetings, people are saying that when the regulations were changed suddenly, people were criminalized for providing for their families."

"To have local people, people who have been here, grew up with us, managing our local agencies, who understand the rhythm of the people who live here – it goes such a long way. Giving people some level of comfort that at least at some levels they're being understood. When you have somebody who has the highest level of respect for the people who are hunters, and based regulations on their recommendations – they earn that level of trust. Everyone has equal access according to the Constitution, but if somebody can be flown directly to the migration route, they have better access than those that have to wait along the river."

- Film traditional knowledge holders demonstrating traditional knowledge, e.g., safe hunting practices, processing uguruk or other resources.
- Incorporate gardens. For example, Kikiktagruk Inupiat Corporation (KIC) has a hydroponic garden.

## Other Economic Activities

"Better than saying 'economic development' would be to say 'How to sustain our activities?' or 'sustainable.' We can achieve what we need to."

- Change to cleaner diesel and renewable energy (e.g., wind turbines, solar panels).
- Lower energy costs and provide more housing options to alleviate overcrowding in remote communities. In Kivalina, up to 21 people live in the same home. Buckland grew from 400 to 600 people in recent years, and used grant funding to weatherize and build additions to existing houses.
- Consider mineral resource development (e.g., Red Dog, offshore drilling, upper Ambler Road). Participate in those decisions: How can we mitigate them, so our environment is protected and our people are part of the decisions? Can we influence them somewhat?
- Provide future generations with a high-quality level of education.

## Leadership and Communication

"We need to find a balance: up the value of people who have survived for millennia. Give ourselves a real bright future of opportunity instead of 'woe-is-me.' I'm sick and tired of our people being a ward of the government. If we're going to save our language, we have to own it. How much are we willing to do the work? Some responsibilities we have to accept; we have to lead. For future generations, it's our time to lead with blended knowledge."

"You can want something, and it never happens. We're demanding to be involved, to be at the table. If we're not there as people who live here, in this place that policy makers are making decisions on, it's like, 'Oh we're going through this again?' Those of us who may have let things quietly go by, we are demanding to be at these different tables."

- Arctic Youth Ambassadors Program: The Arctic Youth Ambassadors Program brings together youth from different perspectives, with different goals and provides a platform for youth as decision-makers

and policy-makers. It has involved travel in Alaska, the Lower 48, and internationally. Some of the Arctic Youth Ambassadors met with U.S. senators, heads of federal agencies, senior advisors to the President, etc. There is a nomination process to become an Arctic Youth Ambassador; each Ambassador is paired with a mentor. Arctic Youth Ambassadors have social media and a website on Alaska Geographic.

“The planning process is a way the community can feel more in control of the situation and more empowered to adapt to the changes. The people I’ve worked with on these plans are some of the most resilient people I’ve worked with anywhere. Because these changes are going so fast, they need additional partnerships and assistance.”

- Alaska Climate Change Impact Mitigation Program: The Department of Interior funded four Strategic Management Plans (SMP) through the Coastal Impact Assistance Program. Newtok, Shaktoolik, Shishmaref and Kivalina did SMPs to increase community resilience to natural hazards, mostly climate-related natural hazards. Elements that are essential to successful resilience include:
  - Strong community leadership: The community led each SMP. The project funded a full-time community coordinator in each village for two years and brought agencies into working group meetings. Understanding each other is essential: it is important for people to speak face-to-face with each other and to have an interpreter at meetings. Newtok’s SMP laid everything out graphically so that everyone can read it.
  - Agency support and collaboration: Agencies were very involved; they brought resources, funding, technical expertise, a reality check for some ideas, and came up with some ideas that others did not. When you bring together people with various areas of expertise, on a regular basis, people start talking, brainstorming, and thinking about how they can collaborate and leverage resources. Interagency working group meetings are still happening.
  - Careful effective planning: Resiliency is based on relationships, so the SMPs provide a comprehensive blueprint for their resiliency process and how communities and agencies will work together in the future. They are action-oriented, with specific timelines, sequencing of actions, who is responsible, where to get funding, and alternate sources for funding. Each plan was a two-year process: Year 1 established community ownership of the planning process, identified issues and priorities; Year 2 focused on action items. Any plan is a living document, only as good as the information you have now. Things change, and a plan needs to be updated to respond to those changes.
- Establish a Kobuk River Watershed Council.

“People outside the community can’t be the people who decide what we need; that has to come from locals. It has to be people locally who go to specialists, who have to be responsive to the locals.”

- Attend subsistence meetings to get feedback about science and what hunters want to know.
- When it comes to the health and safety of the people, how can that really be expressed, so that no matter where this document goes, people will feel it? So that action can be taken before more lives are lost?
  - Bring people to the region (e.g., the Obama Climate Change Commission); involving them in helps because if they are not personally invested, nothing is likely to be done.
  - Congressional staffers need things to be communicated to them in *extremely* simple terms because they have to deal with and help make decisions on such a huge variety of things.

- A documentary video [shown at the workshop] was separated into three- to five-minute segments for each community, so that each community could use it to tell their story when seeking support from outsiders.
- Interviews have been conducted with participants at each of the Resilience and Adaptation project workshops; they will be shared through the LCC network.

“We have to own our future by taking ownership of our problems, control what we keep and what we move toward, what our new communities look like, what is worth preserving.”

- Build capacity. Institutionalize safe practices and share information about adaptation responses with other communities. A climate response is to say that communities are living with it; they are already adapting. Include information about how communities can keep aspects of their culture with that adaptation.
  - Continue to have discussions with scientists, policy experts, local representatives, etc. and share the information throughout the region. Maintain consistent, frequent and effective communication among communities and agencies. The LCCs can help connect people in different agencies, researchers, and communities, including people who specialize in bridging the worlds of science and the end-users of science.
  - Pool traditional knowledge.
  - Invest in people who can make a difference in our communities. Provide mentorships.

“Climate resilience plans are a good idea, and there is funding to do them. But there’s only one person in a community to do it all, and people who think, ‘Why should they care?’”

- Address climate change issues in various agency, community and regional plans. Try to find energetic staff who understand that the overall plan can increase successes and maintain council involvement.
  - The Northwest Arctic Borough assists each of the 11 Borough communities to complete comprehensive community plans. Many are due to be updated and could address climate change. The hunters and SAR teams have local knowledge about the areas around each city.
  - Every village also has an EPA Tribal Environmental Plan (ETEP), which is a good umbrella for finding other resources because part of the GAP grant can be used as matching funds, and labor can be used as in-kind contributions. Maniilaq can assist with capacity building through the program.