INTAROS Community -Based Monitoring Experience Exchange Workshop Report

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INTAROS

ELOKA

IARC
International Arctic Research Center
University of Alaska Fairbanks

UAF
UNIVERSITY OF ALASKA FAIRBANKS

ONE PEOPLE-ONE RIVER
Yukon River Inter-Tribal Watershed Council

By: Maryann Fidel[1], Noor Johnson[2], Finn Danielsen[3], Hajo Eicken[4], Lisbeth Iversen[5], Olivia Lee[6], Colleen Strawhacker[2]

1 Yukon River Inter-Tribal Watershed Council, Indigenous Observation Network

2 Exchange for Local Observations and Knowledge of the Arctic, National Snow and Ice Data Center

3 NORDECO Nordic Foundation for Development and Ecology

4 University of Alaska Fairbanks, International Arctic Research Center

5 Nansen Environmental and Remote Sensing Center

6 University of Alaska Fairbanks, AOK, SizoNet

Photos by: Finn Danielsen

Layout by: Emily Anderson, Yukon River Inter-Tribal Watershed Council

BACKGROUND

This workshop offered an opportunity for practitioners of community-based monitoring (CBM) and observing programs to come together to exchange experiences and perspectives. Representatives from 10 CBM programs from Alaska and Canada were in attendance. Additional participants included researchers and government officials currently involved in CBM (see attached participant list). The workshop was held at the University of Alaska Fairbanks International Arctic Research Center (IARC) as part of the Week of the Arctic activities that concluded the U.S. Arctic Council Chairmanship. Representatives from Arctic Council Working Groups, Alaska and US agencies, and the public were invited to a two-hour dialogue immediately following the workshop focusing on the use of CBM in decision-making and assessment ("Engaging CBM in Decision-Making and Assessment").

The workshop was funded by the European Union-funded Integrated Arctic Observing System (INTAROS) and organized by a host committee that included representatives of INTAROS, the International Arctic Research Center (IARC) at University of Alaska Fairbanks (UAF), Yukon River Inter-Tribal Watershed Council (YRITWC), and Exchange for Local Observations and Knowledge of the Arctic (ELOKA).

INTRODUCTION

The session began with an opening prayer in the Gwich'in language offered by Rev. Trimble Gilbert from Arctic Village. Workshop participants then introduced themselves before Hajo Eicken of the International Arctic Research Center at UAF gave a welcome on behalf of IARC and the host committee. Hajo noted that the workshop goal was to consider "how can we provide better guidance to the research community of how to support CBM work, and what are areas where more knowledge is needed."

Finn Danielsen of the Nordic Foundation for Development and Ecology (NORDECO) in Greenland/Denmark then gave a brief overview of the **Integrated Arctic Observation System** (INTAROS- www.intaros.eu), an effort funded by the European Union to extend and improve existing and evolving observing systems encompassing land, air, and sea in the Arctic. INTAROS involves 49 participants from 20 countries. Along with co-PI Lisbeth Iversen, Finn is leading a component of INTAROS focusing on community-based monitoring. Key activities will include: knowledge exchange workshops (including this workshop in Fairbanks, as well as planned workshops in Canada in late 2017 and Europe and Russia in 2018); exploring opportunities to cross-weave existing CBM programs in the Arctic with scientists' monitoring efforts; and piloting new tools in Greenland and Svalbard to support decision-making.

After introducing INTAROS, Finn then gave an overview of **Opening Doors to Native Knowledge** (PISUNA) program in Greenland, which focuses on monitoring and management of natural resources by hunters and fishermen. The program began in 2009 and is a collaboration between the Government of Greenland and communities in Disko Bay and along the coast northwards to Qaanaaq. 127 months of observations have been reported, and the work is continuing. Finn shared results from the project, which introduced a system for communities to advance natural resource management recommendations to municipal and national authorities based on their review and assessment of participants' observations (https://eloka-arctic.org/pisuna-net/ and www.pisuna.org).

PRESENTATIONS BY CBM PROGRAMS

The first session included presentations from five different CBM programs. The goal of the session was to give participants a sense of the different kinds of programs currently active in Alaska, and to introduce some concepts for further reflection based on the practices of these programs. Presenters were asked to address the following:

1. *How do you sustain the CBM activity?*

2. *Who uses the data/information generated by your program? How do they use it (for what natural resource management purposes)? Please provide an example.*

3. *Would you be interested in sharing the data/information with others beyond current users? What barriers and opportunities exist to doing so?*

The first presentation was by Mike Brubaker of the Alaska Native Tribal Health Consortium, who discussed the **Local Environmental Observer network (LEO-** www.leonetwork.org). LEO maintains a portal where individuals can post observations based on scientific, local, and/or traditional knowledge (TK), and is a precursor to a more structured scientific monitoring. LEO is based on a number of principles, including: 1) Starting local; 2) Making it easy; 3) Focusing on people; 4) Being collaborative; 5) Staying in contact. Participants are unpaid volunteers who are concerned about what is going on; they post when they see something unusual. LEO keeps observers engaged through a newsletter and also hosts conference calls. While the majority of LEO observers are in Alaska, members come from every continent. The LEO map is a collection of "signals of vulnerability," with over 700 observations logged so far. The platform is available to outside groups. Data are publically available and can be filtered by your area of interest. The information is used by community members and experts. Community members post an observation and are often connected to an expert that can help them answer questions about the issue. A researcher can also use the information to learn more about changes that people are observing. The focus on individual observers means that it exists outside of government,

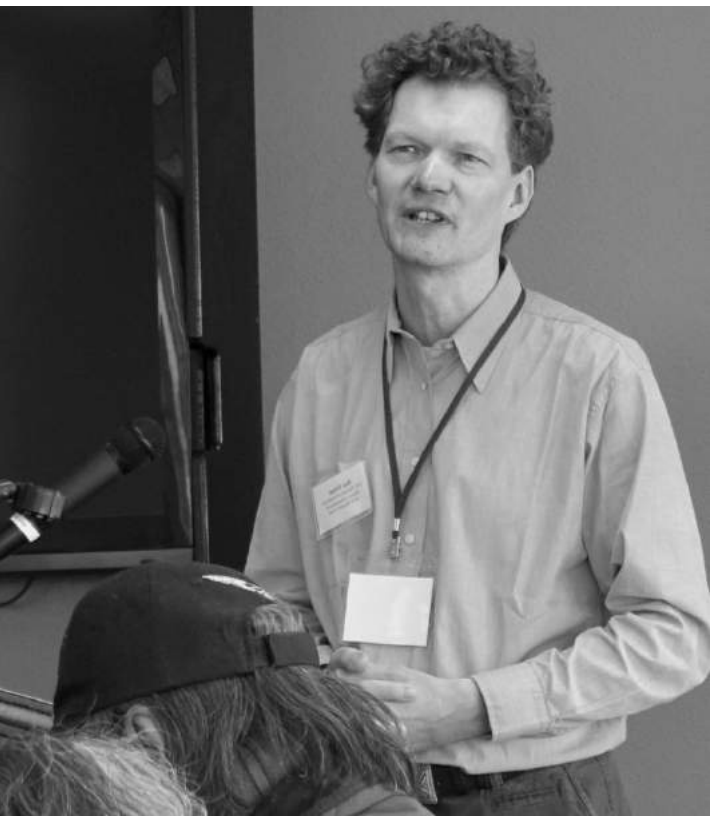
which makes it more sustainable/less dependent. Many of the observations relate to seasonality, timing of snow melt, water quality, sanitation, etc. Collectively, they are a record from which you can begin to understand the change that is happening at the community level. Noted challenges include 1.) blending knowledge and data 2.) seeing the big picture and 3.) the shelf life of 'unusual' – some events, such as berries ripening early, are only considered unusual for a few years and then people start thinking the unusual is the new normal.

Edda Mutter and Kathleen Peters-Zuray gave a presentation on the **Yukon River Inter-Tribal Watershed Council** (YRITWC- www.yritwc.org) which is a consortium of 73 Canadian First Nations and Alaska Native Tribes that reside along the Yukon River and its tributaries. The Yukon River has only one dam, and has one of the longest salmon runs in the world, with five different species of salmon. The YRITWC was initially created in response to water pollution to coordinate community clean-up efforts. Other issues of concern include mining, a decline in the salmon population, and increase in water temperatures in the river. As Edda explained: "Our goal is that in 50 years, we will be able to drink from the Yukon River." Water quality monitoring data has been collected for over 14 years and is collected at over 54 sites over mapping of seasonal subsistence areas. Data collection is based on both TK and science. All physical data is publically available at http://yukon.fieldscope.org/, and most other project data, although some sensitive information at this site is password protected. The program is sustainable because of the commitment of community members. One of the challenges is to have the data acknowledged and integrated into policy making; YRITWC data line up with data from government agencies but use different methods of analysis. Data have been shared with community leaders and have been used to inform their community planning. Data have also contributed to a Watershed Management Plan that was adopted by Alaska Tribes and First Nations in 2013. The Watershed Management Plan main objectives are to maintain 'water quality, water quantity and river flows … substantially unaltered from natural conditions'. At its essence, it represents a coordinated declaration by a diverse group of Indigenous peoples of their sovereign right to clean water to sustain the health of the people, fish and animals, but more work is needed to implement it at the community level.

David Griffith from the University of Idaho's Center for Resilient Communities presented on **Community Based Observing Networks** (CBONs- www.conas-ak.org) and the **EyesNorth Research Coordination Network** (goo.gl/rXupjN). Eyes North is working on identification of best practices for community-based observing (CBO) in the Arctic and beyond. The network is looking at the role of CBO in facilitation of search and rescue and Arctic maritime security. CBONs focus on interoperability with other kinds of observing networks. This was articulated in a best practices workshop held at the University of Washington in 2016. CBONs are "nested" structures where community observations can be linked to instrumented data from other sources, with an emphasis on "quality observed and assured observations." CBONs are being developed in collaboration with the Department of Homeland Security and the US Coast Guard to do coastal monitoring in western Alaska, with the goal of near real time observations and two-way communications with observers on the ground. Their research group is also doing a research project on "situational awareness" to fuse data from different sources, for example overlaying subsistence hunting activity with automated information system from ships to show how hunting patterns are changing in relation to ship traffic over time. The group is developing an information support tool for development of observing protocols created with agencies and community members. David mentioned that sustainability of the CBONs project is currently based on grants and contracts with federal agencies and NGO partners. Data are used by the US Coast Guard and the National Oceanic and Atmospheric Administration. Not all data shared publicly, with decisions about data sharing made collaboratively between community members and funders on a case to case basis.

Vera Metcalf gave a presentation on **Sea Ice for Walrus Outlook** (SIWO- www.arcus.org/search-program/siwo or https://www.arcus.org/search-program/siwo). SIWO started in 2010 as a pilot project. From April – June, hunters from five communities contribute weekly brief reports of sea ice conditions and weather conditions, and weather and ice forecasts, charts and images are provided by National Weather Service, NOAA and other university researchers. The goal is to synthesize information sources and enhance communications between researchers, agencies, and communities. Synthesis includes scientific information and information provided by local observers. The synthesis is made accessible to hunters and coastal communities. The group uses a Facebook site to share information: www.facebook.com/seaiceforwalrus and the open data/information is available for all interested. The bigger goal that the project contributes to is the continuation of TK and language at the community level for the long-term. Hunting walrus on ice instead of open water is important because it minimizes struck and loss incidents. Vera pointed out some areas of improvement that the SIWO team hope to address, including improving satellite images, coordination of feedback, and dissemination of products to communities. Internet bandwidth is limited so they use fax and email to share the information. They hope to strengthen partnerships and potentially expand the program to Canada. They also need to do some additional work to determine the ideal timeframe for delivering information, since it is seasonal, running annually from April to late May or June.

Olivia Lee presented on the **Alaska Arctic Observatory and Knowledge Hub** (AAOKH- www.arctic-aok.org). AAOKH was established to build capacity in sharing information among community-based observations and researcher's data on the seasonal cycle of snow and ice and to empower community members to collect scientific data relevant to them. They are developing a knowledge hub to provide tools and observational data to seven participating communities. The hub will have two levels of data access (building on the community-based coastal ice observations that the Seasonal Ice Zone Observing Network, SIZONet, has been compiling for the past 10 years). Community members have full access and visitors will be able to access more general data. The data includes both community-based observations and instrumented observations of water temperature, salinity, and chlorophyll a concentrations. The program will be sustained by demonstrating "value added service" to communities through provision of data in a way that is relevant. This drives interest on the part of communities; without that interest, project is very hard to sustain after end of funding cycle. The target audience is North Slope communities, while academic researchers are another important user group (but with access to more limited data set). With the new, instrumented data being collected, natural resource managers, the remote sensing community, and students and teachers are also anticipated users. There is interest but there need to be clear agreements on policies, particularly for sharing TK. The appropriate platform for sharing data also needs to be identified. One major consideration is internet connectivity issues in northern communities. Other possible ways to share data include mailing CDs or archiving physically in ways that do not require internet access, but these have limitations as well.



GROUP DISCUSSIONS

After the morning overview presentations by CBM programs, participants were asked to break up into self-selected groups based on three topics:

1) Access to Resources, including environmental changes (e.g.- late freeze-up and snow fall, unpredictable sea ice), human activities and government regulations that affect access to resources;

2) Health of Subsistence Species, including population, and individual health; effects on human well-being, implications for ecosystems;

3) Unusual Events, including observations of unusual weather events, unusual animal/plant observations, and unusual human activity (such as increased vessel traffic in the Bering

Strait). The “access to resources” group began as one large group but split into two smaller groups to make discussion easier. Each of the four groups had about 10 – 12 members. The group participants were asked to answer four questions:

1. What are the issues of concern (in relation to the focus area of this breakout group)? Recognizing that there are different approaches to monitoring (using traditional knowledge, community-based monitoring, and/or scientific monitoring), what is currently being monitored to address these issues of concern?

2. In your experience with community-based monitoring, what challenges do community-based monitoring schemes face in 2017? (you are also welcome to provide suggestions for how these challenges could be solved).

3. Are there gaps (things that ought to be monitored that currently aren’t being monitored) that could be addressed through new collaborations? Can you suggest ‘excellent’ examples that could guide new collaborations?

4. What are current obstacles and opportunities for data and information sharing from community-based monitoring programs?

Common themes identified across the three groups are presented first while unique themes from each group follows. The summaries draw on notes provided by each group’s selected rapporteur; these notes were coded in NVivo, a qualitative data analysis software, and the resulting themes were then summarized. Quotes are reconstructed from notes, and may not be word for word.

Participants noted that the three different groups represented an artificial division that reflected a non-native way of thinking. In particular, the term “resources” was problematic for one participant because it reflected exploitation; an alternative would be “fish, wildlife, and habitat.”
“It’s true that science operates in silos, but there is a science of a ‘system view’ that focuses on the whole system, how can we operationalize working together?”

Common themes from across all three groups

1. Value and role of CBM

The challenges of our time call for greater, more effective collaboration. Environmental change is occurring rapidly. There is an urgency to the situation, a climate crisis. This makes the CBM and documentation of TK more important than ever. Arctic Indigenous Peoples find themselves not only at the ‘front-lines’ of climate change impacts, but are at the front-lines of creating hypotheses about change and adaptation. It is human nature when seeing a change to think about why that change is happening, which can be based on vast knowledge of the environment that often includes information passed down through the generations. Baseline data is often lacking; TK can sometimes fill the gap. Indigenous peoples are often the first to see change since they are traveling, and harvesting on the landscape. They can also provide historical context due to long-term intimacy with the environment, and importantly answer why the change matters, they know when it impacts community/culture. For example, as one participant explained: “There is a word for mammoth in Inupiaq – our history goes back so far that we have a word for an animal that no longer exists.”

Arctic residents are often motivated to participate in community-based monitoring because they are hoping for support/help in facing the challenges of rapid social and environmental change. As one participant noted, “It’s important to understand how change affects us, Indigenous Peoples.” It’s not just academic curiosity to understand a phenomenon. People are already acting and adapting to changing conditions, and support needs to be provided for action. The gap between information and action needs to be shortened. Information is needed to make choices; information needs to be in the hands of people who are adapting. CBM can shorten the gap between research and action, by empowering Indigenous peoples to collect data to address local decision making needs.

2. Identifying monitoring and observing needs

Communities need to define the questions, indicators, and approaches for measuring and answering the question. Projects ought to develop from a co-creation perspective. Developing indicators needs to be linked to a societal benefit within communities.

It is important to understand that male and female views within TK are very different. The male view (focused on weather, access, etc.) often gets more attention, but the female view (focused on quality of meat and health of animal, etc.) is very important and needs to be included.

CBM should incorporate the arts and media.

We need to identify signals of change that are shared among communities.

We need observations that are important to culture.

We need to study the effects of contaminants on human health, there is too much cancer maybe because we harvest food from the environment.

We need to monitor human expansion, mining, hunting, road development as there is a limit to what the environment can absorb.

Biomass projects in communities (e.g. high efficiency wood burning for heat at schools) have created a demand for sustainable forest management as has the introduction of wood bison, all during times of rapid environmental change. In some parts of Alaska wood bison have been reintroduced after their historic range shrunk. This could cause changes in the environment that are important to monitor. CBM of forests and ecosystems near communities is needed for community planning.

There is a need for more information on drug trafficking to rural villages, since there is a lack of information coming in from rural areas about drugs. There needs to be a system to report illegal activity, but this is difficult since it may break cultural norms. Trust relationships are needed to tackle increase in drug trafficking.

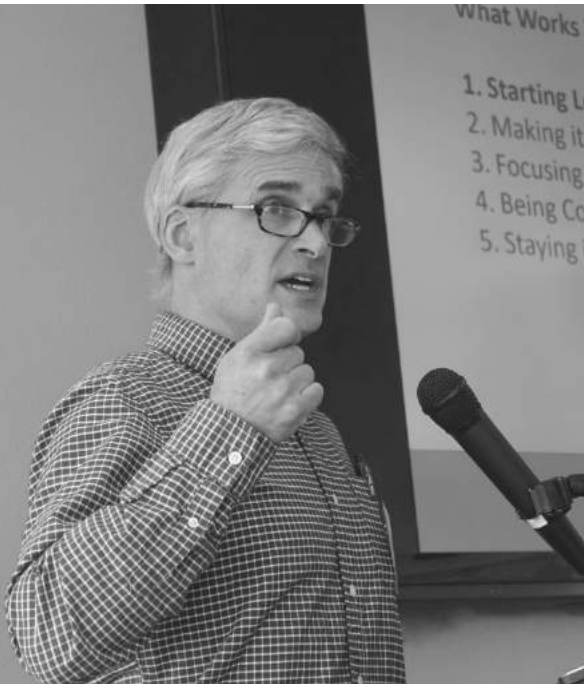
3. Importance of/need for collaboration and network-building

‘Be collaborative; CBM programs should start with communities; young people involved in every stage; often CBM programs tap into the strengths and knowledge of communities and need to build good relationships among partners; build on peoples' experience and skills.’

To avoid duplication, CBM programs should build on what community efforts are already there and extend existing programs instead of creating new ones. They should run in parallel, adding value, tying together what is already happening. Different systems should complement each other. CBM programs need to collaborate with local tribal entities.

Within communities, there is lack of trust in information that doesn’t consider TK. For example, salmon counting sonars, which inform regulations, are not in a good place to accurately count salmon; scientists should have asked the locals where the path is that the salmon follow. It is also often hard for scientists to trust community collected data, which means it less often incorporated into policy. Lack of trust may also be based on negative experiences with researchers in the past.

'They come to our communities, and we are a generous people, so we show them the best berry patches, teach them skin sewing and beading, and then they own it, it is theirs, it is not ours anymore.'



Often Indigenous peoples are required to work within a system that is not suited to reflect traditional ways of knowing. For example, science often compartmentalizes information, while TK views the system holistically with an emphasis of relationships within the system, although there has been progress in the 'system' sciences like ecology, and interdisciplinary environmental/social sciences. Elders are not given adequate time to inform science, and decision-making. Often they have ten minutes to explain how the system works. We need to clearly define terms that we use, because for those that English is not their first language, communication can be difficult and TK is sometimes hard for outsiders to understand. We need to operationalize working together.

To address these issues, there is a need for people in the middle bridging the interactions of communities and scientists. CBM has effectively served to bridge communities and scientists in working on a shared issue/question/problem.

Another important need is for more education about how TK and science can be pursued side-by-side. Scientists working in communities need to be educated about TK and local culture.

There is also a need for better programs and curricula to get Indigenous youth involved in science, get them involved in what is happening now. There is also a need for hunter education to improve safety and so they can document the changes they see.

Another aspect of collaboration is the importance of community-to-community networks.

'*Native peoples need networks to share their traditional ways and ways to meet. From that network, these native peoples can then share with broader audiences, including the science community. Native peoples must get together to decide together on how to proceed before meeting with people from the "Western system." Current money allocation mechanisms don't allow for this.'*

Information demands on communities are overwhelming. Native communities need to come together for a safe exchange of ideas, decide what is important to monitor, then figure out where community members and scientists interests overlap (e.g. there is a scientific need to understand how change affects ecosystem productivity, this will affect harvested fish and wildlife, this is an area of overlap). CBM programs could build from Native knowledge. Sharing information among communities can help with adaptation (e.g. beaver is moving into areas that haven't historically had beaver; those from the Yukon Flats went to teach coastal villages how to trap and eat beaver).

"We need to talk with each other more, need a way to know who everyone is and what they are interested in across the Arctic."

Need more opportunities to learn from each other (those doing the adapting).

'Our ancestors were nomadic, it's not like that anymore, but we need to be open to moving, connecting with others and learning how they are coping and moving forward.'

4. Funding

Funding agencies favor scientists with academic backgrounds. Good partnerships can help equalize the distribution of financial resources, ensuring that an equitable share is infused into the communities. Funders often have a narrow view of what they are willing to fund, of what their priority information needs are. These priorities are decided by people far removed from the realities of village life.
'To address community concerns we need good partners, science allies. Scientist ought to work with communities to write proposals.'

Sustained funding for a monitoring system over a long period of time is difficult to obtain. Funders are more likely to fund research oriented work, not monitoring. But, once a framework is in place you are not dependent on a single source of funding. When community member sees the value and are empowered to run the program, partners will put resources into the system.

Properly documenting TK is expensive. It requires travel for consultation in defining indicators, documentation and review. Consultation is often required before the proposal has been submitted, before there are funds in place. But the consultation process is extremely important.

The political 'wind' (changing leadership, new U.S. administration, budget crisis in State of Alaska with falling oil prices) has a big effect on a nation's priorities, and thus what gets funded. Funding for climate change and impacts to Indigenous peoples is likely to suffer in the U.S., and the State of Alaska.

Many Arctic Indigenous residents are genuinely concerned about the changes they see and want to work with people who are interested in the problem. NGOs and Foundations are providing funding and filling some gaps, e.g. Arctic funders group, STEM (an U.S. educational initiative 'Science, Technology, Engineering and Math) for education, and there is some money for exploring impacts to cultural resources. Private foundations are often more open to funding community projects and they can help secure federal 'matching' funds. Native Corporations in Alaska may be willing to fund some of this work.When you do get funding, it's important to use the money wisely. Use opportunities – Don't have the CBM system rely on single individuals. Provide support, training and transfer the ability to run this type of system to the members, whose priorities will not change.

5. Data and interoperability

The value of data sharing is immense; the more information is distributed, the more valuable it becomes, because people can make use of it. 'We need to take the relatively little information we have and pull it together to see the big picture.' We need to consider the timeliness of sharing information; sometimes information needs are urgent, and science is moving too slowly.

'Sharing different types of data will require enhanced cooperation.' Synthesis for decision-making requires compatible data, but not only are CBM programs not coordinated, neither are government agency data – more coordination is needed, consistent protocols are needed for certain types of data collection.

Not all data can, or should, be shared. “We need to keep traditional knowledge and science separate in general, and bring them together under specific issues.” On the spectrum of TK to physical data, there are many different goals and different methodologies. Different data will require different treatment. While there is an interest in sharing information based on TK, intellectual property rights must be respected, and agreements need to be in place on sharing information. ‘Community review of TEK is extremely important to ‘getting it right.’ ’A collaborative effort to clarify how and what data will be shared needs to take place among community members, funders and researches, respecting that, ‘each community is unique’.

There is a need for a standardized data collection methodology for CBM information, some kind of template – if you have it on paper it is more acceptable to others. Science likes data in familiar forms. A platform, or common infrastructure is needed that includes broad environmental data and TK. Connecting different platforms is difficult, try to plan for it up front, but data needs, and thus platforms will be different.

It is important to keep in mind that information from the internet is often slow or impossible to obtain in remote communities. Disseminating information to communities requires creative, often old fashioned means. ‘Think about the narrative that goes with a dataset, what is the story it is telling? Take that to the communities.’

Real time observations are sometimes needed to enable quick response, but this can be difficult given connectivity issues. Progress has been made on information support tools for near real time observations. CBM could be used for border protection and law enforcement. Geo-tagged photos and GPS are useful observing tools for community members and are a good way to share information, but training needs to be provided; the Guardian Program in Canada is a good example of this and is run by First Nations.

Social media (Facebook, twitter, snapchat) is focused on what is happening now and while everyone uses these, and they can be a good way to communicate, they are not designed for archiving. However, social media is a common structure to communicate, a good meeting place where people with different knowledge (scientific, TK) can have a conversation.

6. Decision-making

Resource management strategies are built on an old, ‘no change’ model that doesn’t incorporate the rapid change that we are now experiencing. Regulations are not keeping up with rapid environmental changes, e.g. moose moving north. Managing wildlife, fish and ecosystems by an outside entity, making infrequent observations is no longer working. Some resource management agencies do their own research to inform management, what is their role in supporting CBM research? We need to prepare Indigenous youth to be natural resource managers.

It is really important that CBM influences regulations (regarding the use of natural resources). Canada has self-governing land claims. All research is reviewed by a local co-management board. The information gathered is used to inform strategies as recommendations from co-management boards. However, federal agencies are still responsible for the final decision-making in the management of natural resources but the recommendations from the local co-management boards are almost always implemented. Policy makers are required to include CBM data in decision making. Alaska Native representation in co-management boards is extremely important

to ensure stakeholder voices are heard. Co-management boards should include seats at the table for Indigenous representatives that are involved in harvesting. We need to build the capacity of agencies to utilize/participate in CBM to collect data essential to their mission. Policy makers need to be a part of the CBM process. Science priorities that are used to inform policy are decided in distant locales, and are often not aligned with village concerns. We need information from science, environmental justice, and Indigenous peoples to inform policy, and we need to get the findings to be brought back to the village level, to those doing the adapting.

7. Role of community

Early engagement with communities during the proposal writing stage is often not occurring partly because of the way funding systems work. Often scientists/funders define the priorities that proposals are written to satisfy, and community priorities are different. CBM ought to be community instigated, not about what communities can do to answer scientist's questions, but the other way around. In this way scientist could produce knowledge that are considered robust by the community members. Communities need to be empowered to set the agenda and priorities for CBM research.

From the scientist's perspective, it can be hard to find reliable community partners with sustained interest in CBM. One way to address this is to be clear if and how the research will benefit the community. Training needs to be provided especially to younger people to develop an Indigenous scientist workforce. Projects should bring money into the community through jobs, using local services, etc. Make sure the collected data is easy for community members to assess and use, communities want 'something tangible'. Simple things like newsletters can help communicate and keep people interested and involved. People often participate because they are expecting help. CBM should support sustainable livelihoods. Connecting youth and elders to learn from each other will make a program more sustainable.

Instruments can be incorporated into CBM work, for example time lapse cameras are used to capture observations over time, because humans are not good at detecting gradual changes. However, scientific equipment is sometimes difficult to use. It's important to make it easy for people to make observations and to provide training where needed.

Unique themes from groups

Group 1: Access to resources

Harvest regulations in many places are not able to keep up with the rapid environmental change occurring in the Arctic. Connecting CBM information to regulation of harvesting and acting on the information is important, for the benefit of residents. For example, moose are moving into Nunatsiavut but as they are a new arrival, few permits are issued. At the same time, caribou are declining, making the need for alternative food sources more important than ever. From a community perspective, sometimes regulations don't match reality. They are made in faraway locations by decision makers that don't understand the local context. Creating stronger, more responsive connections from CBM to regulations is needed.

Access to harvest is affected by environmental change and socioeconomics. For instance, more willows in the creeks make it difficult to boat to areas that were historically used, river ice is softer and the window for safe travel on stable ice is shorter. One area of concern is that government is not moving quickly enough to address issues of environmental degradation. Regulations about harvesting are not keeping up with environmental change. In Alaska, where all citizens (Indigenous or not) have the same rights to harvest, those with the financial means are able to come in from the cities and travel to remote harvest locations. Locals living in the villages, where jobs are scarce, are often limited by the price of fuel. They have been adapting to this by joining with other hunters and sharing the price of fuel and the purchase of equipment.

When environmental degradation occurs, cultural degradation follows. For example, when the populations of sea lions in the Bering Sea declined the transmission of cultural knowledge about sea lions was lost. Similarly, regulations limiting king salmon harvest on the Yukon River have led to a loss of the 'camp life', where families would spend weeks harvesting salmon at remote fish camps. Regulations that limited, or completely disallowed king salmon harvests made it not worth the time and expense to spend extended periods at fish camps. This has had negative impacts on the well-being of many communities along the Yukon River.

'At fish camp, out on the land, that is where we are the healthiest'

'What would we be if we didn't have walrus or whale? Don't want to have to ask that – that aspect of change is just too large.'

Group 2: Health of subsistence species

'Every animal exists in the woods because they are interrelated to one another, and we depend on all of them, and they depend on each other. If one changes it will impact the whole system and we will need to adapt."

The quality of king salmon on the Yukon River is declining, but only the numbers of salmon are counted. The observation is that they are generally getting smaller, and are more likely to have a disease (worms, lesions, white spots on organs etc.). People are concerned about the genetic makeup of the runs. Halibuts are also getting smaller.

Invasive species are a concern, people are seeing species that they have no historical context for (e.g. new birds, invasive crabs).

People have observed an overabundance of certain species with impacts to ecosystems, including: sea otter in Southeast, beaver in interior Alaska (contaminating drinking water), and dog sharks. Seabirds are seen in parts of the interior where they have not been seen in the past.

Other changes include: berry harvests are more unpredictable, whitefish's ability to get to their spawning grounds is affected by more vegetation blocking waterways, the Yukon River is wider and getting more shallow because of increased erosion, water is being contaminated from inadequate sewage treatment, new roads for mining development are blocking the flow of water in wetlands, and earlier snowmelt is having all sorts of effects on plants. Rabbits change color with the seasons, but snow melts so fast they are behind in changing color and this makes them vulnerable to predators. Older pike have been shown to have elevated levels of mercury, which raises concerns about human health, since this is a food source. Lakes are unexpectedly draining.

Group 3: Unusual events

We need ability and infrastructure to track unusual events to ensure that they are being documented. The murre die off in the Gulf of Alaska and the Bering Sea, in 2015-16 was not well documented, but the puffin die off in the Pribilof Islands during fall of 2016 was documented, because there was a CBM structure in place to document it.

We are good at addressing the crisis, but not the CBM for monitoring conditions, which is important to see what is coming and prepare for it. What is considered 'unusual' and often reported on is fleeting – after 3 winters with little snow it becomes the new norm.

Based on the discussion, an observation is that ongoing monitoring is different than documenting unusual events. What appears unusual at one moment of time may become routine as environmental and social change continues in the region. (i.e. presence of more ships, "novel" species observed are no longer novel once they become incorporated into the ecosystem, etc.). Documenting unusual events may require different techniques than ongoing monitoring.There is a need to monitor these emerging trends: increased vessel traffic (potential for a spill to affect subsistence), forest growth and health (increased fire and insects), coastal and river erosion, storminess, increased drug use in rural villages, unusual mortality events, wildfire patterns, wildlife migration, shellfish poisoning, sea ice (affects whaling, travel and other subsistence activities).

AFTERNOON SESSION: ENGAGING COMMUNITY BASED MONITORING IN DECISION-MAKING AND ASSESSMENT: A DIALOG

A two-hour, open session was held in the afternoon that focused on how to engage community-based monitoring and observing in decision-making and assessment. Because the workshop coincided with the Arctic Council Ministerial Meeting, the session was intended to share some of the discussion from the morning workshop with individuals involved in Arctic Council working groups, federal and state agency officials involved in natural resource management or environmental monitoring, and anyone else interested. The session began with a welcome by Larry Hinzman, Vice Chancellor for Research at UAF and co-chair of Sustaining Arctic Observing Networks (SAON), and an introduction to the goals of the session by Noor Johnson, a member of the planning committee and researcher with the National Snow and Ice Data Center. Noor then invited representatives of the three break-out groups to share a brief summary of their discussions. Hajo Eicken then moderated an open dialogue among participants, summarized below:

Participants noted the need for and value of good observations, and the importance of making observations available to contribute to Arctic observing efforts. Sharing these data is extremely important and efforts need to be put into creating platforms for sharing CBM data. The more the information get distributed, the more valuable it becomes. Documented observations can be valuable into the next century. They can serve as a benchmark to measure future changes in the environment. These observations are important because often community members have intimate knowledge of their environment, that visiting scientists may not.

While participants noted the importance of community observations, they also identified challenges and barriers. The global and national communities want information from rural areas, but it can be difficult for communities to respond to this demand. Technology is a huge help to understanding emerging and important issues that need a response and understanding who has capacity to respond, but it is important to keep in mind that many small rural communities don't have internet. We need to figure out how to pull the little information we have and build the broader picture. One component of this is the need for an inventory of networks involved in CBM.

to this demand. Technology is a huge help to understanding emerging and important issues that need a response and understanding who has capacity to respond, but it is important to keep in mind that many small rural communities don't have internet. We need to figure out how to pull the little information we have and build the broader picture. One component of this is the need for an inventory of networks involved in CBM.

Communities need to be able to set observation priorities, because what communities see as important is important. Priority issues for northern communities are: a stable economy, more jobs, and health care. Monitoring shouldn't be done for the sake of monitoring; what is needed are strategic interventions to help people figure out how to adapt. Northern communities are facing multiple stressors from climate change and pollution. We need to deal with these issues within the next 10 years.

There is a great need for information, because without information it is hard to make choices. Information should inform action, so how do you get the information in the hands of those who are acting? And at the right scale. Currently people are acting and adapting to changes. No one is waiting for the next report to tell them how to adapt. The Arctic Climate Impact Assessment (www. acia.uaf.edu) started engaging different people than these type of assessments usually do. We need to do more of this.

A school curriculum needs to be developed to train the next generation of Indigenous scientists, with younger children and at the University level. The universities have a role to play in educating the next generation of community observers. There is a role for the arts and theater in adaptation as well. Government agencies should also support this effort.

State and Federal agencies in Alaska often underestimate the risk that industrial development will impose, so we need to make a more compelling argument that CBM be included in studies assessing the impacts of industrial development. We need a statutory change that would require CBM bodies to be set up to monitor the impact of industrial development. 'Many villages are in constant disagreement with the federal and state agencies, which is one of the reasons we collect our own data.' We need to build capacity and reform our resource management agencies to incorporate community observations into management, and create more co-management entities.

Communities often are expected to do the work with no pay, this is not acceptable. We need to infuse the communities with funding. We also need to respect that it takes time to make the connections and get good information from communities.

CBM is not about what communities can do to answer scientists' questions. It should be turned around, what can scientists do to answer community's questions? Through these types of collaborations, scientists could produce relevant, robust knowledge. There are many aspects of science and community wisdom that intersect; we should build on these. As part of these efforts, scientists need to gain a better understanding of what TK is. It is important to respect the holistic nature of Alaska Native perspectives.

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TK is built on ecosystems, language and culture. This is all one system.

CONCLUSION

There are many excellent community-based monitoring programs in Alaska and beyond. They are actively documenting observations of a wide range of phenomena. While much progress has been made in this field, additional coordination and investment is needed. This can facilitate the ability of CBM programs to contribute relevant data and information in order to address the climate crisis that Alaska Native peoples are experiencing.

Continued work and engagement is required to further develop responsive CBM programs in the Arctic. CBM programs are critical to support Alaska Native peoples in building a sustainable future that preserves culture and community. Below are some of the good practices and needs that were identified during the workshop and dialog.

Good Practices. CBM program should:

Be collaborative, co-producing knowledge and projects.

Gather information that is relevant to communities and adaptation needs.

Empower Indigenous peoples to address local decision making needs.

Utilize TK to fill information gaps, especially baseline conditions.

Avoid duplication by building on what is already in place.

Build bridges between two worlds, Native and Science.

Have data sharing agreements in place, which are co-created by all parties involved and clear to all participants.

Share data with participating communities in locally accepted forms of communication for example in plain language reports, stories and newsletters.

Contribute to communities through training, employment, and honoraria and by providing information needed to inform decision making needs.

Be inclusive, including youth, Elders, and women.

Needs. CBM program should:

Shorten the distance from data collection to action by putting relevant information in the hands of those doing the adapting. Science is too slow to address the rapid changes people are experiencing.

Collect data that is used to inform the management of wildlife, fish and the environment. Regulations are not keeping up with the fast changes people are experiencing, which can cause hardship for those living off the land.

Enhance cooperation for sharing data.

Understand that limited internet connectivity makes communication and real time data sharing difficult; find creative ways to effectively communicate.

Engage communities in a greater role to identify monitoring needs with attention to changes that are occurring across many communities.

Support networks of Native communities so that they may identify shared priorities and identify how science can best contribute.
Work to change the system: Alaska Natives are forced to work within a system that doesn't reflect their way of thinking.

Build trust and relationships.

Support education, for scientist to understand Native ways, and for Native youth and others to get involved in science.

Build effective networks so communities know what others are interested in and can share lessons learned about adaptation.

Develop programs that monitor the impacts of industrial development.

Work to: Change funding systems so that they fund community priorities and not just academic priorities. Increase sustained funding opportunities for monitoring. Educate funders about funding needs to properly document TK. Support sustained priorities so they don't change with the 'political wind.'

Participant List

First Name	Last Name	Organization
Austin	Ahmasuk	Kawerak, Inc
Robert	Albert	YRITWC Executive Committee; Koyukuk, AK
Clarence	Alexander	YRITWC Executive Committee; Fort Yukon, AK
Mildred	Allen	Arctic Borderlands Ecological Knowledge Society
Matthen	Babazs	University of Alaska Fairbanks
Carolina	Behe	Inuit Circumpolar Council - Alaska
Barbara	Blake	State of Alaska
Todd	Brinkman	University of Alaska Fairbanks
Nancy	Brodsky	Sandia National Labs
Mike	Brubaker	Alaska Native Tribal Health Consortium
Joann	Bryant	U.S. Fish and Wildlife
Rich	Buzard	University of Alaska Fairbanks
Leo	Bynum	Sandia National Labs
Robin	Campbell	YRITWC Executive Committee; Nenana, AK
Peter	Captain Sr.	YRITWC Executive Committee; Fairbanks, AK
Terry	Chapin	University of Alaska Fairbanks
Catherine	Coon	U.S. Dept. of Interior, Bureau of Ocean Energy Management
Raychelle	Daniel	
Finn	Danielsen	NORDECO, Nordic Foundation for Development and Ecology, and INTAROS, Integrated Arctic Observation System, Greenland/Denmark
Lauren	Divine	Aleut Community of St. Paul Island
Fannie	Dock	Yukon River Inter-Tribal Watershed Council
Kathryn	Dodge	Fairbanks North Star Borough
Kelly	Donnelly	Yukon River Inter-Tribal Watershed Council
Matt	Druckenmiller	NSIDC/CU/SEARCH

Michael	Duxbury	Alaska State Troopers
Hajo	Eicken	University of Alaska Fairbanks, International Arctic Research Center
Maryann	Fidel	Yukon River Inter-Tribal Watershed Council
Tatiana	Flanagan	Sandia National Labs
Katie	Gavenus	University of Washington, Center for Alaskan Coastal Studies
Trimble	Gilbert	YRITWC Executive Committee; Arctic Village, AK
Mary	Gilbert	YRITWC Executive Committee; Arctic Village, AK
Mellisa	Good	NOAA Sea Grant
David	Griffith	University of Idaho
Larry	Hinzman	University of Alaska Fairbanks
Hannah	Hoag	Media
Lene K.	Holm	Greenland Inst. Natural Resources
Henry	Huntington	Pew Charitable Trusts, and Huntington Consulting
Leslie	Ishii	National Cultural Navigation Theatre Project
Lisbeth	Iversen	Nersc (INTAROS)
Martin	Jeffries	US Whitehouse Office of Science and Technology Policy
Noor	Johnson	University of Colorado, Exchange for Local Observations and Knowledge of the Arctic
Glenn	Juday	University of Alaska Fairbanks
Lee	Kayotuk	Kaktovik, AK
Alexander	Kholodov	University of Alaska Fairbanks
Karen	Kriska	YRITWC Executive Committee; Nenana, AK
Elisabeth	Kruger	World Wildlife Fund
Rodd	Laing	Nunatsiavut Government
James	Landlord	YRITWC Executive Committee; Mountain Village, AK
Olivia	Lee	University of Alaska Fairbanks
Kate	Legner	US Forest Service
James	Magdanz	University of Alaska

David Harry	Maillelle	YRITWC Executive Committee; Grayling, AK
Chris	Maio	University of Alaska Fairbanks
Joe	Matesi	University of Alaska
Larry Ilarion	Merculief	Global Center for Indigenous Leadership and Lifeways
Vera	Metcalf	Eskimo Walrus Commission
Edda	Mutter	Yukon River Inter-Tribal Watershed Council
Mindy	O'Neall	UAF Communication and Journalism Dept.
Santosh	Panda	University of Alaska Fairbanks
Lori	Parrott	Sandia National Labs
Kathleen	Peters-Zuray	YRITWC Executive Committee; Tanana, AK
Judith	Ramos	University of Alaska Fairbanks
Arja	Rautio	University of Oulu
Cheryl	Rosa	US Arctic Research Commission
Akiko	Rotch	National Cultural Navigation Theatre Project
Morgan	Simon	YRITWC Executive Committee; Scammon Bay, AK
Elena	Sparrow	The International Arctic Research Center, University of Alaska Fairbanks
Katie	Spellman	UAF International Arctic Research Center
Colleen	Strawhacker	ELOKA, National Snow and Ice Data Center
Meghan (Sigvanna)	Topkok	State of Alaska
Sean	Topkok	University of Alaska Fairbanks
Betsy	Turner-Bogren	Arctic Research Consortium of the U.S.
Jess	Veldstra	Aleut International Association
Gale K.	Vick	Tanana Chiefs Conference
Helen	Wiggins	Arctic Research Consortium of the U.S.

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