Learning from the Local Scale:

Identifying and addressing information blind spots in environmental decision-making

Wainwright, Alaska case study

Community summary report

By: Tracie Curry
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PhD Candidate, Natural Resources and Sustainability
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Nalukataq, blanket toss
Wainwright, AK
Tracie Curry, 2015

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This report summarizes the research I conducted from 2015-19 towards my PhD in Natural Resources and Sustainability from the University of Alaska Fairbanks. Many people have contributed to this work. I would like to express my greatest gratitude to the people of Wainwright who were willing to share their knowledge, time, and friendship throughout the course of the project. Thanks to Joseph Ahmaogak, Ida Panik, and Terry Tagarook who sat on the project steering committee. They provided invaluable guidance in the early stages of this research and continued to provide feedback throughout the course of my work. I am particularly indebted to Mr. Tagarook who helped me fine tune my interview questions, and spent many hours as the interpreter for my interviews. His abundant humor, kindness, and patience throughout the project made the experience an especially enjoyable one. He is greatly missed.

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“Sometimes you wonder if the people that are making the decisions are even getting the right information”

- Interview N, 2015

INTRODUCTION

Taking action to address climate change and other environmental changes brings together many different groups including representatives from local communities, government agencies, non-profits, and industry. Decisions that impact local people are often made by outsiders who have no connection to the places where people live. As a result, the goals of outside decision-makers often do not fit the goals of the people that are affected. Lack of understanding between different groups of people with different ways of seeing the world is a major part of this challenge, and the focus of this research.

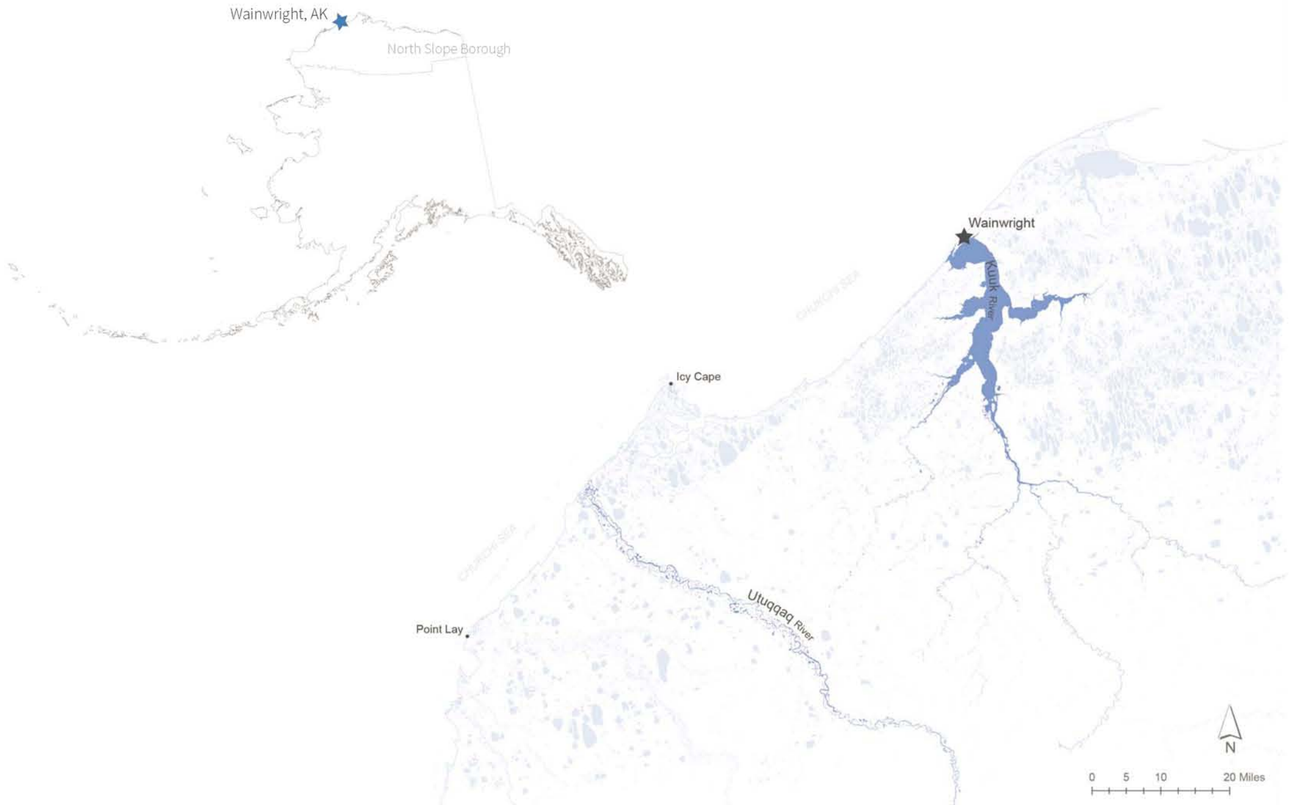
Information blind spots that impact environmental decision-making are explored in three studies through a case study of the Native Village of Wainwright, Alaska. People need good information to make good decisions. To be considered “good”, the information people have access to should be comprehensive, which means it includes all relevant sources of knowledge. While technical information from Western science is necessary to understand the changing Arctic environment, there are other important sources of information, like local and Indigenous knowledge, that are under-represented in decision-making.

There are three types of blind spots explored. The first is the local details that are missed when one-size-fits-all tools are used to understand adaptation in communities. The second blind spot is the unwritten rules, like values and cultural practices, which guide behavior in local communities. These “informal institutions” are unique to each community and it would be helpful for planning purposes to have a way of understanding how they affect local adaptation. The third blind spot is related to the challenge of communicating local information to outsiders. It is difficult to communicate rich detail about life in local environments to decision-makers who

Wainwright, AK
Tracie Curry, 2015

prefer to see numbers instead of text. However, using images to help communicate such information may be a good strategy.

This report explains three studies that try to identify and address key information missing from environmental management because of these blind spots. Suggestions are provided on ways under-represented sources of information might receive more attention and be used to inform decisions. While the interview data comes from Wainwright, the key study findings apply to environmental management in other parts of Alaska, and other rural regions experiencing environmental change across the globe. The primary audience for this research is people involved in environmental decision-making from local communities, to regional agencies, to national and international governments.



ABOUT WAINWRIGHT

This research was conducted in collaboration with the Native Village of Wainwright (traditionally Ulguniq), an Alaska Iñupiat community located on the state's northwestern coast about 75 air miles southwest of Utqiagvik (formerly Barrow, Alaska). With an estimated population of 560, Wainwright is the third largest village in the North Slope Borough (Department of Labor, 2018). About ninety percent of Wainwright residents are Iñupiat (NSB, 2015) descended from the Kuugmiut, people of the Kuuk River, and the Utuqqaġmiut of the Utukok River (Ivie & Schneider, 1988; Wainwright, 2016). Prior to the 20th century, people lived in a series of small, semi-permanent settlements along the coast and river drainages, subsisting on both ocean and inland resources, and moving as their needs required (Nelson, 1982). In 1904 a school was established in Wainwright by the Alaska Native Service (Wainwright, 2016). The reliable resources of the area drew people from their inland winter settlements and Wainwright eventually became the only community in the region (Nelson, 1982).

Wainwright has seen significant changes over the last century. The development of oil resources at Prudhoe Bay followed by the creation of the North Slope Borough (NSB) in 1971. The NSB's ability to tax oil industry facilities, brought significant income to the region (Knapp et al., 1991). Through its Borough-wide Capital Improvement Program (CIP), the NSB invested tens of millions annually in schools, community halls, water and sanitation facilities, public health programs, and other public services (ibid.). Wainwright today is a modern community. Even so, traditional values remain a central to the Iñupiat way of life (Wainwright, 2016). In particular, subsistence resources and the activities associated with the harvest of these resources support key values in Iñupiat culture (NSB, 2015).

Wainwright aerial photo
North Slope Borough
Planning Department,
2013

4th of July Celebration
Wainwright, AK
Tracie Curry, 2015

The Wainwright economy is part cash, part subsistence-based. Between 2008 and 2009, 85 percent of households supported themselves on a combination of subsistence, employment, and some other source of income such as retirement or dividend payments (Kofinas et al., 2016). People must have income to be able to purchase outside goods and maintain the kind of life they are used to living. The ability to purchase outside goods also provides access to the fuel, supplies, and equipment necessary for modern subsistence activities (e.g. boats, snow machines, firearms, warm clothing). Still, even with access to outside goods, high transportation costs resulting from the village's remote location result in high prices (NSB, 2015). Without connection to road networks, air travel is the only reliable year-round transportation to and from Wainwright. As a result, people rely on subsistence resources to fulfill a large portion of their nutritional needs (Kofinas et al., 2016).

Like many northern communities, Wainwright is already experiencing the effects of climate change. The climate is becoming warmer with an increase in average annual temperature of 4.59 (°F) between 2010 and 2019 over historical averages (SNAP, 2019). This warming has resulted in decreases in snow and ice, with delayed fall accumulation and early spring time melt (AMAP, 2017). This affects conditions for travel and access to subsistence resources. Residents are also observing a shift in animal migratory patterns, eroding shorelines, thawing permafrost, and a number of other environmental changes. The task of responding to environmental uncertainty becomes more complicated with the economic challenges and opportunities involved, including the potential for arctic shipping, tourism, and resource extraction. Iñupiat people have tremendous resilience, as shown by their long history in the Alaskan Arctic. However, communities still require support and collaboration from outside resources to fund local initiatives, provide information, and enact policies that strengthen local ability to adapt.

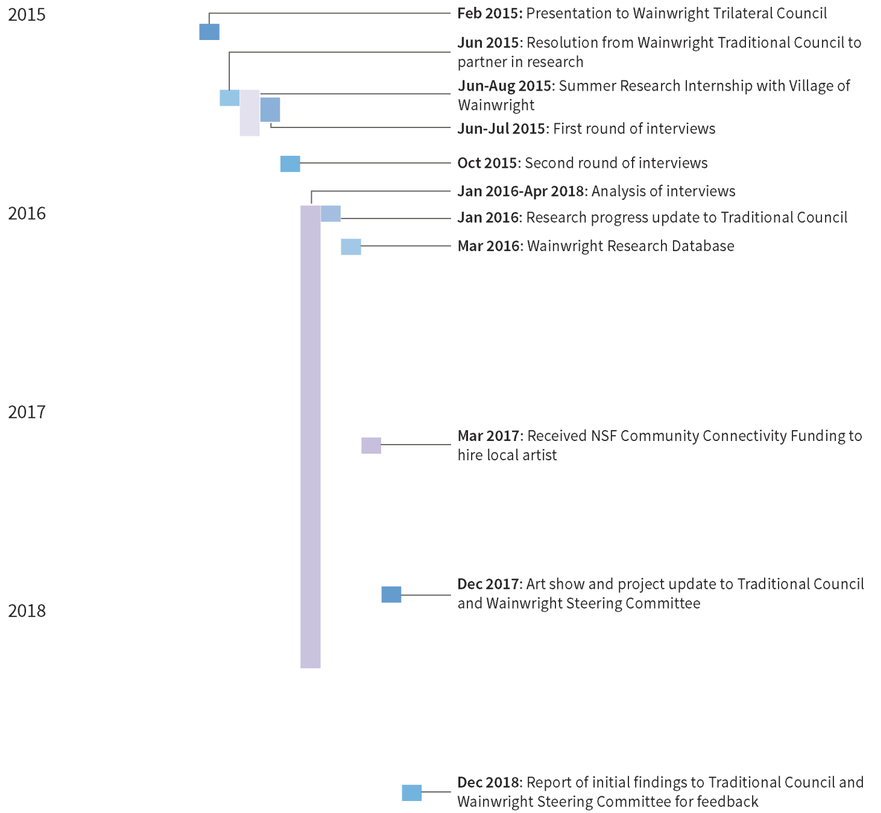
Opposite:
Erosion control
Wainwright, AK
Tracie Curry, 2015

Top:
Erosion control
Wainwright, AK
Tracie Curry, 2015

Bottom:
Infrastructure repair
Wainwright, AK
Tracie Curry, 2015

RESEARCH TIMELINE
Summary of major activities

- February 2015: The UAF Research Team including Tracie Curry and principal investigator Gary Kofinas made it's first visit to Wainwright to present the project.
- June 2015: The Wainwright Traditional Council formally agreed to become a partner in the project with a resolution (see Appendix A).
- June to July 2015: Tracie received funding to do a summer research internship in town with the Village of Wainwright. Her activities during this time included:
  - Collected and organized documents and other information from past research related to Wainwright to create a database where electronic copies of finished reports are centrally located and easily accessible for the community and for future research
  - Revised interview questions and found interview participants with the help of project steering committee and Village of Wainwright administrators
  - Conducted first round of interviews
- October 2015: Tracie returned to Wainwright to conduct the second round of interviews.
- March 2016: The Wainwright Research Database (based on research collected as part of the summer internship) became available online.
- March 2017: additional funding was received to hire a local artist to produce artwork about the topics brought up by participants in the interviews.
- August 2017: The selected artist, George Leavitt of Utqiagvik, completed his work and an art show was organized in Wainwright that December. Additionally, project updates were presented to the community and to the Wainwright Traditional Council at that time.
- December 2018: Draft research findings were presented to the Wainwright Traditional Council and the Wainwright Steering Committee.



INTERVIEW PROCESS

Ethical conduct of research

Several steps were taken to make sure this research was conducted in an ethical way. The Village of Wainwright was the primary point of contact for the project. Also, a project steering committee was set up to advize the research. The steering committee members were Joseph Ahmaogak, Ida Panik, and Terry Tagarook. The steering committee helped to make sure the interview questions and other research methods were appropriate and useful. Before each interview, researchers provided an overview of the project and got written consent from each participant. Native Iñupiaq speakers were given the option to conduct their interview in Iñupiaq with the assistance of a translator. Project updates were provided to both the Village of Wainwright and the Wainwright Steering Committee (formerly the Trilateral Council) at major project milestones. Research findings were reviewed by members of the project steering committee, Traditional Council, and Wainwright Steering Committee.

Terry Tagarook helps Tracie refine interview questions
Naomi O'Neal , 2015

Participants

Interviews (15) were conducted with 17 long-term residents from the Village of Wainwright. Participants had to be community members that (1) were age 40 or older, (2) had lived in Wainwright the majority of their lives, and (3) had significant experience outdoors in the Wainwright Traditional Use Area. Local elders (10) were the primary target group because they are repected members of the community with rich and long-term knowledge. Middle-aged community members (7) identified as having strong knowledge of the outdoors were also interviewed.

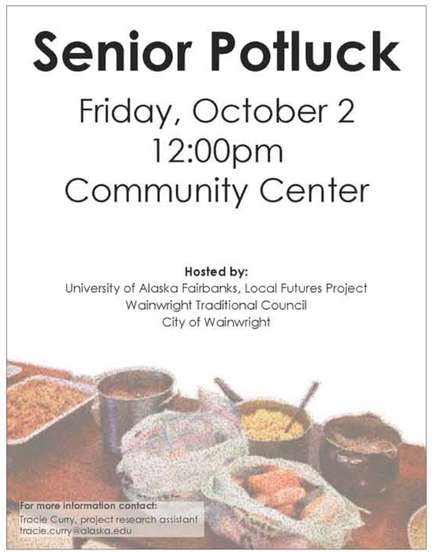
Participants were identified based on suggestions from the project steering committee and the Village of Wainwright. At the end of each interview, I asked for suggestions for other people that I should interview. Flyers were posted around the community to advertise the project. I also hosted a Senior Potluck to share information about the project with the community.

Conducting the interviews

Interview questions asked about each participant's observations of change throughout their lifetime as well as family and community responses to unexpected events, environmental changes, economic development, and other factors. A local student living in Wainwright was hired to assist with recording the interviews. Each interview lasted about one hour.

Analyzing the interviews

Each audio-recorded interview was transcribed into text. The text was then analyzed with software to help identify major themes, the number of people that mentioned each theme, and connections between themes. This data was used in the three studies that are described in the following sections.



Project flyers
Tracie Curry , 2015

Wainwright, AK
Tracie Curry, 2015

Wainwright, AK
Tracie Curry , 2015

STUDY 1

Place-Based Classification:

A place-based approach for improved understanding of adaptation in local communities; Wainwright, Alaska case study

Blind spot:

Local details are missed when one-size-fits-all tools are used to understand adaptation in communities

Objective

Typical ways to classify types of adaptation are designed to be used in a wide range of planning situations and are not specific to local places. However, when an overly general tool is used to understand a particular community, there is a chance that important information might be missed. Using qualitative research methods, I look at what information is potentially left out when planners use overly general tools to classify adaptation, and how a place-based approach that is specific to a local community might provide additional useful information.

Methods

1. Analyzed Wainwright interview data using a general classification with nine categories to organize adaptation themes
2. Themes that didn't fit in the general categories represent information that might be missed when a n overly general approach is used to classify adaptation in a local community like Wainwright
3. These 'missing' details were added to the general classification to create a "place-based" classification of adaptation in Wainwright. In Table 1, the nine general adaptation categories are listed and the added details are shown underlined in bold.

Key terms:

Adaptation: The process of adjustment to actual or expected changes and their effects

Adaptation classification: A key step in adaptation planning is deciding what adaptation options make sense for a particular place. Adaptation can happen in many ways and it would be difficult for planners to consider each individually. Classifying the numerous adaptation types into a smaller set of categories is one way of making the information manageable.

Adaptive capacity: The resources and conditions that make it possible to adapt

Table 1: Place-based Classification of Adaptation

Adaptation Categories		Description	# of Interviews/ 15
Adaptation response options	1. Mobility	Physically moving through areas based on availability of resources. **Also includes the timing and speed of movement**	14
	2. Storage	Reduces risk over time by balancing periods of abundance with periods of scarcity	4
	3. Diversification	As an adaptation practice, diversification can be applied in many different ways. It involves using alternative assets, resources, or skills to address risk and opportunity	13
	4. Communal pooling	Members of a group working together with the objective of pooling their resources (e.g. food, hunting equipment, environmental knowledge, labor, income) to address risk or opportunity.	14
	5. Market exchange	Sale or trade of goods and services with local or outside markets. **Also a general category for actions related to participation in the cash economy including wage labor, and purchasing goods.**	13
Elements of Adaptive Capacity	6. Infrastructure & Technology	**All** infrastructure improvement and technology that contribute to local adaptive capacity	11
	7. Research/ Knowledge/ Observation	Available knowledge that is considered meaningful to members of a community. Includes local observations, indigenous knowledge, Western science, or research into new technologies and strategies for adaptation.	12
	8. Educational/ Behavioral	Sharing knowledge through training, education (formal and informal), or information exchange with the goal of guiding or changing behavior (Feenstra et al., 1998)	10
	9. Institutional	Formal organizations, rules, and regulations of any scale (local, regional, state) that impact adaptive capacity (Noble et al., 2014).	11

Notes: Topics underlined and in bold are additions made to the non-specific classification. The right column is the number of interviews (out of 15) in which participants referenced the element of adaptive capacity.

Categories adapted from Agrawal, Arun. (2008). The role of local institutions in adaptation to climate change. Washington D.C.. and Noble, et al. (2014). Adaptation needs and options Climate Change 2014: Impacts, Adaptation, and Vulnerability

Findings

The mixed subsistence-cash economy that exists in Wainwright and other Alaska Iñupiat communities is a unique characteristic of the region that was responsible for two main differences between the general and the place-based classification (mobility and market exchange). In a subsistence-cash economy, both subsistence and income are necessary for physical and spiritual well-being.

Mobility

The description of mobility was changed to include timing and speed of movement. These were important themes in Wainwright due to changes in the timing of subsistence hunting due to the responsibilities of employment as well as changes in seasons and animal migration patterns. For example:

Wainwright, AK
Tracie Curry , 2015

Hunters in Wainwright have become accustomed to making quick trips:

In the past "… when they went hunting they stayed up there or they stayed down there or somewhere till they got enough you know, instead of just going up there over the weekend and coming right back maybe with nothing but when they go hunting they waited for the animals and got them and bring them back."

(Interview O, 2015)

In reference to walrus hunting, one participant said:

"What used to be like, maybe a two or three week period of hunting, you're cramming it into maybe a week or week and a half… this year was a week. The ice was here and it was gone… no more than 10 days it was nearby."

(Interview N, 2015)

Findings (continued)

Market exchange

The description of market exchange was changed to include all activity in the cash economy including wage labor and purchasing goods. The coexistence of subsistence and capitalism create a unique situation in Wainwright where people are always balancing the need for subsistence with the need for income. For this reason, activities like finding a job or purchasing imported supplies that were not considered adaptation in other studies (Agrawal, 2010), are highlighted in Wainwright.

Wainwright, AK
Tracie Curry , 2015

Access to outside markets has allowed people to purchase supplies and gear that used to be handmade. However, some noted a decline in quality of clothing despite the convenience of store-bought clothes.

"…when we were growing up we had warm caribou boots made out of caribou legs, which were called tuttulik caribou they were very warm. But nowadays we have basketball shoes with a lot of holes in them. Everybody is catching cold and we didn't have no problem with what our parents or grandparents sewed together for us to use for the cold winters."

(Interview B, 2015)

Findings (continued)

Infrastructure & technology

Infrastructure & technology was another category that differed significantly. In the non-specific classification, this category is limited to planned infrastructure and technological improvements with specific objectives (Noble et al., 2014), like the sea wall in Wainwright. However, this does not capture technological advances such as GPS, snow machines, and social media, that many people talked about during their interviews. This shows how advances that are significant at the individual and community level can get overlooked in non-specific approaches.

In the past, before cell phones and before VHF radio, whaling crews communicated with people in the village using a system of flags. Today, whaling crews can send updates to people in town using their cell phones if they are within range. Social media platforms like Facebook are widely used in North Slope communities and help people keep in touch with friends and family living in other villages. Social media is helpful for sharing news about environmental observations. This is increasingly important as seasonal migration patterns have changed with warming temperatures. Hunters know when the animals are headed their way once people in neighboring communities have started seeing them (personal communications, 2015).

Wainwright, AK
Tracie Curry , 2015

Findings (continued)

Examples of activities classified into each category are shown in Table 2.

Table 2: Examples of adaptation categories

Adaptation Categories		Examples
Adaptation response options	1. Mobility	- Extending hunting range during food shortage - Adjustment from long to short hunting trips due to employment responsibilities - Greater preparedness and urgency stimulated by shorter window of opportunity for hunting walrus - Decision to stay local or move outside the community for economic opportunity
	2. Storage	- Large quantities of food traditionally stored in ice cellars. Means of moderating periods of resource availability to with periods of scarcity - Freezers have provided a suitable, but not equivalent alternative as many ice cellars fail
	3. Diversification	- Pursuing alternative livelihoods, like reindeer herding - Adoption of snow machines as an alternative means of transportation to dog teams - Diversification of traditional family roles to allow households to access multiple resources that overlap in timing of availability
	4. Communal pooling	- Sharing food - Helping elders with chores - Hunting as a group with family or hunting partners - Pooling money to support those in need
	5. Market exchange	- People must work to obtain fuel and other supplies necessary for subsistence - Ability to purchase gear and supplies that used to be handmade
Elements of Adaptive Capacity	6. Infrastructure & Technology	- Sea wall to protect shoreline from erosion - Houses built on raised platforms to protect from flooding - Adopting modern technologies that address local needs
	7. Research/ Knowledge/ Observation	- Pride and respect earned for having deep knowledge of one's environment - People rely on local and indigenous knowledge as well as information from outside sources, such as weather reports - Information collection and sharing is important for making informed decisions (e.g. safety during hunting, decisions local leaders make that impact the community)
	8. Educational/ Behavioral	- Teaching young people cultural norms like always helping elders - Information exchanged by learning from parents and grandparents
	9. Institutional	- Regional initiatives (e.g. North Slope Borough Capital Improvement Program) - International representation (e.g. Inuit Circumpolar Council, Alaska Eskimo Whaling Commission) - Regulations can adversely affect adaptive capacity (e.g. conservation measures that restrict ability to hunt non-threatened species)

Findings (continued)

Closely related adaptations

The classification categories are not strict boundaries. The analysis of interviews showed that some adaptations often happen together (see Table 3). *Diversification-Market exchange*, *Mobility-Research/ Knowledge/ Observation*, *and Educational/ Behavioral-Institutional* are three pairs that stood out. *Market exchange*, in many cases, was the change that allowed *Diversification* to happen. For example, access to outside markets provided new ways to make a living (e.g. trapping, wage employment) and also introduced non-local food options to the community. *Mobility* was often paired with *Research/ Knowledge/ Observation* in relation to hunting and travel conditions. *Educational/ Behavioral* was paired with formal *institutions*, which provide many educational opportunities. In contrast, some participants felt dividend payments and other *institutional* handouts had negative *behavioral* impacts for the few people who rely on them as a replacement for work.

Table 3: Adaptations that frequently happen together

Frequently paired adaptation categories	**Examples**
Diversification-Market Exchange	- Access to outside markets providing opportunities for diversification (e.g. fur trade, different food options, transportation options, employment options) - Ability to rely on subsistence to supplement or replace (past) lack of money - Finding a balance between working and hunting
Mobility- Research/ Knowledge/ Observation	- Knowledge of ice conditions for safe travel - Knowledge of where animals are so you know when to prepare to hunt - Knowledge of the land and how to reach a targeted location from multiple directions - Traveling to hunting camp as a learning opportunity for young people
Educational/ Behavioral-Institutional	- Relationship between formal education (e.g. schools, training programs) and opportunity - Potential for school or community-sponsored programs to teach hunting and other traditional values - Potential relationship between “handouts” (e.g. dividend payments) and a lack of motivation among some

Research/Knowledge/Observation & Mobility

“One more thing about caribou... three of us go hunt [together] all the time... with dog team, and when we go from here we meet up there somewhere. We know the land, where we gonna meet. No matter which way you go, we get together up there so we can camp together.”

(Interview G, 2015)

Educational/Behavioral & Institutional

“But still, some kids hardly ever go out to go hunting because their parents don’t go out hunting because they don’t have the boat or the skidoos or, you know. But still you know, they should concentrate on getting those kids that are less fortunate to try and get ‘em involved through the school or community to try and ah get them involved in hunting or something.”

(Interview O, 2015)

Wainwright, AK
Tracie Curry , 2015

Key Takeaways and applications

- A place-based approach to adaptation classification captures local details that a non-specific approach does not. In the case of Wainwright, three categories had significant differences; mobility, market exchange, and infrastructure & technology.

Applications

- Potential benefits to using a place-based classification of adaptation

  1. Instead of just thinking about how outside initiatives and technology can help a community adapt, a place-based classification can provide information about a community's history of adaptation and the things people are already doing to respond to change as individuals, households, and communities.

  2. A place-based classification can also help agencies and organizations better understand how their policies and regulations influence local adaptive capacity.

  3. This might help identify new ways to support adaptive capacity through policy.

  4. Additional research is needed to know if the same place-based classification developed in this study can be applied to other similar communities in northern Alaska. If so, the place-based classification can be a way to make comparisons between communities. Such comparisons can inform not only regional, but national and international policy.

- A place-based classification is not a replacement for non-specific approaches. Instead it is a way to complement them and make sure important information is not being left out.

Wainwright, AK
Tracie Curry, 2015

Wainwright, AK
Tracie Curry , 2015

STUDY 2

Informal Institutions and adaptation:
Patterns and pathways of influence in a remote arctic community

Blind spot

The relationship between adaptation and informal institutions (the unwritten rules that guide human behavior) is understudied, and there is much to be learned.

Objective

Informal institutions are the unwritten rules and strategies that guide human behavior. Informal institutions are closely related to local culture and their influence on adaptation is understudied in part because they are difficult to identify, measure, and quantify (Ostrom, 2005; Soysa and Jutting, 2006). However, just because something is difficult to measure, doesn't make it less important to decision-making. Using qualitative research methods, I take an in-depth look at informal institutions in Wainwright to understand their relationship to adaptation, and also how they might be used to support local adaptive capacity.

Methods

1. A classification system for Wainwright informal institutions (see Table 4) was made based on the Inupiaqatigiigñiq (the traditional Iñupiaq value system for the North Slope region). Definitions were also drawn from a number of other sources including the Iñupiat Ilitqusiat (a very similar value system from the Northwest Arctic region), and from local advisor insights.
2. Wainwright interview themes were analyzed using this informal institution classification. Additionally, the place-based classification of adaptation analysis from Study 1 was used again, this time to help study the relationship between informal institutions and adaptation.
3. Patterns were found where interview participants talked about events that included both informal institutions and adaptation.

Key terms:

Classification: Items or concepts arranged into categories

Institutions: Widely understood rules, norms, or strategies that guide and also limit human behavior and action.

Formal institutions: Institutions that are linked to government powers and can be enforced legally

Informal institutions: Socially shared rules such as social and cultural norms of behavior that are created, communicated, and invorced unofficially

Table 4: Classification of Informal Institutions

Informal Institutions	Description
Compassion	Being helpful to one another without expecting anything in return, continuing the tradition of helping each other[a]. Warmth, kindness, and caring[b].
Cooperation	Combining resources or working together to accomplish a common goal[a]. In some cases such as whale hunting it would be impossible for one person to complete the activity on their own. In other cases such as caribou hunting, while it is possible for one person to hunt on their own, there are distinct advantages to working in a group. Communal society with close-knit extended families[c]. Cooperation is related to humility, being willing to accept help from others[d].
Cultural knowledge (not including environmental knowledge)	Knowledge of language: Language as identity. Our language helps us know our minds and our hearts[c]. Family and Kinship: Belief in knowing who we are and how we are related to one another. Our families bind us together[c]. Knowledge of family tree ensures you will always have a place to stay when visiting other villages[d]. Traditions and history: Performing dances, hearing stories[a].
Domestic skills	Taking care of the home (cooking, cleaning, keeping the house warm). Turning raw materials into food, supplies, and gear. Children learning by observation and helping out[a]. Closely related to family roles, but distinct. A role is the responsibility to do something, a skill is the ability to do it[d].
Environmental knowledge	Includes basic knowledge of where the animals are, and where they should be at certain times; familiarity with the land and ocean, making keen observations, knowledge of seasonal patterns, knowledge of place names, passing on knowledge to young people, and using information from western science[a].
Family roles	Similar to cooperation but at the family scale. Working together to accomplish a common goal. Also, responsibilities and tasks carried out by specific members of a family. One important aspect of having family roles is showing children, so they will have the knowledge when they get older[a]. In traditional Iñupiaq society, many jobs were divided making final outcomes a cooperative effort[b].
Hard work	Necessity to always be moving and working to ensure that the needs of family and community are met. Balancing multiple obligations. Working for what you want and not expecting handouts[a]. There is a connection between hard work and respect for nature, domestic skills, and family roles[d].

Informal Institutions	Description
Hunting traditions	Hunter success depends on skill, perseverance, foresight, imagination, cooperation, safety, and knowledge about the environment (animal habits, weather, etc.). Necessity to follow Inupiaq protocols and beliefs to have hunter success[a]. Reverence for the land, sea and animals[b]. Self-esteem for the successful harvest of a resource, and family and public appreciation in the distribution of the harvest[d].
Love for children	Ensuring the safety and protection of children, giving children the knowledge and skills they need to survive, teaching children about their history and culture, seeing children as the future leaders of the community[a]. Involving children in celebrations and meetings. Even though they may not be active participants, they are part of the "Future Realm"[d].
Mental attitude	Humor: Focusing on good things during hard times, and finding humor in challenging situations[a]. Laughter is the best medicine[b]. Avoidance of conflict: Being non-confrontational, and not escalating disputes. Belief that a person will get what's coming to them in the end[a]. The Inupiaq way is to think positive, act positive, speak positive, and live positive[b]. Allows a person to recognize his/her role in the family and community, cope with the issues of today, and put aside differences to help each other[d]. Humility: Never boasting[a]. Acting on goodness and expecting no reward in return[b]. Sharing with others teaches one to be humble[d]. Fortitude: Strength in the face of adversity. Living day-by-day and not getting too far ahead of yourself[a].
Respect	For each other: Honoring others' opinions, listening, treating people well, never turning ones back on anybody that needs help, respecting other people's property[a]. Related to sharing, welcoming visitors with a place to sit and refreshments. Working together, everyone makes a contribution even though they have different talents[d]. For elders: Respect for the knowledge and guidance of elders[a]. Being taught to always help and provide for elders[a]. Our elders model our traditions and ways of being. They are a light of hope to younger generations. May we treat each other as our elders have taught us[b]. An Elder is anyone who is considered an Elder by their community. A characteristic that distinguishes Elders from elderly people is their leadership skills, including leading by example and sharing their knowledge with younger generations[d]. For nature: Wasting nothing, working to ensure the continued health of the environment, acknowledging the limited power of humans in comparison to "mother nature"[a]. Ultimate importance of respecting the gift of nature for future generations[b]. If nature is treated with disrespect, it may retaliate[d].

Informal Institutions	Description
Responsibility to uphold Iñupiaq culture	Efforts contributing to the strength, wellbeing, and safety of the community. Upholding community values. Includes responsibility to teach younger people[a]. 'Tribe' means something different to each person. Can mean family, others in the community, or the people you shared a childhood with in ancestral lands. Tribe can also refer to culture and responsibility to pass down Iñupiaq knowledge to children[d].
Sharing	Sharing food and resources with those in need[a]. Acts of giving always come back[b]. Sharing is also related to knowledge and other non-physical things like sharing time with elders and dancing[d].
Spirituality	Integration of spiritual or non-physical elements within a belief system. Examples include Christian faith, belief in God's ability to intervene, prayer, the power and agency of nature "mother nature", awareness possessed by animals "6th sense"[a,b].
Traditional food (connection to)	Being able to provide for one's own family and community, cultural connection and health benefits of traditional food[a]. Subsistence resources and the activities associated with the harvest of these resources provide the most basic memories and values in an individual's life[e].

Notes: Classification of informal institutions

[a] Wainwright interviews, personal communication, 2015

[b] North Slope Borough School District. (2008). Inupiaq Education:Values Units. Retrieved March 18, 2019, from https://www.nsbsd.org//site/Default.aspx?PageID=2767

[c] Alaska Native Knowledge Network.). Inupiaq Cultural Values. Retrieved May 05, 2015, 2015, from http://ankn.uaf.edu/ANCR/Values/Inupiaq.html

[d] Topkok, Charles Sean Asiqluq. (2015). Inupiat Ilitqusiat: Inner Views of our Inupiaq Values. (PhD), University of Alaska Fairbanks.

[e] NSB. (2015). Economic Profile & Census Report. North Slope Borough Mayor's Office. Barrow, AK.

Findings

How are informal institutions related to adaptation?

Table 5 highlights the informal institutions and adaptation dimensions that were mentioned together by the most interview participants. Three main findings are discussed below:

1. The adaptation that most informal institutions were related to was **communal pooling**. Communal pooling was a very popular adaptation category due to the wide range of events and conditions in which people used communal pooling, as well as the number of people involved in the activity. For example, communal pooling is associated with many activities including sharing food, helping with household chores, raising money for a cause, cooperative hunting practices, and organizing a unified response to injustice. Many of the potential uses of communal pooling are part of everyday life and happen frequently (e.g. helping out and cooperative hunting). Also, communal pooling by definition directly involves many people.

Informal Institutions

Adaptation Categories	Compassion	Cooperation	Environmental knowledge	Family roles	Hunting traditions	Respect	Responsibility to uphold	Sharing
Communal pooling	10	9	4	7	13	8	13	13
Diversification	1	2	3	7	9	2	2	2
Educational and behavioral	2	2	5	6	7	5	7	3
Institutional	0	2	3	1	4	2	6	0
Market exchange	0	0	1	5	8	2	3	1
Mobility	2	3	7	5	12	1	5	4
Research and observation	0	5	11	4	9	5	5	0

Table 5: *Most referenced Informal institution and adaptation dimension pairs. Shows the number of interviews (out of a possible 15) in which participants talked about events that included each pair at least once.*

Sharing(+) and Communal pooling

"When the famine in early 40s when they had WWII, the famine started out from there. Hardly any caribou, hardly any seal. Not much animals were around, they're hard to find… Most of the hunters get seals. And they have to rush home in order to let people have food. The hunters don't get the animals for themselves but they spread it out to the... whole village just about… And we got, ah, flippers from Pribilof Island, seal flippers the send us some… and divided through the whole village."

(Interview G, 2015)

Compassion(+) and Communal pooling

"To come together, you know to help one another out, which is still a strong tradition …sometimes we hear on the VHF [radio] that so and so needs some food, and we share even with a bag of, a little sugar or something with all the other families that give a little it's a whole bunch. That's one thing too that has not been lost, to give to the needy people that are less fortunate."

(Interview K, 2015)

How are informal institutions related to adaptation? (continued)

2. **Hunting traditions** stood out as the informal institution that was involved in the most types of adaptation and also involved with most other informal institutions. This finding is consistent with a key message from the Inuit Circumpolar Council's Alaskan Inuit Food Security Conceptual Framework. Subsistence resources and the activities associated with the harvest of these resources are the cornerstone of Iñupiaq culture (Inuit Circumpolar Council-Alaska, 2015). These activities provide not only nutritional value, but also define and establish a sense of family and community, and are the avenues through which cultural values and skills are learned (NSB, 2015)

3. A third finding is that many informal institutions are engaged at the same time when people are adapting. This shows that informal institutions support adaptation as a group rather than individually. Table 6 shows the number of interviews in which participants mentioned informal institutions in relation to other informal institutions. The pairs most widely mentioned are highlighted blue.

Informal Institutions

Informal Institutions	Compassion	Cooperation	Environmental knowledge	Family roles	Hunting traditions	Respect	Responsibility to uphold	Sharing
Compassion	11	3	8	5	7	0	8	8
Cooperation	3	13	2	7	9	3	5	3
Environmental knowledge	8	2	12	6	9	3	7	4
Family roles	5	7	6	13	9	3	9	6
Hunting traditions	7	9	9	9	15	9	10	10
Respect	0	3	3	3	9	13	4	0
Responsibility to uphold	8	5	7	9	10	4	14	10
Sharing	8	3	4	6	10	0	10	14

Table 6: Informal institution associations. *Shows the number of interviews (out of a possible 15) in which participants talked about events that included each pair at least once. Note: The number of times an informal institution is cross referenced with itself represents the total number of interviews in which it was referenced overall.*

Hunting traditions(+) and Mobility

"Since the climate has changed quite a bit, the hunters naturally they think that, like for instance the spring whales, they've already passed by. So nowadays they start, they always try and start preparing early and then go out early. Or kinda ah, go down there as soon as the waters open… "

(Interview G, 2015)

How are informal institutions changing?

The findings of this study provide insight into how local adaptation might be impacted by changing informal institutions based on the way informal institutions have supported adaptation in the past. Interview participants identified changes in several informal institutions over their lifetimes. These included c*ooperation, cultural knowledge, environmental knowledge, domestic skills, family roles,* and *mental attitude*. Examples of these changes are provided below:

Two interviewees said whaling traditions were strong, but there were still some changes. It used to be that the whole community would pitch in, but two participants said that today it is mostly just the whaling crews (*cooperation*) (Interview K, 2015). Another local advisor noted that, while many people would like to help out, they are unable because they don't have their own means of transportation or the resources to purchase the proper attire to stay warm (Personal communication, 2018).

With the exception of whaling, several participants noted that hunting is more individual today than it was in the past. Extended families used to hunt together (*cooperation*). Today, people mostly go out with just their immediate families. This negatively impacts an important pathway for passing knowledge down to younger generations (Interviews O, B, and C, 2015).

People have more sources of information to draw *environmental knowledge* from than in the past. Today, people have access to GPS technology, weather forecasts, and other outside research. Hunters also get fast, up-to-date, information on the location of animals through reports from neighboring communities via social media (Interviews H, L, and N, 2015).

One local advisor noted that Facebook and social media culture today seems to contradict the traditional value of *humility*. Older generations were taught by their elders to not brag. Today, people "make a big scene because they want recognition for what they did" (personal communication, 2018).

Traditional family roles and *domestic skills* were said to be less common today. In the past, the whole family contributed to household chores (e.g. hauling ice for water, stockpiling coal) and hunting activities as a necessity for survival. Also, people sewed their own clothing and made their own gear, which were high quality,

but time consuming to make. Today, modern amenities like indoor plumbing, and access to outside food and supplies, have made life easier (Interview B, 2015).

Again, whaling is an exception to the decline of traditional family roles and domestic skills. One local advisor commented that, in whaling families, tasks like getting whaling gear ready (e.g. fixing snow machines, working on sleds), cleaning out cellars, and shuttling supplies to/from camp are considered "men's work". It is the women's responsibility to prepare the food. This involves having knowledge of the different ways of preparing the heart, kidneys, meat, muktuk [whale blubber], and intestine. Great care is taken to prepare clean, high quality food (Personal communication, 2018).

Some participants perceive a change in parenting styles. In the past, the raising of children was more a communal activity (*responsibility to uphold* / *cooperation*). Today, many parents are less open to having their child scolded or told what to do by others (Interviews B and C, 2015). Similarly, the way that people give constructive criticism is perceived to have changed. As one local advisor observed, "It used to be done with more *humor* than it is today" (Personal communication, 2018).

Two respondents noted that there are very few Iñupiaq speakers today (*knowledge of language*). Many parents do not speak the language themselves and cannot pass it on to their children (Interviews A and M, 2015).

How will changing informal institutions impact adaptive capacity?

The findings of this study provide insight into how local adaptation might be impacted by changing informal institutions based on the way informal institutions have supported adaptation in the past. For example, some potential impacts of declining *cooperation* are described below and in Figure 1.

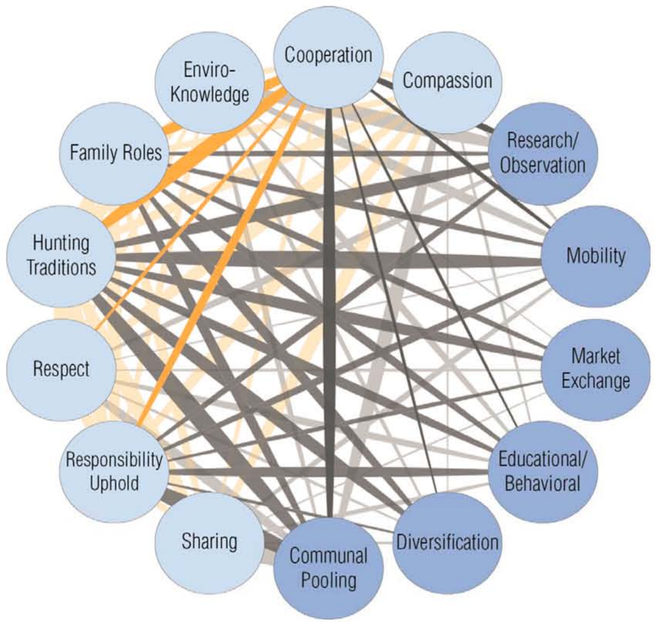
The informal institution *cooperation* has a strong relationship with the adaptation response communal pooling. Therefore, a decline in cooperation may negatively impact adaptation actions related to communal pooling, including activities like cooperative hunting, breaking trail, and the hauling and butchering of animals.

Changes in cooperation are also likely to impact other informal institution categories that are closely related (*family roles*, *hunting traditions*, and *responsibility to uphold*). Together, these informal institutions have strong involvement in the adaptation dimensions communal pooling, research & observation, diversification, educational & behavioral, market exchange, and mobility.

Three interview participants observed a decline in the practice of cooperative hunting. This impacts the ability of young people to gain *environmental knowledge* and *cultural knowledge*, which is tied to their ability to spend time out on the land, engaging in *hunting traditions*, and learning from their relatives and Elders. If a child's parents and immediate family members do not hunt, they may miss out on gaining important knowledge that is essential for both survival and cultural identity (Interview O, 2015).

Figure 1: Relationships between cooperation, other informal institutions, and adaptation dimensions

Links between cooperation and other informal institutions are shown in yellow, and links between informal institutions and adaptation categories are shown in gray. The width of each line increases with the number of interviews (out of 15) in which each link was made.



Wainwright, AK
Tracie Curry , 2015

Key Takeaways and Applications

- This study identified eight key informal institutions that were shown to be a common source of influence in local adaptation. These were *compassion, cooperation, environmental knowledge, family roles, hunting traditions, respect, responsibility to uphold,* and *sharing.*
- Multiple informal institutions support each potential adaptation option. *hunting traditions* again stands out for its widespread influence.
- The list of informal institutions highlighted as most influential in this study is likely incomplete. The information in this study was limited to the topics interview participants were willing to discuss with the interviewer.

Applications

- Knowledge of the relationship between local informal institutions and adaptation dimensions in Wainwright can guide the design of policies that complement rather than undermine existing practices.

  For example, *hunting traditions* stood out as a key category associated with nearly every dimension of adaptation. While many hunting traditions have changed, the practice of whaling was identified by participants as one that is still going strong and contributing to the continued strength of other informal institutions (e.g. *cooperation, environmental knowledge, family roles, respect, responsibility to uphold, sharing*). For this reason, any activities that might negatively impact whaling practices, such as offshore oil drilling or increased shipping, deserve intense scrutiny from all decision-makers.

- These findings provide evidence that justifies the funding of social initiatives that support proven strategies for adaptation. For example, the informal institution *cooperation* has a strong association with the adaptation communal pooling. Access to proper gear and transportation were identified by local advisors as barriers to *cooperation* in relation to communal activities like serving on a whaling crew. Funding programs that support access to basic gear is an example of a policy that supports both social needs and local adaptive capacity.

Nalukataq
Wainwright, AK
Tracie Curry, 2015

Open lead,
George Leavitt, 2017

STUDY 3

Images as Information:
Improving reporting methods to better understand local places

Blind spot:

Decision-making biases favoring Western science over other information sources make it difficult to communicate rich detail about firsthand experiences and observations of change in local environments

Objective

This third study takes on the challenge of communicating local knowledge (which is tied to the unique characteristics of local people and environments) to outside audiences that have never experienced life in a particular place. Also adding to this difficulty are preferences for technical information among decision makers from a Western worldview. This means other sources of information, like local and Indigenous knowledge, are underrepresented in decision-making (Lemos, 2008). I looked at two methods of addressing this challenge; 1) using context-rich images to communicate local information, and 2) presenting local and technical information on equal footing in the same document. The results provide useful information for future research, and also offer insight into how images and other ways of reporting information might help improve outsider understanding of local knowledge.

Methods

This research had three main parts:

1. Creating images to represent major themes from Wainwright interviews.
2. Audience study: Interviewing people who are knowledgeable about information needs in public sector environmental management.
3. Main study: Creating and testing three versions of a sample report (baseline, baseline + local quotes, and baseline + local quotes + context-rich images) using a survey and follow-up interviews with participants who work at public agencies and have decision-making influence.

Key terms:

Bias: prejudice in favor of or against a thing, person, or group compared with another, usually in a way considered to be unfair

Context-rich image: detailed visuals that address aspects of specific environments and cultures

Indigenous knowledge: local knowledge held by indigenous peoples, or local knowledge unique to a given culture or society

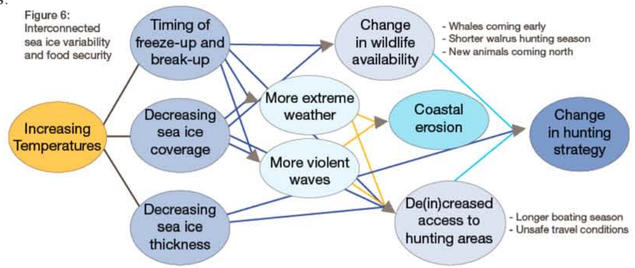
Local knowledge: knowledge created through observations of the local environment and held by a specific group of people

Western science: consists of value-neutral descriptions of events in nature reduced to generalized principles

Context-rich images

A typical scientific image is a simplified version of events that occur in reality with all details removed except what is important to communicate the desired message. By reducing information clutter, this type of image helps us to get a better understanding of complex processes (Kress & Van Leeuwen, 1996). A simple diagram is an example of this:

Figure 6: Interconnected sea ice variability and food security



In contrast, a *context-rich* image is one that includes detail about context (the background or setting of something being described that allows it to be fully understood or interpreted). An example of an image that is rich in detail is a photograph:

Visuals are helpful for communicating complex information effectively and, often times, more quickly than text. This study was interested in seeing if context-rich images are effective at communicating local concepts like social live and lived experience to outside decision-makers.

1. Creating images from major themes

North Slope Artwork

The project received funding from the Sitka Sound Science Center to hire a North Slope artist to create images for the project. The Village of Wainwright helped to advertise the job. The artist, George Leavitt of Utqiagvik, drew inspiration from interview themes and direct quotes related to seasonal change, sea ice change, and their impacts on hunting and transportation. Examples of Mr. Leavitt's work used in the project are shown in Figures 2 and 3.

Figure 2: "Duck hunting in spring".
George Leavitt, 2017.
Hunters must exercise caution when traveling along shore ice in the early spring. It is best to travel with a partner.

Figure 3: "Getting close to the lead", painted scene on baleen.
George Leavitt, 2017.
Depicts Iñupiat whalers breaking trail to open lead. Decreased sea ice leads to increased winds, which in turn push pressure ridges against village shorelines, making trail-breaking hard work.

Figure 4: "Pulling up a whale in spring hunt", sketch
George Leavitt, 2017.

Figure 5: "Whaling crew makes it to open lead", painted scene on canvas
George Leavitt, 2017.

Figure 6: Special painting for the Village of Wainwright
George Leavitt, 2017.

1. Creating images from major themes (continued)

Other images

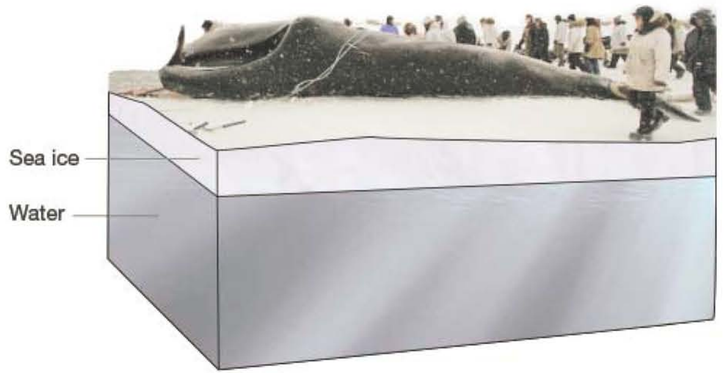
Additional context-rich images used in the study were made from photographs showing Iñuit hunters and their relationship to sea ice. For example, the three photographs in Figure 7 create a story about the movement of ice floes. It attempts to show the challenge presented to hunters by ice floes that are further away as a result of declining sea ice.

Figure 7: Sea ice coverage impact on walrus hunting
Walrus remain in the vicinity of coastal villages as long as there is pack ice nearby. This important food source is less accessible to hunters when ice floes are far out to sea

(a) USFWS 2006,
(b) USGS 2010,
(c) Photo of Willie Hoogendorn by Boogles Johnson, taken east of Cape Nome, May 2018

The *montage* image in Figure 8 shows the detail of a photograph combined with the simplification of a diagram. The photo shows the size of a whale and the large number of people involved in whaling. It is also meant to show the relationship between people, whale, and sea ice. The diagram below the photo is meant to focus the reader on the important details below the sea surface, like the minimum thickness needed to hold a whale's weight for a safe and successful harvest.

Figure 8: Sea ice thickness and whaling
A minimum 3-4 feet of ice thickness is needed to support the weight of a whale



2. Audience study

Interviews were conducted with five natural resource management professionals who are knowledgeable about information needs in public sector agencies. Questions were asked to get an understanding of who the target audience should be, how the study should be designed, and how qualitative information like local and Indigenous knowledge are currently communicated.

Target audience

Key informants advised that mid- to senior-level agency personnel are the most likely group to use a combination of qualitative and quantitative information. People in this group have many job responsibilities that require a wide range of information sources. They also have the authority to make decisions based on that information.

Study design

Based on the target audience, the design of the study should include information that is short and to the point. Sample reports could take the form of a policy or issue brief that is 2 to 3 pages in length and has a familiar report structure with introduction, supporting information, and a conclusion or key takeaways.

How qualitative information is currently communicated

Qualitative information is usually reported in agency documents using text and direct quotes from research participants.

One key informant was frustrated that many of the people with quantitative backgrounds at her agency did not like to work with this type of information and were sometimes skeptical about whether or not it was reliable.

Informants that worked at public agencies reported that they did not usually see local and Indigenous knowledge presented with Western science. These two separate information sources were often presented in separate sections of the same report, but not together. This is against the advice given by Ascher et al. in their book *Knowledge and Environmental Policy* (2010). Instead, they suggest the following:

> The presentation of environmental information to policymakers should avoid segregating knowledge based on different approaches. In order to minimize the likelihood that policymakers will ignore or neglect some information and therefore under-appreciate the values that it reflects, this information should be presented to the greatest degree possible in the same section and format as other information.
>
> (Ascher et al., 2010)

3. Conducting the main study

Participants

Information from the audience research guided the main study design. To be part of the study, participants had to have 1) expertise in environmental policy, planning, and/or decision making, and 2) decision making influence in their agency or organization. Eight people from six public agencies completed the survey. Six participated in a follow-up interview.

Survey

Participants were asked to complete an online survey in which they were shown three versions of a report.

Report A (baseline) was designed to look like a typical report, with information from the natural sciences in the form of text with scientific graphics (e.g. tables, graphs, maps, and diagrams).

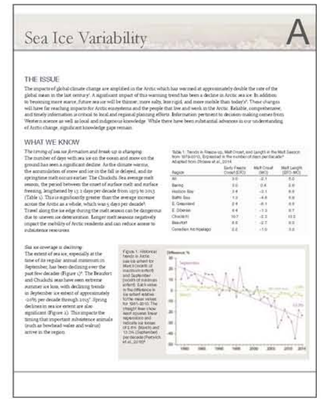
Report B (baseline + local quotes) included the same information as Report A with local quotes added

Report C (baseline + local quotes + images) included the same information as Report B with context-rich images added (see Appendix B for a copy of Report C)

The first page of each report is shown in Figure 9.

Follow-up interviews

As a follow-up to the survey, interviews were conducted to gain additional information about each participant's survey responses and thoughts. Interviews were conducted over the phone and lasted 30 minutes to 1 hour each.



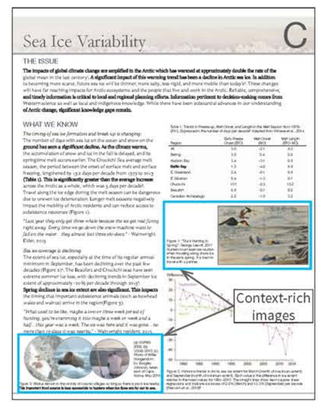


Figure 9: Sample reports A, B, and C

Findings

Credibility

Participants were asked to rate the credibility of each report compared to the previous version. The versions with quotes and images (Reports B and C) were rated either equally or more credible than the version without (Report A).

Participants rated **Report B** (baseline + local quotes) as either equally (62.5%) or more (37.5%) credible than Report A (baseline). One respondent noted:

> "[Report B] would certainly be more credible to a wider audience, and adds human, on-the-ground verification of the scientific findings."
>
> (Survey participant 6)

Another participant suggested that more information is needed to show the quotes are not just a single individual's opinion:

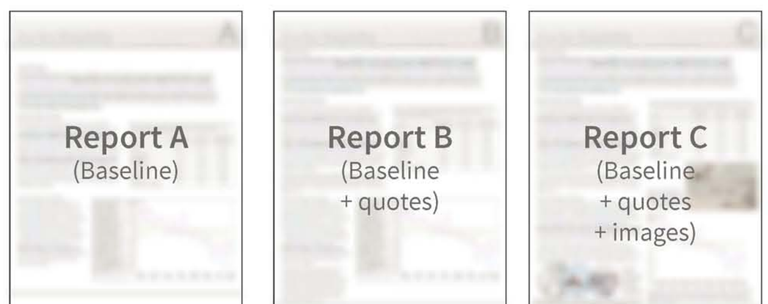
> "I like report B better because it presents information about the social relevance of the issue. Because the information is in the form of individual quotes without evidence that the statements have been corroborated by others in the region, I hesitate to call it more 'credible'"
>
> (Survey participant 1)

Participants rated **Report C** (baseline + local quotes + context-rich images) as either equally (85.7%) or more (14.3%) credible than Report B (baseline + local quotes). One respondent explained:

> "For me, these particular images don't add or detract from the credibility, though they do add some really key perspective."
>
> (Survey participant 2)

The above findings are summarized in Figure 10

Figure 10: Report credibility comparison



Report A average credibility rating =
3.4 out of 4

B versus A
B = A (62.5%)
B > A (37.5%)
B < A (0%)

C versus B
C = B (85.7%)
C > B (14.3%)
C < B (0%)

Findings (continued)

Ability to convey information

For each context-rich image in Report C, participants were asked if the figure helped to improve their understanding of the information provided in the report (1 not at all to 4 very much so). Some images were more successful than others:

Figure 8 was the most successful (57% of respondents said very much so)

> "[The figure] reinforces the statement it's paired with quite well, and nicely draws the connections between the academic text and the quote".
>
> (Survey Respondent 2)

Figure 2 was the least successful (50% of respondents said not at all)

> "I think the figure is slightly misleading, as it illustrates a landfast ice case, yet the report is about the pack ice. Ideally, figures would be consistent with the text".
>
> (Survey Respondent 4)

Overall preference

When asked to choose which, if any, of the reports (A, B, C) was preferred given the goal was "to provide an understanding of current knowledge as well as the local context and experience of Northern environmental changes", 7 out of 8 respondents chose Report C. The remaining respondent chose Report B. One participant who chose Report C said:

> "For the first part of the purpose, you only need report A and/or B. To meet the second part of the purpose (i.e., both context and experience), you must have report C".
>
> (Survey Respondent 2)

Figure 8: Sea ice thickness and whaling

A minimum 3-4 feet of ice thickness is needed to support the weight of a whale

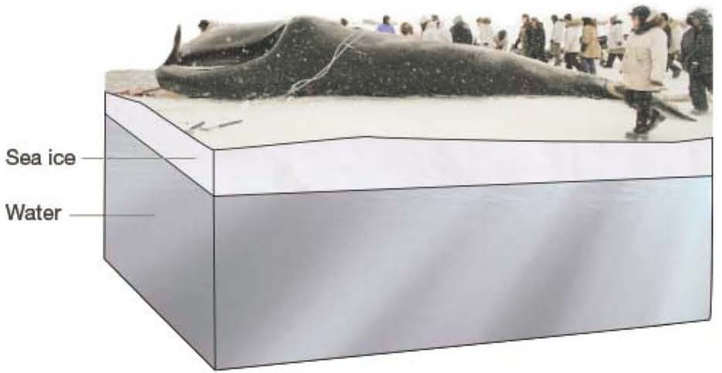


Figure 2: "Duck hunting in spring".

George Leavitt, 2017.
Hunters must exercise caution when traveling along shore ice in the early spring. It is best to travel with a partner.

Wainwright, AK
Tracie Curry , 2015

Key Takeaways and applications

- The findings show there are potentially significant benefits to be gained from using context-rich images in addition to local quotes for reporting information about the local context and experience of Northern environmental change.
- The approach of reporting information from Western science side-by-side with local observations did not have a negative impact on the credibility of the information overall. This was true for both local quotes and context-rich images.

Applications

Study participants suggested several potential applications of this research:

- Managers and policy-makers are concerned not only with scientific facts, but also with relevance to society, which the quotes and context-rich images provide. (Interview 1).
- Effective techniques that bring Western science and local and Indigenous knowledge together would be useful both inside and outside of agencies. Internal briefing papers about the Arctic may be sent to people in headquarters offices in Washington D.C. who are far removed from changes on the North Slope. This group is likely to understand the value of local and Indigenous knowledge more if its contribution of context to Western science is made more visible (Interview 4).
- Also, for transparency, agencies must show how they are using the local and Indigenous knowledge they collect. Formatting techniques for external communications that show how agencies are integrating these knowledge sources in their work are needed (Interview 4).
- Many people at environmental management agencies that become decision-makers are from a natural science background and tend to prefer information from hard science. One of the advantages of reporting local and Indigenous knowledge together with Western science is that it reminds decision-makers about other important factors to consider (Interview 6).

Wainwright, AK
Tracie Curry, 2015

Nalukataq blanket toss
Wainwright, AK
Tracie Curry , 2015

CONCLUSION

The research summarized in this report addresses a need to bring more local information into environmental decision-making through an in-depth look at information blind spots that negatively impact efforts to address climate change in the Alaskan Arctic.

The first study, titled *Place-Based Classification of Adaptation: a Place-based approach for improved understanding of adaptation in local communities*, showed that overly general approaches to adaptation classification may miss important local details, and that a place-based approach is a good method for capturing these details. It also suggests a methodology that researchers interested in using a place-based approach can follow. This research can help decision-makers from public agencies and other outside organizations be more aware of what they don't know about local communities. Potential benefits for people in Wainwright and other North Slope Communities include helping to improve communication between local communities and outside decision-makers, as well as identifying culturally relevant ways that planned initiatives can help support local communities (Agrawal, 2010; Thornton & Manasfi, 2010).

The second study, titled *Informal Institutions and Adaptation: Patterns and pathways of influence in a remote Arctic community*, identified several key patterns that connect informal institutions (the unwritten rules and strategies that guide human behavior) and adaptation in Wainwright. Based on information from interview participants, *compassion, cooperation, environmental knowledge, family roles, hunting traditions, respect, responsibility to uphold Iñupiat culture,* and *sharing* played an important role in past adaptations in Wainwright. There are also patterns that show informal institutions are related to each other. *Hunting traditions* stands out as the informal

Wainwright, AK
Tracie Curry, 2015

institution with the most connections to others. This research can help planning efforts by providing knowledge about the way policies can help communities maintain the practices that have made them strong and adaptable in the past (Adger et al., 2011; Agrawal, 2010). Researchers believe these types of policies are more sustainable in the long term because they are more likely to obtain local support and require less resources to maintain (Balvanera et al., 2017). Additionally, by showing how particular informal institutions are linked to adaptation, this research also provides data that can be used to justify the financial support of various social initiatives that target informal institutions given their long history of success in Wainwright.

The third study, titled *Images as Information: Improving reporting methods to better understand local places*, produced promising results in support of context-rich images that help to communicate detailed information about local environments and the local experience of environmental change. Feedback from participants did not support a preexisting theory that reporting local information side-by-side with Western science would have a negative impact on the way the scientific information was received. This was true both for context-rich images and local quotes. These findings contribute toward the development of improved reporting methods that help outside decision-makers better understand local places, which supports the goal of creating better outcomes for local communities like Wainwright.

Study limitations:

All three studies were based on data from interviews with Elders and other long-term residents of Wainwright, Alaska. The number of participants (15 interviews with 17 people) is a small portion of the local population and is not a representative sample. While a small sample is appropriate for research that aims to collect rich, detailed information that focuses on each participant's experience (Charmaz & Belgrave, 2012; Singleton & Strait, 2010), the views expressed in this study cannot be said to represent the entire community. Additionally, local advisors suggested that the study would have benefitted from the inclusion of youth participants whose opinions and observations may differ significantly from Elders. While Elders hold a wealth of knowledge, it is important to also hear the youth perspective because they are the next generation that will be taking the lead in efforts to address Wainwright's ongoing social and environmental changes.

REFERENCES

Adger, W Neil, Barnett, Jon, Chapin III, F Stuart, & Ellemor, Heidi. (2011). This must be the place: underrepresentation of identity and meaning in climate change decision-making. Global Environmental Politics, 11(2), 1-25.

Agrawal, Arun. (2010). Local Institutions and Adaptation to Climate Change. In R. Mearns & A. Norton (Eds.), Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World (pp. 173-198). Washington D.C.: The World Bank.

AMAP. (2017). Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. Arctic Monitoring and Assessment Program (AMAP).

Ascher, William, Steelman, Toddi, & Healy, Robert. (2010). Knowledge and environmental policy: Re-imagining the boundaries of science and politics: The MIT Press.

Balvanera, Patricia, Calderón-Contreras, Rafael, Castro, Antonio J, Felipe-Lucia, María R, Geijzendorffer, Ilse R, Jacobs, Sander, . . . Locatelli, Bruno. (2017). Interconnected place-based social–ecological research can inform global sustainability. Current opinion in environmental sustainability, 29, 1-7.

Charmaz, Kathy, & Belgrave, Liska. (2012). Qualitative interviewing and grounded theory analysis. The SAGE handbook of interview research: The complexity of the craft, 2, 347-365.

De Soysa, Indra, & Jütting, Johannes. (2006). Informal Institutions and Development, Think Local, Act Global? . Paper presented at the OECD Development Centre and Development Assistance Committee International Seminar.

Department of Labor. (2018). Alaska Population Estimates by Borough, Census Area, City, and Census Designated Place (CDP), 2010-2014. Retrieved 1/15/2019 http://laborstats.alaska.gov/pop/popest.htm

Inuit Circumpolar Council-Alaska. (2015). Alaskan Inuit Food Security Conceptual Framework: How to Assess the Arctic from an Inuit Perspective: Summary Report and Recommendations Report. . Anchorage, AK.

Ivie, Pamela, & Schneider, William. (1988). Wainwright: Land Use Values Through Time in the Wainwright Area (pp. 104): Prepared by the North Slope Borough for the NPR-A Planning Team.

Knapp, Gunnar, & Morehouse, Thomas A. (1991). Alaska's North Slope Borough Revisited. Polar Record, 27(163), 303-312.

Kofinas, Gary, BurnSilver, Shauna, Magdanz, James, Stotts, Rhian, & Okada, Marcy. (2016). Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. (BOEM Report 2015-023DOI; AFES Report MP 2015-02). School of Natural Resources and Extension, University of Alaska Fairbanks.

Lemos, Maria Carmen. (2008). Whose water is it anyway. Water management, knowledge, and equity in NE Brazil. In: PERRY, R, 249-270.

Nelson, Richard K. (1982). Harvest of the Sea: Coastal Subsistence in Modern Wainwright (pp. 1-126). Wainwright: North Slope Bourough's Coastal Management Program.

Noble, Ian R, Huq, Saleemul, Anokhin, Yuri A, Carmin, J, Goudou, Dieudonne, Lansigan, Felino P, . . . Villamizar, Alicia. (2014). Adaptation needs and options Climate Change 2014: Impacts, Adaptation, and Vulnerability (Vol. Part A: Global and Sectoral Aspects. Contribution of Working Group II, pp. 833-868). The Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

NSB. (2015). Comprehensive Annual Financial Report of the North Slope Borough (July 2014-June 2015): North Slope Borough.

Ostrom, Elinor. (2005). Understanding institutional diversity. Princeton, New Jersey: Princeton University Press.

Singleton, R, & Strait, B. (2010). Approaches to Social Research (5th ed.). New York: Oxford University Press.

SNAP. (2019). Community Climate Charts. Retrieved 5/22/2019, 2019

Thornton, Thomas F., & Manasfi, Nadia. (2010). Adaptation Genuine and Spurious: Demystifying Adaptation Processes in Relation to Climate Change. Environment and Society: Advances in Research.

Wainwright, Village of. (2016). Wainwright Community Guide. Wainwright, AK.

APPENDICES

WAINWRIGHT TRADITIONAL COUNCIL

Resolution 2015-11

RESOLUTION ON THE PROJECT ENTITLED: Local Futures: Adaptation and Arctic Change

Whereas the coastal landscape is changing in ways that may affect local livelihoods;

Whereas, the Local Futures Project is studying: 1) how traditional Iñupiat values have shaped adaptation to changes in the past, 2) what are current changes and their implications for local people, and 3) what are community goals for the future and ways to achieve desired outcomes;

Whereas, the Local Futures Project is focused geographically on Wainwright, including the Wainwright homelands and traditional use area;

Whereas, the Local Futures Project seeks to work collaboratively with organizations of the Wainwright community to complete the project;

Whereas, the Local Futures Project proposes a collaboration with Wainwright organizations and residents to document local and traditional knowledge about adaptation;

Whereas, the Local Futures Project will compensate local knowledge holders for their contributions;

Whereas, the Local Futures Project will work with the Village of Wainwright as the project's primary contact organization;

Whereas, the Local Futures Project will involve youth in the documentation of Elder knowledge and other project activities;

Whereas, the Local Futures Project will share project findings with the Wainwright Traditional Council for its review and use;

Whereas, the Local Futures Project will do its utmost to protect against the release of sensitive information from the community to non-local organizations;

Whereas, the Local Futures Project will work with a local steering committee of three to five residents to help with project design and communications;

Whereas, the Local Futures Project seeks to contribute to the needs and concerns of the Village of Wainwright;

The Wainwright Traditional Council, therefore agree to partner with the University of Alaska Fairbanks in completing the Local Futures Project.
CERTIFICATION

Passed on this ___ day of ____2015 with a quorum of __ FOR,__AGAINST, ___ ABSTAINING.

Attest:

Howard Patkotak, President

Cindy Ahmaogak, Secretary

PO BOX 143 * 1212 AIRPORT ROAD * WAINWRIGHT, ALASKA 99782
PHONE: (907)763-2575 * FAX: (907)763-2576

Sea Ice Variability

DOCUMENT C
Not for Print

THE ISSUE

The impacts of global climate change are amplified in the Arctic which has warmed at approximately double the rate of the global mean in the last century[1]. A significant impact of this warming trend has been a decline in Arctic sea ice. In addition to becoming more scarce, future sea ice will be thinner, more salty, less rigid, and more mobile than today's[2]. These changes will have far reaching impacts for Arctic ecosystems and the people that live and work in the Arctic. Reliable, comprehensive, and timely information is critical to local and regional planning efforts. Information pertinent to decision-making comes from Western science as well as local and indigenous knowledge. While there have been substantial advances in our understanding of Arctic change, significant knowledge gaps remain.

WHAT WE KNOW

The timing of sea ice formation and break-up is changing:
The number of days with sea ice on the ocean and snow on the ground has seen a significant decline. As the climate warms, the accumulation of snow and ice in the fall is delayed, and its springtime melt occurs earlier. The Chuckchi Sea average melt season, the period between the onset of surface melt and surface freezing, lengthened by 13.2 days per decade from 1979 to 2013 (Table 1). This is significantly greater than the average increase across the Arctic as a whole, which was 5 days per decade[3]. Travel along the ice edge during the melt season can be dangerous due to uneven ice deterioration. Longer melt seasons negatively impact the mobility of Arctic residents and can reduce access to subsistence resources (Figure 1).

"Last year they only get three whale because the ice get real funny right away. Every time we go down the snow machine want to fall on the water... they almost lost three ski-doos." - Wainwright Elder, 2015

Sea ice coverage is declining:
The extent of sea ice, especially at the time of its regular annual minimum in September, has been declining over the past few decades (Figure 2)[4]. The Beaufort and Chuckchi seas have seen extreme summer ice loss, with declining trends in September ice extent of approximately -20% per decade through 2015[5]. Spring declines in sea ice extent are also significant. This impacts the timing that important subsistence animals (such as bowhead wales and walrus) arrive in the region(Figure 3).

"What used to be like, maybe a two or three week period of hunting, you're cramming it into maybe a week or week and a half... this year was a week. The ice was here and it was gone... no more than 10 days it was nearby." - Wainwright resident, 2015

(a) USFWS 2006, (b) USGS 2010, (c) Photo of Willie Hoogendorn by Douglas Johnson, taken east of Cape Nome, May 2015

Figure 3: Walrus remain in the vicinity of coastal villages as long as there is pack ice nearby. This important food source is less accessible to hunters when ice floes are far out to sea.

Table 1: Trends in Freeze-up, Melt Onset, and Length in the Melt Season from 1979-2013, Expressed in the number of days per decade[3] Adapted from Stroeve et al., 2014

Region	Early Freeze Onset (EFO)	Melt Onset (MO)	Melt Length (EFO-MO)
All	3.0	-2.1	5.0
Bering	3.0	0.4	2.6
Hudson Bay	3.4	-3.1	6.5
Baffin Bay	1.3	-4.6	5.9
E. Greenland	2.4	-6.1	8.5
E. Siberian	8.4	-1.3	9.7
Chuckchi	10.7	-2.5	13.2
Beaufort	6.5	-2.7	9.2
Canadian Archipelago	2.2	-1.0	3.2

Figure 1: "Duck Hunting in Spring", George Leavitt, 2017 Hunters must exercise caution when traveling along shore ice in the early spring. It is best to travel with a partner.

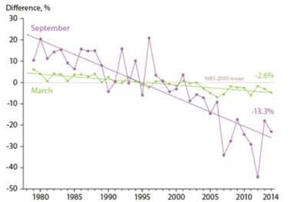


Figure 2: Historical trends in Arctic sea ice extent for March (month of maximum extent) and September (month of minimum extent). Each value is the difference in ice extent relative to the mean values for 1981–2010. The straight lines show least squares linear regressions and indicate ice losses of 2.6% (March) and 13.3% (September) per decade (Perovich et al., 2015)[4]

DOCUMENT C

WHAT WE KNOW (continued)

Sea ice thickness is declining:
Sea ice thickness is among the most difficult geophysical parameters to measure at large scales and, because of large variability and limited observational data, evaluation of ice thickness trends is difficult. However, based on subsurface sonar, aircraft-mounted sensor, and satellite lidar and radar data, it is estimated that the annual mean ice thickness in the broad region of the central Arctic basin where submarine data is available has decreased from 3.59m in 1975 to 1.25m in 2012, a 65% reduction[5].

"Well, in my time, we used to have good ice for our whaling. Nowadays, it's pretty hard for us to find thick ice to pull up a whale" - Wainwright Elder, 2015 (Figure 4)

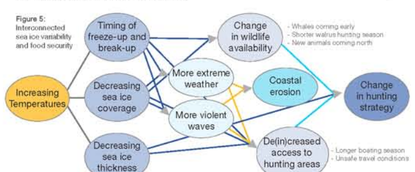
Figure 4: A minimum 3-4 feet of ice thicknesses is needed to support the weight of a whale

Figure 6: "Getting close to the lead", painted scene on baleen, George Leavitt, 2017
Depicts Iñupiat whalers breaking trail to open lead. Decreased sea ice leads to increased winds, which in turn push pressure ridges against village shorelines, making trail-breaking hard work.

IMPACTS ON LOCAL FOOD SECURITY

In the Iñupiat worldview, food security is synonymous with environmental health and encompasses a wide range of concerns from availability (ability of the Arctic ecosystem to maintain a high variety of life) to accessibility (having the ability to live off the land and to obtain sufficient access to diverse sources of healthy food)[6]. Sea ice variability has significant impacts on all dimensions of food security (Figure 5), necessitating an adjustment in traditional hunting and management strategies[6] (Figure 6).

Figure 5: Interconnected sea ice variability and food security



KNOWLEDGE GAPS

Sea ice research is limited by the availability of reliable long term data sets. In contrast to readily available sea ice coverage data, Arctic sea ice thickness observations are temporally and spatially discontinuous[8]

Available sea ice data primarily covers free floating ice in the open ocean. Reliable data for the near-shore environment is lacking[7]

There is a need for high resolution data, which is often not available via remote sensing, to assist local decision-makers[8]

RECOMMENDATIONS

- Support Arctic communities to identify local solutions to environmental challenges[6]
- Adapt traditional management methods to changing environmental conditions[6]
- Collaborate with Arctic coastal residents for near-shore sea ice monitoring and other high resolution data needs[9]
- Increase synergy of information generated from natural and social science[6]
- Develop organizational capacity to make the best use of all available information for decision-making[10]

1 IPCC, 2013. Climate Change 2013: The Physical Science Basis.
2 AMAP, 2017. Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. Arctic Monitoring and Assessment Program
3 Stroeve, J. C., T. Markus, L. Boisvert, J. Miller, and A. Barrett (2014), Changes in Arctic melt season and implications for sea ice loss, Geophys. Res. Lett.,41
4 AMAP, 2017. Adaptation Actions for a Changing Arctic: Perspectives from the Bering-Chukchi-Beaufort Region. AMAP, Oslo, Norway. xiv + 255pp
5 Lindsay, R., & Schweiger, A. (2015). Arctic sea ice thickness loss determined using subsurface, aircraft, and satellite observations. The Cryosphere, 9(1), 269
6 Inuit Circumpolar Council-Alaska 2015, Alaskan Inuit Food Security Conceptual Framework: Summary Report and Recommendations Report. Anchorage, AK.
7 Carmack, E., Winsor, P., & Williams, W. (2015). The contiguous panarctic Riverine Coastal Domain: A unifying concept. Progress in Oceanography, 139, 13-23
8 Vargas-Moreno, et al., (eds), 2016. Prioritizing Science Needs Through Participatory Scenarios for Energy and Resource Development, GeoAdaptive, LLC, MA
9 Carmack, Eddy, et al., 2012 "Detecting and coping with disruptive shocks in Arctic marine systems: a resilience approach to place and people." Ambio 41.1.
10 Kendall, J.J., et al., 2017. Use of traditional knowledge by the United States Bureau of Ocean Energy Management to support resource management, Czech Polar Reports 7(2): 151-163, ASSW 2017

Alpine milk vetch
Astragalus alpinus

Arctic poppy
Papaver macounii

Quŋulliq
Arctic sorrel
Oxyria digyna

Atchaaqłuk
Beach greens
Honckenya peploides

Aqpik
Cloudberry
Rubus chamaemorus

Milukataq
Coltsfoot
Petasites frigidus

Pikniq
Cotton grass
Eriophorum

Tilaaggik
Dwarf fireweed
Epilobium latifolium

Fleabane
Erigeron eriocephalus

Piḻgaurat
Heather
Cassiope tetragona

Marsh fleabane
Senecio congestus

Moss campion
Silene acaulis

Mountain avens
Dryas integrifolia

Nodding bladder-campion
Silene uralensis

Nodding saxifrage
Saxifraga cernua

Taqilakisaaq
Snow buttercup
Ranunculus nivalis