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Addressing Climate Change Vulnerability in Alaska Native Villages Through Indigenous Community Knowledge*

Elizaveta Barrett Ristroph
Ristroph Law, Planning, and Research, Alaska, USA

From a Western standpoint, Alaska Native Villages (ANVs) and other indigenous groups have a particular vulnerability to climate change. At the same time, these groups may be seen by themselves and Westerners as having particular knowledge that can help them adapt to climate change. This paper explores how ANVs are vulnerable to climate change and considers factors such as colonization that aggravate this vulnerability. It then explores how indigenous community knowledge may reduce vulnerability and facilitate adaptation and resilience. It concludes that indigenous community knowledge alone is insufficient to support adaptation and resilience, given the degree of social, political, and climate change, so long as Western institutions privilege Western science over other forms of knowledge. That said, indigenous community knowledge should inform agency decision-making and development projects and may serve as cultural capital that can support resilience. The desire to use indigenous knowledge may be a proxy for a larger issue—the need to include indigenous communities in decision-making about climate change.

Keywords: Alaska Native Villages, indigenous knowledge, climate change, adaptation, vulnerability

Introduction

I begin this paper with a description of an indigenous community in Arctic Alaska affected by climate change. The community was almost entirely washed out by a flood decades before. Many of the "temporary" houses installed after the flood are still in use, and many other houses remain in their original location adjacent to the flooding river. Chunks of the river bank break off and erode into the water as the permafrost beneath them melts. The caribou that residents have traditionally relied on for their nutritional and cultural needs have not passed near the village in five years. Residents are not sure whether this is the fault of outside hunters or climate change. Climate change is certainly a problem, but it is one of many concerns. There are no roads into the community, so nearly every non-local object has been imported by plane. Gas is $7.50 a gallon (nearly $2 a liter). There is still no running water in the homes. Cell phones do not work. There are no police. The community is supposed to be alcohol-free, but fighting alcohol is a constant challenge. Residents press forward doing many of the same things they have done for thousands of years (hunting and fishing) even as Western technology and institutions have left their indelible imprint.

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Elizaveta Barrett Ristroph, Ph.D., J.D., principal, Ristroph Law, Planning, and Research, Alaska, USA.

This community is just one of 229 Alaska Native Villages (ANVs), United States-recognized tribes and settlements composed of Alaska native individuals. Consideration of these communities is important to the larger field of indigenous climate change vulnerability and adaptation for several reasons. First, Alaska is home to 41% of the United States' nationally recognized tribes (BIA, 2017). How these communities adapt to climate change and how the government assists this adaptation is an issue of national importance. Second, Alaska has distinct impacts, as it is warming far more rapidly than other parts of the United States (Chapin III, Trainor, Markon, & Serreze, 2014). ANVs are grappling with changes in flooding and erosion, changes to the species on which they subsist, melting permafrost, and later formation of ice along their shores each fall—ice that used to serve as a protective barrier from destructive fall storms (Chapin III et al., 2014; Field, 2014; Ristroph, 2010). Thirty-one ANVs have been described as "imminently threatened" by climate change, and several are in need of relocation due to severe erosion and permafrost melting (Government Accountability Office [GAO], 2003; 2009). Climate change impacts and adaptation efforts for ANVs may be a harbinger for what happens with other indigenous and place-based communities in the United States that are vulnerable to climate change.

The first purpose of this paper is to provide a more holistic view of Arctic Alaskan vulnerability than what might be garnered from a vulnerability assessment narrowly focused on the physical aspects of climate change. The second purpose of the paper is to evaluate the potential for using indigenous community knowledge to help ANVs reduce vulnerability and build long-term resilience.

Methods

The paper draws from dissertation research exploring how ANVs are adapting to climate change and how policies, planning processes, and indigenous community knowledge facilitate adaptation (Ristroph, 2017a). A limitation in the initial research design was the focus on adaptation strategies specific to climate change, rather than trying to understand the various factors contributing to vulnerability. As discussed in this section, since the analysis involved both a deductive and an inductive component, I was able to bring into the study themes concerning vulnerability.

Interviews

I reached out to almost all the ANVs across the State of Alaska to explain the nature of my research and obtain recommendations for knowledgeable residents to participate in my study. I had semi-structured interviews and interview-like conversations with residents until I felt that I had a sample representing the diversity of ANVs across Alaska, and was not getting any new information. This resulted in interviews or interview-like conversations (for those that did not wish to be formally interviewed) with 76 people from 59 ANVs. Figure 1 shows the ANVs from which participants came. There was at least one participant from each of Alaska's 12 cultural/geographic regions, and participants from ANVs with a diversity of economic, political, and development characteristics (Huntington, 2000; Loring, Gerlach, & Penn, 2016; Bixler, 2013). There was a diversity of participants in terms of age, gender, ethnic background, and profession.

To better understand adaptation strategies and barriers from the perspective of those outside ANVs, I had interviews or interview-like conversations with 77 individuals associated with entities outside of ANVs. I first identified representatives from the agencies that play a role in ANV adaptation to climate change, making a chart of key state and federal agencies, laws, and programs authorized by the relevant laws. From there, I identified additional interviewees using a "snowball" technique, where I got recommendations from previous

interviewees for additional participants (Tongco, 2007; Bernard & Ryan, 2009; Jacobs & Brooks, 2011). These included not only representatives from agencies, but also representatives from the state and national legislature, Alaska native non-profit entities, and lawyers and planners who worked with ANVs.

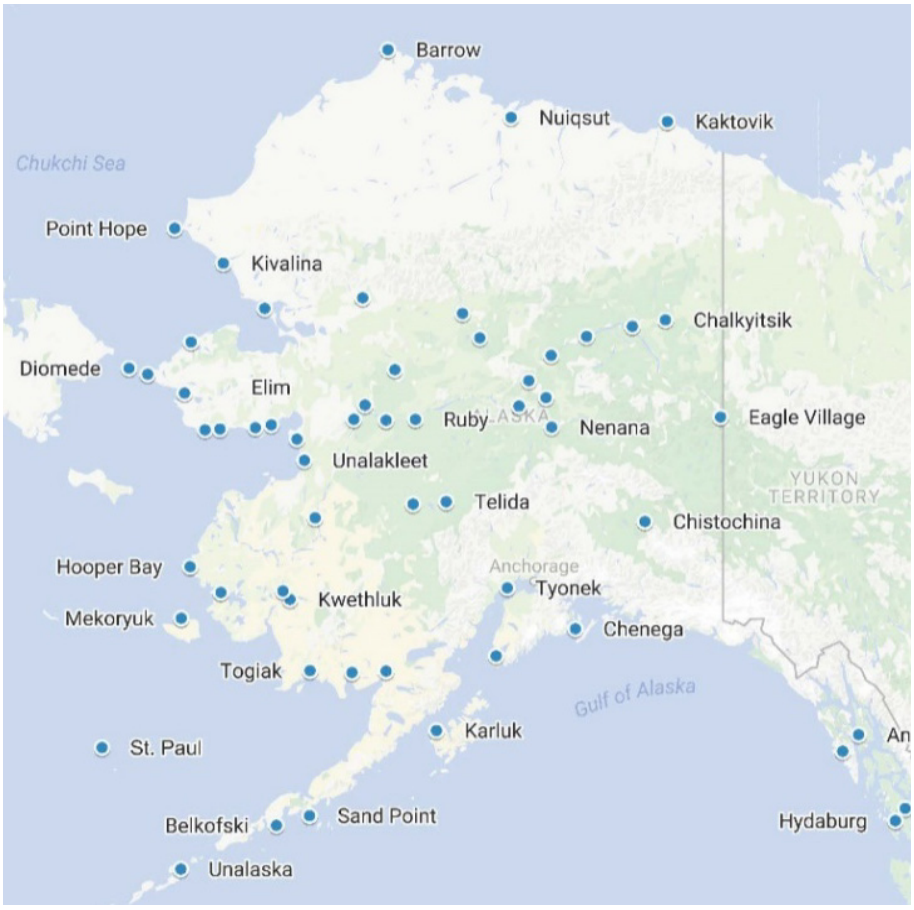

Figure 1. ANVs from which participants came (Google Maps).

I prepared slightly different questionnaires for ANV residents and those from outside, although both focused on the role of planning, adaptation strategies, adaptation obstacles, the role of communities in planning for and carrying out adaptation, and the role of external assistance. Interviews, which took place pursuant to university institutional review board protocols, were held by phone, in communities, at conferences, or in participants' offices during 2016 and 2017.

Analysis

I used qualitative content analysis (Miles & Huberman, 1994; Corbin & Strauss, 2007) to identify themes that arose from interviews and those conversations that covered interview questions, as well as in ANV plans. As recommended by Miles and Huberman (1994), I started creating codes deductively and "etically" (from the researcher's point of view) with themes already identified in the relevant literature, on which I based my interview questions (i.e., attitudes on indigenous community knowledge and its role in adaptation) (Bernard & Ryan, 2009; Ryan & Bernard, 2000). Some new themes (including "emic" themes from the participants' points of view) emerged inductively as I conducted and reviewed more and more interviews, while some of the initial "etic" themes became insignificant (Miles & Huberman, 1994; Corbin & Strauss, 2007; Ryan & Bernard, 2000).

Thus, I revised the codes over time to eliminate duplications as well as themes that were raised only one time (Bixler, 2013; Bernard, 2006; Silverman, 2000). I tracked the coding using both a spreadsheet and a document that corresponded to all of the column headings within my spreadsheet. This resulted in a "case-by-variable matrix" where each row corresponds to one participant or "case" and each column corresponds to a theme or "variable" (Bernard & Ryan, 2009). Variables include coded themes as well as (a) background information gathered on participants' villages from census information (i.e., average income, geographic region, flood declarations, and existence of hazard mitigation plan); (b) personal information on participants (i.e., gender and approximate age).

I provided each participant (ANV residents as well as outsiders) with an interview or conversation summary and asked for confirmation (Corbin & Strauss, 2007). Many participants did not respond, while 16 confirmed the summaries and 42 offered minor edits.

Differences in the questions and themes each participant chose to discuss limited the my ability to quantitatively compare responses between different participants. Given this limitation and the subjectivity of the coding, statistical analysis was not appropriate (Ryan & Bernard, 2000; Zhang & Wildemuth, 2005). I thus avoid referring to specific numbers of participants, simply using the terms "a few" (about 2 to 5), "several" (about 6 to 10), "a number of" (11-30), or "many" (more than 30). These categorizations are not statistically significant and should not be interpreted in that manner.

For purposes of this paper, there are a few instances where I have supplemented my research findings with my experience as a lawyer and planner for the North Slope Borough, a county-level government in Arctic Alaska (2007 to 2011), and for the ANVs of Allakaket (2016 to 2018) and Newtok (2017 to 2018).

Literature Review on Climate Change Vulnerability, Indigenous Knowledge, and Adaptive Capacity

"Vulnerability" is a term researchers use to describe communities' susceptibility to climate change impacts. There are as many definitions as there are researchers (Cutter et al., 2008; Oppenheimer, Campos, & Warren, 2014), with some focusing on the potential to reduce vulnerability through adaptation (Marshall & Stokes, 2014; Nelson, Adger, & Brown, 2007). The Third National Climate Assessment provides an example of the latter kind of definition, which I adopt for purposes of this research: "a function of the character, magnitude, and rate of climate variations to which a system is exposed, its sensitivity, and its adaptive capacity" (Bierbaum et al., 2014, p. 672). Here, "adaptive capacity" means the "potential of a system to adjust to climate change … to moderate potential damages, take advantage of opportunities, and cope with the consequences" (Bierbaum et al., 2014, p. 672).

It is important to point out that some researchers privilege Western notions of "vulnerability" over those of the indigenous communities they are describing (Haalboom & Natcher, 2013). These communities may not see themselves as vulnerable. The "vulnerable" label may pave the way for greater Western interference in communities, perpetuating Western colonial institutions that bypass indigenous values and knowledge (Howitt et al., 2013; Veland, Howitt, Dominey-Howes, Thomalla, & Houston, 2013). This may result in greater dependencies on Western institutions, moving indigenous communities further from self-sufficiency and autonomy (Haalboom & Natcher, 2013). My use of the term "vulnerability" in this paper is a short hand for the various risks that ANVs face. It is not meant to imply that they are somehow helpless or unable to actively adapt, as they have done for thousands of years (Theriault, 2012; Nakashima, 2012).

What Makes ANVs Particularly Vulnerable

Climate change must be considered in context, as one of several factors that contributes to the vulnerability of ANVs and other communities (Loring, Gerlach, & Penn, 2016; Arctic Council, 2017; Wildcat, 2013). As Lynch and Brunner (2007, p. 109) described the situation in Barrow/Utqiagvik, "Minimizing vulnerability to climate change is only one of the community's interests, and must compete with other interests for limited time, attention, funds and other resources." Understanding this context is important in efforts to reduce ANV vulnerability and adapt in a holistic and sustainable manner (Wilbanks & Kates, 2010; Chief, Daigle, Lynn, & Whyte, 2014; Freitag, Abramson, Chalana, & Dixon, 2014; Reid et al., 2014; Wolf, Alice, & Bell, 2013; Ford et al., 2016). This section outlines the "background" vulnerability of ANVs, and then explains how climate change aggravates this vulnerability.

Geographic vulnerability. Most ANVs are located in remote (at least from an urban viewpoint), Arctic, or sub-Arctic environments with limited means of accessing Western goods and services. Many are accessible only by planes or off-road vehicles, and only in decent weather. When severe weather impedes flights, residents are left with limited resources (Cochran et al., 2013; Chapin & Cochran, 2014). Remoteness also impedes recovery from severe weather and disasters. Not only does it complicate access, it reduces the likelihood that those who provide disaster funding will have spent time in and identify with ANVs (McClintock, 2009).

Remoteness increases the importance of "subsistence" hunting and fishing (Berger, 1999), which not only feed and clothe, but also serve as a communal glue and a medium for passing down knowledge and values (Hanna, 2007; Nuttall et al., 2005; Wernham, 2007). I am hesitant to use the term "subsistence," since many Alaska natives (especially in the Northeast) simply refer to "traditional hunting, fishing, and trapping," but it is a convenient term that already has a legal definition (Alaska St. § 16.05.940).

So important is subsistence and the lifeway built around it that many cannot imagine ANV life without it (Hibbard & Adkins, 2013). The idea of moving away from an ANV and leaving behind this lifeway is unthinkable to some ANV residents (Huntington, Kruse, & Scholz, 2009). Such attachment to place can increase vulnerability if it means that people are unable to relocate to safer places (Marshall & Stokes, 2014).

Vulnerabilities related to colonization. This subsection explains how colonization has constricted ANV control over resources needed for adaptation, increased competition for limited resources, and hobbled cultural and social capital. Prior to contact, Alaska's indigenous peoples were able to freely relocate from flooded areas and shift food production to correspond to available species (Pratt, Stevenson, & Everson, 2013). School attendance laws and missionaries herded tribes into permanent villages (Bronen, 2013; Huntington & Watson, 2012). As other researchers have noted, many settlements were positioned along waterways that are not suitable for year-round inhabitation due to flooding and erosion (Lynch & Brunner, 2007; Bronen, 2013; Marino, 2012; Ford, Pearce, Duerden, Furgal, & Smit, 2010). Settlement patterns also affected traditional hunting and fishing lifeways, as communities were no longer able to move seasonally to follow game and had to compete with settlers for the same resources (Kofinas et al., 2010). As Alaska's population has increased, fish and game management agencies are dividing limited quantities of salmon, caribou, and moose among more and more people.

Not only did colonization change the demographics, it shifted power from the tribes themselves to an external, far away source that does not always have a good relationship with the tribes or understanding of their problems (Marino, 2012; Haycox, 2006). While Alaska tribes retain some of the inherent sovereign powers held by all tribes [see 25 U.S.C. § 476 (h) (1)], they generally lack jurisdiction over what were once their lands.

The Alaska Native Claims Settlement Act (ANCSA) provided for portions of these lands to be transferred to regional and village Native Corporations in fee simple, generally regulated in the same manner as any private land (43 U.S.C. §§ 1611, 1613, 1618, 1620). The result is that leadership in many ANVs is divided between a tribal council with jurisdiction only over tribal citizens' behavior; a corporation that makes decisions regarding the land; and a municipal government with some control over infrastructure and land use (Chaffee, 2008; Smiddy, 2005). For some ANVs, being associated with three distinct entities can mean political clashes that impede consensus on community-level adaptation actions (Chapin & Cochran, 2014; Hibbard & Adkins, 2013).

Without the ability to move freely or manage resources needed for sustenance, ANVs have become dependent on Western goods and services that are hard to produce locally—especially fossil fuels (Marino, 2012). It is true that many urban residents are similarly dependent on non-local goods. But the difference between most cities and ANVs is that most ANVs have limited opportunities for earning wages (Chapin et al., 2014; Berger, 1999). Excluding the oil-rich North Slope, rural Alaska has some of the lowest household incomes in America and the highest costs of fuel and other commercial goods (e.g., $7-12 per gallon for fuel) (Cochran et al., 2013). In the four decades following ANCSA, much of the funding for community services in ANVs has been provided by the oil-rich State of Alaska along with federal agencies (Huntington et al., 2009; Haynes, 1974). Dependence on outside government funding means adhering to the priorities of these non-native institutions, which can further disconnect ANVs from their more holistic goals of self-determination (Thomas, Savatgy, & Klimovich, 2016). The overall effect of increased dependence on Western goods and outside funding is an erosion in long-standing cultures of self-reliance (Loring et al., 2016; Lynch & Brunner, 2007; Huntington, Fox, Berkes, & Krupnik, 2005). In turn, decline in self-reliance (particularly in the form of subsistence and utilizing traditional skills to craft goods) can impede cultural resilience (Reid et al., 2014; Chapin & Cochran, 2014; McNeeley, 2009; Chapin et al., 2006).

Added to this decline in self-reliance are other social problems in ANVs, including a sense of disempowerment, chemical addictions, violence, and weakened traditional knowledge, values, and social ties (Chapin et al., 2014; Berger, 1999; Napoleon, 2014; Wexler, 2014; Kemberling & Avellaneda-Cruz, 2013; Tobias & Richmond, 2014; Seale, Shellenberger, & Spence, 2006; Indian Law and Order Commission, 2015). These social problems can reduce adaptive capacity to address challenges like climate change (Abate & Kronk, 2013; Hausam, 2013).

Some families and individuals from ANVs have sought better lives by moving to urban settings. This may not be the "climigration" that Bronen (2013) had heralded so much as a long-term trend due to various social and economic factors (Hamilton, Saito, Loring, Lammers, & Huntington, 2016). Particularly in Interior Alaska, a number of ANVs have dwindling populations (Hamilton et al., 2016). While outward migration is an individual and family adaptation, it may leave a village vulnerable in terms of having no inhabitants to fulfill basic functions. In contrast, populations are rising in north and west coast villages (Hamilton et al., 2016), which benefit from a more flexible subsistence regime for marine mammals and more sources of revenue (industrial development in the north and commercial fisheries in the west). Hamilton et al. (2016) speculated that rapidly increasing youth populations could increase vulnerability in these regions, as there are more dependents in need of support and relatively few wage-earning jobs available.

Vulnerabilities specific to climate change. In the last few decades, fast-moving climate change has added to ANV vulnerability. Since the 1950s, average temperatures in Alaska have increased by 3 °F (Stewart, Kunkel, Stevens, Liqiang, & Walsh, 2013). This has resulted in changes to snow cover and precipitation

patterns, changes in flooding and erosion, species shifts, melting permafrost, more wildfires, more acidic oceans, and later formation of landfast ice (Chapin et al., 2014; Stewart et al., 2013; Field et al., 2014). Under the most conservative estimates, Alaska is projected to warm by 6 °F to 8 °F in the north and 4 °F to 6 °F in the rest of the state by the end of the century (Stewart et al., 2013). These changes affect weather events as well as subsistence (Cochran et al., 2013; McNeeley, 2009).

Researchers have documented climate change impacts in various interior, west coast, and north coast ANVs from the vantage of Western science (Brown, Knapp, & Trainor, 2015; Carothers et al., 2014; Chapman, Kim, & Mark, 2009; Ignatowski & Rosales, 2013; Nichols, Berkes, Jolly, & Snow, 2004) as well as indigenous community knowledge (Cochran et al., 2013; Ignatowski & Rosales, 2013). Vulnerability assessments have sought to portray some ANVs as more vulnerable than others (Himes-Cornell & Kasperski, 2015; Alessa et al., 2008), without necessarily considering the context of each ANV and the qualitative factors that contribute to vulnerability (Huntington et al., 2009; Rosales & Chapman, 2015).

In 2003, the Government Accountability Office (GAO) found that flooding and erosion affected 86% of all ANVs. In 2009, GAO identified 31 ANVs facing imminent flooding and erosion threats, with four villages in dire need of relocation. Climate change has increased the risks of flooding disasters (Chapin et al., 2014; Field et al., 2014; Jones et al., 2009), which in turn increases dependence on federal aid and outside intervention (Luft, 2016). A number of climate change-threatened ANVs see their future existence as dependent on outside government-assisted relocation (Ristroph, 2017b).

Aside from flooding and erosion, researchers have described species shifts (changes in species abundance or migration routes due to climate change) (McNeeley, 2009; Rosales & Chapman, 2015), difficulty accessing species across thin ice and snow coverage (Kofinas et al., 2010; Knapp et al., 2014), and difficulty preventing harvested food from spoiling (McNeeley, 2009; Brubaker, Berner, Bell, Warren, & Rolin, 2010). The combination of climate change and legal restrictions has impeded subsistence opportunities (Kofinas et al., 2010; McNeeley, 2009; Knapp et al., 2014; McNeeley, 2012; Wilson, 2014).

Addressing Vulnerability and Building Adaptive Capacity Through Indigenous Knowledge

Research describes how knowledge from indigenous communities can help address climate change by improving understanding of vulnerability and adaptive capacity (Nakashima, 2012; McNeeley, 2009; Bennett et al., 2014; Anderson, 2012; Denton & Wilbanks, 2014). There are different names for this kind of knowledge. The most frequently used name in the literature may be Traditional Ecological Knowledge, but there is a growing body of literature that uses the term "indigenous knowledge" (Makondo & Thomas, 2018; Birch, 2016; Wildcat, 2009). The latter term emphasizes the distinct nature of the indigenous epistemology—a way of knowing and thinking that differs from Western outlooks (Jojola, 2013). In this paper, I use the term "indigenous community knowledge," which modifies the term "community knowledge" I used in a previous paper (Ristroph, 2012) while making clear that the knowledge is generally collective and tied to a local culture. In some cases, it may be more appropriate to use the term "knowledges" to avoid creating a binary between indigenous or community knowledge and Western science and recognize the spectrum of knowledges that must be bridged to better address climate change (Nursey-Bray et al., 2014).

If adaptive capacity is based on different resources or "capital" that a community can draw from, including social, human, natural, manufactured, or financial capital (Walker et al., 2006), indigenous community knowledge may be an additional capital (Warrick, Aalbersberg, Dumaru, McNaught, & Teperman, 2017). This

knowledge and the values intertwined with it may support the social capital and sense of self-efficacy that are important to surmount climate change obstacles (Warrick et al., 2017). There has been criticism of efforts to assist with climate change adaptation and disaster recovery that fail to recognize indigenous knowledge and indigenous rights (Howitt, Havnen, & Veland, 2012).

The importance of indigenous knowledge has been emphasized in the context of Arctic and Alaskan climate change adaptation and fish and game management (Arruda & Krutkowski, 2017; Jos & Watson, 2016; Williams & Hardison, 2013; Chapin III, Folke, & Kofinas, 2009). Much of this research relates to using indigenous community knowledge to identify or expand on Western knowledge of environmental change and climate change impacts that contribute to vulnerability (Ignatowski & Rosales, 2013; Huntington, Quakenbush, & Nelson, 2017). Research on how indigenous knowledge has helped Arctic communities adapt to climate change impacts is generally limited to personal subsistence practices, i.e., monitoring subsistence resources, awareness of alternative resources, and knowing how to survive hazardous conditions (Berkes, Colding, & Folke, 2000; Berkes & Jolly, 2001; Pearce, Ford, Willox, & Smit, 2015). There is little research on how indigenous knowledge has successfully been incorporated into fish and game management in Alaska beyond the community level (with the exception of the success of the Alaska Eskimo Whaling Commission) (Huntington, 1992), or how indigenous knowledge has facilitated adaptation in areas outside of subsistence.

Still, researchers on Arctic and Alaska adaptation have become more sophisticated in terms of bridging indigenous and Western knowledge, and there are opportunities to do better (Rathwell, Armitage, & Berkes, 2015). One example is a mapping project by Martinez-Levasseur, Furgal, Hammill, and Burness (2017) to show how walrus hunting areas in Canadian Arctic communities have shifted over time. This project incorporated the subjectivity and limitations of indigenous knowledge by showing the geographic boundaries of the knowledge holders on the maps that depict walrus areas. Henri, Jean-Gagnon, and Gilchrist (2018) likewise paid attention to the geographical and temporal limitations in their collection of information on avian cholera in the Canadian Arctic, but note that in many cases the geographic and temporal limitations of Western science data were greater than those of indigenous knowledge. Other mapping projects based on indigenous knowledge (e.g., Iñupiaq Web GIS and Local Environmental Observer Network) have proved successful, though the end-users have often been subsistence participants rather than agency decision-makers (Eisner et al., 2012; Berner et al., 2016). More work is needed to determine how to bring Arctic community-based observations and data into decision-making beyond the community level (Johnson et al., 2015). Many researchers from both an ecological and social science background see the "co-production" of knowledge as a way to achieve this goal (Henri et al., 2018; Berkes, 2009; Armitage, Berkes, Dale, Kocho-Schellenberg, & Patton, 2011; Watson & Huntington, 2008; Sandercock, 2004).

Key Findings

Vulnerability Beyond Climate Change

I did not ask participants about "vulnerability" other than to ask ANV participants about how climate change had affected their lifeways. Yet the themes raised in the Literature Review on ANV vulnerability emerged on their own and emphasized the need to avoid viewing climate change as a singular problem. A number of participants (nearly a sixth of all participants) mentioned colonization or Westernization and problems it has caused. Nearly half of those who raised this topic were ANV participants, and most of these were older native males. One older native male from northwest Alaska said, "The government made the people

feel less than human" with changes in language, religion, and where they lived, such that people "had to change everything … Maybe it wasn't such a big issue then, but it sure turned out to be a big issue now."

More than a fifth of all participants, particularly those in ANVs, described social and cultural changes that had occurred since colonization, including loss of indigenous community knowledge, reduced participation in subsistence, loss of language and values, such as respect for elders, increased subsistence abuse, domestic violence, sexual assault, suicide, outward migration, and loss of motivation. An elder native male from interior Alaska said that one of his elders predicted that native people would live in square homes and be poor. This participant explained that the prediction had come to pass: "People used to live in circular homes. ... Now we live in square homes and we're poor. We're poor because we put our value in the wrong place, like money and material things. But we're poor in spirit."

Some ANV participants spoke out strongly against colonization. One older native male from interior Alaska said that the church had a role in settling natives and getting them on welfare. The result was that "adaptability was gone in two generations." An older native female from northwestern Alaska said, "The federal government is accomplishing its goal of making us weak." A middle-aged native male from western Alaska said, "From those first episodes of contact Alaska natives were looked upon as savages and every law since then has built upon the notion that Alaska natives are nothing and require all of the Western world's assistance and system of governance."

Not all native participants shared this point of view. Two emphasized the importance of Western education, with a middle-aged male from Western Alaska suggesting that some of his community's success came with Westernization and loss of language, and a middle-aged male from interior Alaska saying "Are we going to go back to our history of no medicine, and not reading and writing?"

A number of participants, particularly older men both from and outside of ANVs, discussed the importance of self-sufficiency. About half of those who discussed this theme suggested that ANVs have become too dependent on external assistance. But many did not see a clear path for becoming more self-sufficient. One non-native male outsider said:

> There is a lack of motivation for self-help, and no one, at least outside the native community, feels like they can come out and say this. People don't fix things themselves because they are used to having other people fix it for them. It's not a native problem, it's a psychological problem. People need motivation.

Only a few participants (all from more remote ANVs) described their community as self-sufficient or independent. A few others expressed an entirely different belief—that they had not been colonized at all and were not controlled by the Western government. One middle-aged male from Northeastern Alaska described how his people continue to do what they have always done regardless of laws governing land use and subsistence: "Corporations come and go, governments come and go. But the people and what we do, remains."

In summary, while I did not ask participants about factors that contributed to vulnerability, many came up. The loss of indigenous community knowledge emerged as a small part of a much larger loss of culture and self-sufficiency.

Indigenous Community Knowledge as an Adaptation Strategy

About half of the research participants discussed the utility of indigenous community knowledge as a strategy for adapting to climate change. More than two-thirds of those who discussed indigenous community knowledge were ANV participants, and the vast majority of those who discussed the issue were Alaska native.

The majority of those who discussed this knowledge said that it was useful. A little more than half of those who described the knowledge as useful were older natives who might be thought of as indigenous knowledge bearers. One older native male from southeast Alaska described the knowledge as "our Web, our Internet, how we got information." An older female northwest Alaska described it in a more forward looking way, saying it "will always be there, it will always work. They just need to teach it right."

Many participants gave reasons why indigenous community knowledge is useful in adaptation. Several participants in ANVs referred to its use in current subsistence practices, particularly with knowing seasons or weather or where to find things. For example, one middle-aged male from northeast Alaska described how knowledge regarding whitefish has become more important since salmons have declined, and more people are learning to fish, cut, and preserve whitefish.

Several participants from different ANVs across Alaska said that their elders had predicted climate change, just as they continue to predict climate and weather patterns. As one middle-aged male from southwest Alaska said, "These people were in tune with Mother Nature and their surroundings and had the ability to see what was coming."

A number of participants referred to the importance of indigenous community knowledge in processes that typically rely on Western science. For example, several participants (mostly in ANVs) noted that indigenous community knowledge may be more expansive than what Western researchers have gathered, such that it can supplement Western research. Several (mostly in ANVs) suggested that indigenous community knowledge can help tailor climate information, plans, or strategies to a specific locale.

Other participants focused on the cultural importance of indigenous community knowledge. Several emphasized the need to keep the knowledge alive and pass it to their children. While ANV participants clearly valued their culture, they generally did not romanticize pre-colonial practices that technology has replaced. Only one participant (a native who had moved out of an ANV) suggested that indigenous community knowledge is useful for revitalizing traditional practices if current practices become impractical (i.e., due to species shift or loss of fuel/government support). Rather, culture is valued for the human connections associated with it. For example, one native male from Northern Alaska explained how the traditional practice of whaling has kept his community together.

Aside from the cultural importance of indigenous community knowledge, there was little focus on its use outside of subsistence adaptation. Only two participants suggested that this knowledge could be useful in determining where to relocate if the community becomes uninhabitable due to climate change.

Despite the widespread recognition of the importance of indigenous community knowledge, few participants specifically referred to it when asked them to identify adaptation strategies. A few mentioned the need for more teaching of traditional knowledge and cultural practices. Only two referred to collecting what might be considered "traditional" indigenous knowledge from their elders as a way to adapt. Collecting "new" environmental knowledge (i.e., community-based monitoring) was mentioned as an adaptation strategy far more often by a number of participants within and outside of ANVs. This kind of knowledge may fall under the banner of community indigenous knowledge, though it is more often based on Western ways of collecting, storing, and reporting information. Several participants (mainly those from ANVs that have Western scientists on staff or as a resource) specifically referred to the importance of Western science-based data collection protocols and adequate training in order for regulatory agencies to accept ANV-collected knowledge. Such protocols have enabled these ANVs to achieve regulatory changes regarding subsistence. A few participants

specifically emphasized the need to document climate change impacts in a manner that garners agencies' attention (i.e., through publication of reports).

To summarize, participants saw value in community indigenous knowledge in addressing climate change. But they were far more likely to suggest collecting knowledge in a manner that conforms to Western science than in ways more typically associated with traditional indigenous knowledge.

Limitations of Indigenous Community Knowledge

Several participants—almost all older natives—suggested that indigenous community knowledge had limited use, and a few natives in ANVs said that it was not useful for adaptation. A number of participants identified specific limitations, even if they still believed that the knowledge was useful overall. Limitations included the contextual nature of the knowledge, the extent to which it may be outdated and inapplicable to current situations, the loss of knowledge or its use by only a small segment of the population, and the inability of Western scientists and agencies to use the knowledge.

The difficulty in bridging indigenous community knowledge with Western science was a repeated theme raised by a number of participants. Those outside of ANVs recognized that many pay lip service to indigenous community knowledge, but few, if any, know what to do with it. Those within ANVs expressed frustration that their knowledge was not accepted by regulatory agencies. For example, one ANV participant, a young female from the Aleutian Islands, described a proposal to close an area to commercial fisheries. The proposal was based on indigenous community knowledge since there was insufficient Western science for the area. But the regulatory board only wanted specific numbers, not "anecdotes." Another ANV participant, a young man from Northern Alaska, noted that agencies want ANVs to "have faith" in agency studies, yet the agencies do not have faith in the ANV's knowledge even when an ANV is being directly impacted by a project or climate change. These examples illustrate the disparity in power between different knowledge systems. Nothing compels agencies to use indigenous community knowledge if they choose to disregard it.

Related to the power disparity is a disparity in "capacity" from a Western standpoint. One non-native agency representative acknowledged that a lot of ANV knowledge regarding fish and game populations could be put to use in decision-making and is not being used currently. "But there are real capacity challenges in rural Alaska to obtaining this information in a consistent manner and providing it regularly." This person suggested a more coordinated effort between agencies and communities that makes room for various types of information to be considered and trains biologists in human dimensions of management.

A native agency representative offered a more positive perspective, suggesting that her agency was using more indigenous community knowledge in part because it was collaborating better with ANV residents and hiring them to collect samples. As discussed in the previous section, it seems to be key for ANV residents to have training in Western science protocols for collecting data.

To summarize, indigenous community knowledge can seem "limited" when viewed through a Western lens unless it can be stripped down and forced into the parameters of Western science. Indigenous community knowledge can also seem limited if climate change has made it inapplicable or if the knowledge holders no longer exist.

Failure to Consider Community Knowledge in Decision-Making

About a third of the research participants discussed what they viewed as "maladaptations" or adaptive efforts that had unintended consequences. For example, a number of participants referred to decisions made or

projects completed by outsiders without considering the community's knowledge. The participants had pointed out that the proposed infrastructure was designed for temperate climates and would not withstand local conditions, yet their knowledge was ignored. The local knowledge of Arctic and sub-Arctic environments in this example may or may not fall into the same epistemological category of "indigenous community knowledge" discussed by participants in other contexts. Regardless of what it is called, however, what is important is the consequence of failing to consider it.

Some examples of maladaptations did concern "traditional" knowledge held by elders. For example, one older male ANV participant referred to a community decision to relocate following a flood in the early 1970s. Some elders in the community opposed the selected new site, since they had seen this site flood in the late 1920s. But the rest of the community discounted their elders' wisdom and decided to relocate to the new site, which later experienced severe flooding.

To summarize, not only are there negative consequences for those who depend on subsistence lifeways when their knowledge does not translate to a Western system, there are also negative consequences for communities when their knowledge is not taken into account in decisions regarding infrastructure.

Discussion

This paper outlines a range of factors that have contributed to ANV vulnerability beyond climate change—most significantly, those associated with colonization. Even though my original research design did not seek to gather information on vulnerability beyond that related to climate change, participants raised these issues on their own. Thus, while the key findings regarding vulnerability likely do not convey the complete picture, they should not be ignored in research and decisions to address ANV vulnerability to climate change. A narrow vision of adaptation that simply focuses on climate change or indigenous community knowledge can overlook community concerns and goals, leading to interventions that may be well-meaning but perpetuate colonialism (Loring et al., 2016; Cameron, 2012).

Continuing to view indigenous community knowledge so separately from Western science may also perpetuate colonialism (Nursey-Bray et al., 2014; Cameron, 2012), as it tends to exoticize this knowledge and lump it all into one category. I found a range of epistemologies among my research participants, from the distinctly non-Western, traditional views of some elder native men to those of younger and more urban natives well-versed in Western institutions and business practices. Several ANVs have successfully navigated the Western system in regard to subsistence regulation by harnessing Western techniques to prove what they know to be true. While collecting data in cooperation with Western scientists or for submission to Western agencies may not be seen by some as "indigenous community knowledge," it has emerged as an important adaptation strategy.

In cases where projects led by external entities have failed due to disregard for indigenous community knowledge, the failure was not only mechanical but also social and political. It may have aggravated the sense of being colonized or distrust towards the government and outsiders. This suggests that the need to consider indigenous community knowledge is not just about the substantive value of the knowledge, but also the procedural importance of adequate consultation and community participation in decision-making (Veland et al., 2013).

Rather than narrowly focusing on indigenous community knowledge as a vehicle for adaptation, the focus should be on ensuring that a range of community voices are front and center in decisions and projects that

affect these communities. Indigenous community members could benefit from being trained in Western science and law to the point where they can "speak the language" and navigate the agency and legislative decision-making processes. I recognize that this statement may be perceived as upholding the system of colonization that has contributed to indigenous vulnerability in the first place. That said, there is a need for education and fluency in the Western system in order to change it, given the institutional inertia that works to maintain the current system (Munaretto & Klostermann, 2011; Munckaf Rosenschöld, Rozema, & Frye-Levine, 2014). At the same time, agency representatives and decision-makers should be incentivized to spend sufficient time in communities listening and learning so that they can understand concerns, goals, values, and cosmologies related to climate change and other matters (Kofinas, 2016).

Finally, I want to focus on the cultural aspect of indigenous community knowledge. The difficulty of bridging this knowledge with Western science relates to the fact that it is interwoven with place, language, subsistence practices, and values—all of which are aspects of culture. Much has been written about the value of "cultural capital" in indigenous resilience (Arctic Council, 2017; Ford et al., 2010; Wexler, 2014; Nilsson, Hovelsrud, Amundsen, Prior, & Sommerkorn, 2016; Houkamau & Sibley, 2011), although cultural capital has different significance for different communities and even among those within the same community (Wexler, 2014). To the extent that identifying and fostering indigenous community knowledge is important to an ANV, the ANV and outside supporters should support this effort. But teasing out particular nuggets of indigenous community knowledge in the hopes that this will build resilience does not support holistic adaptation.

Limitations of This Research

As stated in the "Methods" section, a limitation of this research is that it was initially more narrowly focused on adapting to climate change, rather than understanding the underlying vulnerabilities that contribute to climate change and the relationship between these vulnerabilities and indigenous community knowledge. The finding that participants had much more to say about how their knowledge can be used for external advocacy than how it can be used for adaptation may relate to how the interview questions were posed rather than a lack of internal adaptation strategies. An additional limitation was that the research did not quantitatively analyze how attitudes about vulnerability and knowledge differ according to age, gender, and ethnicity. While future research could seek to analyze vulnerability more systematically, this may or may not be useful to ANVs and others trying to maintain their culture and knowledge in the face of climate change. What may be more useful is for researchers to understand that vulnerability is complex, and neither climate change adaptation strategies nor indigenous community knowledge should be viewed outside of the context of the societies in which they exist.

Conclusions

Already challenged by colonization and other problems, ANVs have entered an era of rapid climate change. Some of the indigenous community knowledge that aided adaptation in the past has likely declined. Simply relying on a revival of this knowledge to rebuild resilience and adaptability is probably insufficient to sustain ANVs in the modern Western world in which they find themselves. Knowing how to navigate the Western system of laws, funding, and bureaucratic processes is necessary to obtain resources that ANVs need to adapt.

This does not mean that the knowledge should be discarded—there are many important applications. One is the continued value of the knowledge related to subsistence, which is still useful in adapting subsistence

practices. Another is the slowly growing partnership between indigenous communities and scientists to document and better understand environmental changes. Another relates to the importance of consulting with residents of an indigenous community before embarking on development projects in the area. Aside from ethical and legal duties to consult, there is a practical reason to vet projects with locals: They have knowledge of what may fail and why. Finally, indigenous community knowledge can be a source of cultural capital, along with other aspects of culture that contribute to resilience.

Those who seek out indigenous community knowledge should understand the power dynamics that lie behind the practical applications of the knowledge. Beyond just sharing knowledge, indigenous communities want to be respected and treated as partners in decision-making. Efforts to assist ANVs respond to climate change should not just gather knowledge, but also seek to understand the larger picture of ANV challenges, values, and goals. This requires understanding what the community itself considers to be indigenous knowledge and how the community want to see this knowledge used. It also requires looking more broadly at the problems created by climate change and partnering with communities to find political and practical solutions informed by community as well as Western knowledge.

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