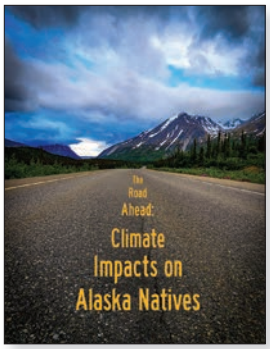
FEATURE STORY




# Impact of Climate Change on Alaska Natives

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Abstract **Alaska, with its unique geographical and ecological characteristics, is experiencing the detrimental effects of climate change at an alarming rate. The Alaska Native (AN) population, deeply connected to the land and its resources, faces disproportionate vulnerability to these impacts. We call attention to climate change impacts on AN food sovereignty, mental and behavioral health, cultural and spiritual practices, resiliency and adaptation, and how local Alaskan organizations are addressing climate change impacts.**

**This article also highlights the urgent need for environmental public health professionals to engage with AN and Native American communities, address health inequities, and participate in mitigation and adaptation efforts to address the environmental public health threats and consequences of climate change. Increasing awareness of climate-related health impacts on these communities is crucial and immediate actions are needed to support safer, healthier, and more sustainable and climate-resilient communities. Government agencies at all levels should also seek to integrate perspectives from Indigenous Peoples, engage in co-management strategies, and provide equitable funding and support for Indigenous communities. Unity, resilience, and adaptation become attainable goals by joining communities in caring for the environment. This message resonates not only in Alaska but also globally, highlighting the need for collective action in the face of climate change.**

## Introduction

The National Environmental Health Association (NEHA), in partnership with the Centers for Disease Control and Prevention (CDC), are committed to elevating and raising awareness of the environmental public health concerns that are disproportionately impacting the Native American and Alaska Native (AN) populations. Environmental public health professionals play a critical role in addressing the health and well-being of their communities and environment, and are well-positioned to address health inequities that are exacerbated by climate change, environmental injustice, and social inequities. In this article, we call attention to the impact of climate change on AN communities and highlight resources environmental public health professionals can use when engaging with these communities.

## Alaska and Its Unique Challenges

Alaska is at the forefront of climate change, which is impacting people, wildlife, and the environment. AN communities are disproportionately vulnerable to the impacts of climate change due to their deep socioeconomic ties with ecological systems and the institutional barriers that limit their ability to adapt to rapid environmental and social changes (Gray et al., 2018; U.S. Climate Resilience Toolkit, 2023). As the largest state in the U.S., Alaska is almost one fifth the size of the combined lower 48 states. Located on the northwest extremity of North America, the northern one third of the state lies above the Arctic Circle and is abundant with natural resources and is economically dependent on oil, mining, fishing, and tourism (State of Alaska, n.d.). Alaska is home to 40% of the nearly 600 federally recognized tribal nations in the U.S. (U.S. Climate Resilience Toolkit, 2023).

Alaska's climate has been warming 3 to 4 times as quickly as the global average since the 1950s (Rantanen et al., 2018). In December 2022, Utqiagvik, the state's northernmost community, hit a record high of 40 °F, the warmest temperature on record for that season (Borenstein, 2022). A warmer climate has impacts that stretch across the

## An Alaska Native Perspective on Climate Change

The following shares an Alaska Native perspective on traditional science-based culture and the life of the Yup'ik as it relates to the historic life-way juxtaposed with the current challenges of climate-related health threats. As stated by Krupnik et al. (2009), "Long ago our beliefs and our way of life weren't seen as separate things. But nowadays, they look at those two as separate."

This perspective was shared with us by Angutekaraq Estelle Thomson, a Native Village of Paimiut Traditional Council Member, Tribal Development lead, and Yup'ik Tribal Doctor/Traditional Healer:

At the very center of our cultures was our connection to The Creator-God, The Divine. Ellam Yua (the Person of our Universe). We situated everything around our belief system—our family life, how we organized and governed our communities, our traditional life-way, all activities of living. Relationships with self, relationships with our Creator, with family and your partner, with our community, with the land, the water, the plants, and the animals. That primary relationship with our Creator was at the heart of everything. It made us whole. We based our code of conduct in the human and natural worlds on that relationship. We understood that the natural order of things in our Universe was based on that relationship. We had Yuyaraq, which was a basic code of conduct.

Yuyaraq is a word that breaks down into two concepts: "person" and a "way of doing or being." Yuyaraq is "the way of the real human being." Our lives as human beings were always thought to be a moral act between responsibility and respect. The rules and prohibitions that subscribed to our behavior, our thoughts, and our intentions constantly reinforced that our life was a spiritual practice. Every choice (good or bad) was rewarded with an equal consequence. After contact with Western society and time, a key piece of who we were and what we knew about ourselves as being "Real People, Real Human Beings" was lost, which is that awareness that every aspect of our life had spiritual connection.

We had consequences for not recognizing and cultivating those connections.

For the Yup'ik harvest disruptions accomplished by means of a natural disaster were not perceived as arbitrary or externally imposed events. On the contrary, they were the result of an infraction in the elaborate code of interaction between humans and the natural environment. High water and freezing weather, along with the hardships and famine that attended them, were caused by human misdeed, not arbitrary chance (Fienup-Riordan, 1986).

For years now, the Yup'ik people in Southwest Alaska have been among some of the hardest hit Indigenous cultures of Alaska by low salmon returns, thinning ice, permafrost thaw, coastal and riverine erosion, and more effects of climate change. These are things Elders have long since warned us about. For decades, Yup'ik Elders have foretold a time of hardship.

Yup'ik People, like many of the world's Indigenous Peoples, have long been applied scientists. To be an Indigenous Person, who is living a traditional life-way, is to be observant, adaptive, and innovative, and to rely on traditional teachings to help guide us in our lives and how we take care of our families.

"Yupiit augkut qaqimallruyaaqelliniut ciuqliput. Ca cuqingasterluni. Ca nallunritesterluni. Tamaa-i tamakut cuqingailriit cat nalluvkenaki, callrit-llu nalluvkenaki. Scientist-aullrulliniameng augkut ciuliaput."

Translated to English: "Our Yup'ik ancestors apparently were complete with everything needed to keep the culture alive. They had experts who could measure and understand happenings in their daily lives. Our ancestors apparently were scientists" (Fienup-Riordan, 2007).

Science in all our cultures meant we understood and lived with, not tried to mold, the environment around us. That in part was accepting where our spiritual practice stood in relation to how we developed our technology. We as Indigenous Peoples didn't have textbooks. We have oral history. Our Elders are our teachers. If we no longer have our Elders with their traditional knowledge, we no longer have that information. We teach by showing, we learn by watching and doing. Just as there is nuance in our traditional languages, there is nuance in traditional education, with the rules for our behavior, our cultural values, and the code by which we live.

In many models of traditional life-way, it is said that society begins in unity and co-activity. Yup'ik Elders believe that reciprocity is the way, and keeping the rules will allow us to keep our humanity. With the drastic changes in the Arctic climate in recent years, we have no teachings to rely on.

state and are projected to cost from $3.3 to $6.7 billion to address (Gray et al., 2018).

Climate change in Alaska is modifying Arctic marine ecosystems, decreasing the average annual sea ice coverage, reducing the size of glaciers, and degrading permafrost. The marine ecosystem in Alaska is a major part of the economy and a source of subsistence harvests. The decreasing average Arctic sea ice coverage and increasing ocean acidity have large-scale impacts on marine ecosystems and their inhabitants, including the distribution of sea life and food sources.

The increasing temperatures have also physically and biologically altered Alaska's land. The impact on the land includes permafrost degradation, increasing coastal erosion, and changing vegetation due to intensifying wildfires and elevated temperatures (Chapin et al., 2014). Thawing permafrost has profound effects on Arctic Alaska including physical impacts that compromise important infrastructure such as building and pipeline foundations, road and power lines, and wastewater containment. The increasing risk of larger and more frequent wildfires poses a direct risk to human health by elevating exposure to smoke and particulate matter (Centers for Disease Control and Prevention [CDC], 2021). Shrinking glaciers are expected to continue and have been linked as one of the largest contributors to global sea level rise. Glacial water is rich with organic compounds that are vital to marine life and these changes impact Alaskan fisheries (Climate Adaptation Science Centers, n.d.).

## Alaska Natives

For hundreds of generations, ANs have passed down their knowledge, stories, and experiences. Their sacred connections between humans and the environment are nurtured through all the pieces found within an ecosystem, including the essence, the cycles, and throughout the whole system. In their culture, science meant that they "understood and lived with, not tried to mold, the environment around us" (Thomson, 2019). It is impossible to unweave ANs from their environment or ignore the profound impacts that climate change is having on their very existence. The environment is key to not only their physical existence but also their spiritual and cultural way of life.

*Collins J. Fleming, Sr. shared his insight on the importance of subsistence hunting and fishing.*

Alaska is home to 229 tribes that consist of 5 groups of AN people with 11 cultures, 20 languages, and 300 different dialects (Alaska Department of Environmental Conservation, 2023; Travel Alaska, 2023). Of the 730,000 Alaskan residents, 15% are ANs. There are five groups of ANs, identified by region. These regions include the Arctic (Iñupiat and Yup'ik), Southcentral and Interior Alaska (Athabascan), Southwest Alaska (Central Yup'ik and Cup'ik, Unangax̂ and Sugpiaq), and the Inside Passage (Eyak, Haida, Tsimshian, and Tlingit; Travel Alaska, 2023).

Many ANs live in villages along the coastline and rivers and depend on subsistence hunting and harvesting for survival as they have done for thousands of years. Reliance on the land and environment for food, shelter, and medicine—as well as close relationships between their social, mental, spiritual, and cultural well-being with nature—make ANs more vulnerable to the impacts of climate change (Bennett et al., 2014). Agatha Napoleon, councilmember of the Native Village of Paimiut, describes the impact of climate change on their village as "not just breaking down of culture, it's the breakdown of our little society" (A. Chang, personal communication, July 3, 2023).

More recently, AN communities in the Arctic have become reliant on the oil and gas industry to subsidize essential services and infrastructure such as running water, flushing toilets, and modern medical and school facilities that could otherwise not be possible without these funds. While the oil and gas industry has brought positive consequences to AN communities, the environmental impact of this industry has also brought negative consequences that affect their traditional economy, social structures, and environment (National Research Council, 2003).

## Climate Change Impacts on Alaska Natives

### Impact on Food Sovereignty

Climate change is a major concern for AN food sovereignty efforts to preserve and support traditional practices while also conserving the environment and restoring biodiversity (Inuit Circumpolar Council Alaska, 2020a). The AN connection to their environment and animals extends beyond daily sustenance. Herman Ahsoak, a whaling captain from Utqiavik, describes the practice of whaling harvesting as, "We do not pick the whale, the whale picks us. It gives itself to the people" (G. Bare, personal communication, February 3, 2023). According to the Inuit food security conceptual framework, food sovereignty and food security are intimately connected, with food sovereignty being a necessity to maintain food security (Inuit Circumpolar Council Alaska, 2020b). Common concepts such as resource management and subsistence do not capture the multifaceted dimensions of food security for ANs.

> As defined by the Inuit, food security is: The natural right of all Inuit to be part of the ecosystem.…It allows for all Inuit to obtain, process, store, and consume enough of healthy, nutritious, and preferred food—foods Inuit physically and spiritually crave and need from the land, air, and water. (Inuit Circumpolar Council Alaska, 2020b)
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> Food sovereignty as defined by the Inuit is: The right of all Inuit to define their own hunting, gathering, fishing, land, and water policies; the right to define what is sustainably, socially, economically, and culturally appropriate for the distribution of food and to maintain ecological health. (Inuit Circumpolar Council Alaska, 2020b)

Traditional subsistence foods consumed by ANs vary depending on their location. Common subsistence sea and land animals include various species of fish (e.g., salmon, herring, pike, whitefish, halibut), whale, caribou, moose, elk, bear, rabbit, lynx, seal, walrus, geese, beaver, shrimp, crab, various eggs, and more. Commonly consumed sub-

sistence plants include berries (e.g., crowberries, lowbush salmonberries, blueberries, cranberries, huckleberries, elderberries), seaweed, sea asparagus, fireweed jelly, wild onions, teas, and more (Alaska Native Health Board & Alaska Native Epidemiology Center, 2004). ANs consume or use every part of an animal. For example, seal meat is eaten, skin is transformed into hunting buoys or food storage containers, intestines are used for clothing materials, and the hide is used for water-resistant gloves or boots (Maxwell, 2022). One study showed that subsistence foods make up between 12% and 34% of AN total energy intake, varying by region. Subsistence foods are the main source of protein, vitamin B-12, iron, and 96% of all the omega-3 fatty acids (Alaska Native Health Board & Alaska Native Epidemiology Center, 2004). In a more recent study, however, researchers found that over a 10-year period, traditional foods consumption has declined significantly (Redwood et al., 2019).

Increasing temperatures have altered Alaska ecologically and threaten the food security of AN communities. The decreasing and changing sea ice patterns have affected access to subsistence marine mammals due to the shift of animal distribution, timing, behavior, and local abundance (Huntington et al., 2016). For example, the bowhead whale, an important animal hunted traditionally in the Iñupiat community, has altered its seasonal pattern by arriving earlier in the spring and later in the autumn. Although more bowheads have been spotted by hunters, the cumulative impact of thinner annual shorefast ice has made it difficult for hunters to find ice thick enough to haul and butcher whales (Huntington et al., 2016). Herman Ahsoak states that "ice conditions are a major challenge. Every year now the ice thickness and conditions have started to vary. Many years ago, you could rely on the sea ice being 12–14 ft thick, but not anymore" (G. Bare, personal communication, February 3, 2023). Due to the reduction and thinning of sea ice, hunters face increased risks such as boating accidents and falling through the ice. The change in sea ice has also decreased Alaskan salmon populations and introduced invasive marine species to Alaskan seas, thereby altering or reducing subsistence resources for ANs (Alaska Sea Grant, 2015).

In the southwest region of Alaska, an area where salmon was once plentiful and a critical food source for inhabitants, salmon numbers have been in steep decline. According to Agatha Napoleon, they are "seeing more disease in our fish" and must throw "about one fourth of them away" (A. Chang, personal communication, July 3, 2023). The National Oceanic and Atmospheric Administration Fisheries (2022) attributes the decline to several factors including warm water temperatures. Ellen Napoleon, council president of the Native Village of Paimiut, also attributes the salmon decline to the commercial "trawler fishing out in the Bering Sea" (A. Chang, personal communication, July 3, 2023).

In 2023, to increase and protect salmon numbers, Alaska Wildlife officials restricted

## Resources to Build Engagement With Indigenous Peoples

Local, national, and international policies and decisions impact the daily lives of Indigenous Peoples. Impacts include Indigenous sovereignty, food security, health, environment, economy, and more. Indigenous Peoples need to be more than just partners in these discussions, they need to be prominent drivers of the decisions that affect their communities.

In working with a community, it is important to spend time, money, and energy with the people to understand their values and protocols for engagement (Inuit Circumpolar Council, 2022). Environmental public health and other local government agencies need to acknowledge that inequity is a structured system and not based solely on individuals. Agencies and organizations need to integrate and institutionalize equality and social justice concepts and values into their policies, procedures, practices, norms, and values.

The following resources provide a starting place for promoting a health equity lens within an agency or organization.

### Protocols and Considerations for Engagement With Indigenous Communities

- Circumpolar Unit Protocols for Equitable and Ethical Engagement: www.inuitcircumpolar.com/project/circumpolar-inuit-protocols-for-equitable-and-ethical-engagement/
- Working Effectively With Alaska Native Tribes and Organizations Desk Guide: https://mentalhealthce.com/courses/contentWAK/WAK-Working-with-Alaska-Natives-Protocol-Etiquette.pdf
- Guidance for Federal Departments and Agencies on Indigenous Knowledge: www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf
- Health and Wellness Planning: A Toolkit for BC First Nations: www.fnha.ca/WellnessSite/WellnessDocuments/FNHA-Health-and-Wellness-Planning-A-Toolkit-for-BC-First-Nations.pdf

### Examples of Equity and Social Justice Integration Into Environmental Public Health Agencies and Services

- National Environmental Health Association
  - Integrating Environmental Justice and Climate and Health: www.neha.org/Images/resources/Integrating%20Environmental%20Justice%20and%20Climate_FINAL_5-10-23.pdf
- Seattle–King County, Washington
  - Equity and Social Justice Strategic Plan: https://kingcounty.gov/elected/executive/equity-social-justice/strategic-plan.aspx
  - True North and Values: https://kingcounty.gov/elected/executive/constantine/initiatives/true-north.aspx
- Los Angeles County, California
  - Racial Equity Strategic Plan: https://ceo.lacounty.gov/racial-equity-strategic-plan/
- City of Lawrence, Kansas
  - Equity and Inclusion Department: https://lawrenceks.org/equity/

salmon fishing in southwest coastal villages such as Hooper Bay (Martínezcuello, 2023). Fishing restrictions on salmon have further stressed ANs who struggle with food security due to the decrease in salmon over the last few years. Agatha Napoleon states that villagers must travel to other areas to hunt or fish, which can involve traveling 60–80 mi in 1 day on a snowmobile, and "then sometimes we catch nothing" (A. Chang, personal communication, July 3, 2023).

Another example of decreasing hunting opportunities is seen in northwestern and western Alaska. Historically, migration of seals lasted for 2 months, but migration has shortened to a 2-week period. The compressed migration season reduces hunting opportunities to a smaller window of time (Huntington et al., 2016). Cyrus Harris, a long-time resident of the Kotzebue region, describes the situation as, "We have been dealing with a lot of climate change for a least 15 years by far. So that year [2018–2019], we had a 3-day window and that's a very short window. If you missed that opportunity, we know you're empty-handed. That happened for a couple of years" (G. Bare, personal communication, May 4, 2023).

The warmer temperatures and higher humidity have also affected the safety of harvested meats and seafood through algal blooms that can produce harmful toxins to humans when consumed and through thawing ice cellars that have traditionally been used to store food (CDC, 2021). Communities that have not found alternative food storage methods have had to alter their diets to Western foods that can cost twice as much in rural Alaska than in Anchorage (Gray et al., 2018). The rapid shift from traditional foods to Western commercial, prepackaged food has impacted the health of ANs. Research shows that AN adults were 50% more likely than non-Hispanic White adults to be obese and AN adolescents were found to be 30% more likely than non-Hispanic White adolescents to be obese (Office of Minority Health, 2020). Being overweight increases the likelihood of illnesses such as diabetes, which has been increasing among ANs (Alaska Native Epidemiology Center, 2017).

Thawing permafrost from warmer temperatures has also posed health threats to ANs by releasing human-made and naturally formed pollutants. Pollutants can enter drinking water sources and can cause additional water and food safety and security issues (Evengard et al., 2011). Rising temperatures and longer growing seasons have increased the risk of larger and more frequent wildfires that can alter the vegetation distribution essential to wildlife, and thereby alter the distribution of wildlife populations that are vital to the diet of ANs (Gray et al., 2018). Additionally, a majority of the >200 AN communities are affected by coastal and river erosion, which is exacerbated by climate change. Increased coastal and river erosion elevates the threat of flooding events, disturbance of sensitive ecosystems, and damage to food system infrastructure, which further threaten efforts toward food sovereignty (Alaska Federation of Natives, 2018).

*A herd of caribou runs across the frozen landscape as the sun rises on the horizon. Climate change has affected migration seasons in Alaska.*

## Impact on Cultural and Spiritual Practices

Environmental impacts of climate change also have direct affects on AN cultural and spiritual practices. The land, environment, and animals are interwoven with their identity, culture, and spiritual practice (Bennett et al., 2014). Climate change threatens long-established practices in hunting and harvesting food that are vital aspects of AN culture and traditions.

The deep relationship between food and tradition is described by a long-time Arctic resident:

> When we think about what sea ice means to us, food is at the center. We have traveled the sea ice our whole lives, like our ancestors before us, to hunt for food. The food we harvest provides more than nourishment for our bodies. Being able to give food to our families and children, our elders, our dogs, and our community, feeds something deep within us; a satisfaction or knowing that we have provided, we have cared for, and we have respected our traditions. (Gearhead et al., 2013)

Cultural and spiritual connections can also be severed through accelerated physical environmental changes caused by a warming climate, such as permafrost thaw, coastal and river erosion, glacier melts, and wildfires. These processes can destroy and damage culturally and spiritually significant sites at an accelerated pace, including historical structures, landscapes, buildings, archaeological sites, and ancestral lands (Nicu & Fatorić, 2023). Extreme weather events such as major storms resulting in damage to physical structures have also occurred (CDC, 2021).

In 2022, Typhoon Merbok devastated the village of Hooper Bay. Angutekaraq Estelle Thomson of the Alaska Wildlife Alliance described the impact of the storm on Hooper Bay:

> It did a lifetime of erosion in one storm. All dunes, including the old village and houses, were completely swept around. These were the houses of our ancestors. That was a very historic and cultural site and that was very hard for us. That was a site for well over 1,000 years. (G. Bare, personal communication, June 6, 2023)

## Impact on Mental and Behavioral Health

Climate change is exacerbating and increasing mental health issues that stem from experiences with rapid sociocultural changes and acculturation in the last century. Increased mental health issues such as stress and anxiety, psychosomatic symptoms, and depression have been associated with acculturative stress (Bell et al., 2010). Examples of acculturative stress include the loss of traditional food resources and habits, cultural practices, and jobs (Berner & Furgal, 2005). Climate change impacts on ANs have forced communities to behave or adapt to new cultural structures, which add to the stress of existing acculturation or can cause re-traumatization (Bell et al., 2010). Other ways climate change affects mental health is by disrupting social, economic, and environmental determinants of health, and inducing stress by introducing an uncertain future and disrupting traditional cultural practices (Bell et al., 2010).

The psychosocial stress exacerbated by climate change has manifested in higher in-

cidences of social problems seen in AN communities. Alcohol abuse, in the form of regular to sporadic binge drinking, has increased accidents and violence and is linked to suicide, job instability, and domestic abuse (Bell et al., 2010). An example of the detrimental impacts of climate change on mental health is the shortening period for subsistence seal hunting in northwestern Native Alaska. This change can lead to feelings of loss and grief that when built on longer-term feelings of disconnect, can contribute to mental and behavioral health issues such as depression, suicide, and substance abuse (Berner & Furgal, 2005). Agatha Napoleon describes the impact of climate change on their community's mental health: "We're all getting frustrated and it does not do a community good at all when everybody is getting frustrated. It's not a healthy community" (A. Chang, personal communication, July 3, 2023).

### Resiliency and Adaptation

ANs have a long history of resiliency and adaptation to the harsh conditions and the dynamic climate and ecological shifts of Alaska (Bennett et al., 2014; Cook Inletkeeper, 2020). For centuries, their strong cultural ties—bolstered by traditional subsistence harvesting and resource sharing between networks of individuals and communities—have been key to their resilience and ability to adapt. An example is the decrease in the caribou population and increase in the moose population that occurred over one hundred years ago in interior Alaska. Their ability to shift from caribou to moose for subsistence hunting ensured their survival (Kofinas et al., 2010). Another important factor in the resiliency and adaptive abilities of ANs was a nomadic lifestyle that enabled communities to move freely to different regions where subsistence resources were abundant through changing seasons (Kofinas et al., 2010).

The importance of traditional values and knowledge for resiliency and adaptation is encompassed in this quote from an AN resident:

> Even as the world around us changes, which it always has in one way or another, knowledge is adapted and the lessons, skills, and values of the past still matter and still provide wise guidance for anyone living the Arctic way of life. (Gearhead et al., 2017)

#### Example of Food Sovereignty in North Slope Borough, Alaska

In the northernmost borough of Alaska and within the Arctic Circle, the North Slope Borough is home to approximately 7,000 people, with the majority of the population being Iñupiat, meaning "real or genuine person" (Alaska Native Language Center, n.d.). The borough includes 89,000 $mi^2$ of land that stretches from the Arctic Ocean coastline to the foothills of the Brooks Range.

The harvest of marine and land mammals, fish, and migratory birds are a way of life for the Iñupiat and their culture, identity, and livelihood are intertwined with hunting (Brower & Hepa, 2010). The bowhead whale and caribou are the most important resources for the Iñupiat. As a cultural touchpoint for generations, the harvest of bowhead whales involves much of the community. Herman Ahsoak, a whaling captain from Utqiagvik, expressed that "our people have been whaling for hundreds of years. It is very important to our community. The whale provides us with daily food. We use every part of the whale in some way" (G. Bare, personal communication, February 3, 2023).

At an early age, children are taught the skills needed to harvest bowhead whales that include crafting the umiaq (the traditional skin boat) and traversing dangerous sea ice to whaling camps (Brower & Hepa, 2010). Maintaining food sovereignty allows the Iñupiat to pass down longstanding traditions and culture to future generations and also provides the residents with food that is needed for survival and to achieve food security. The high cost of living in rural Alaskan communities, with limited and expensive imported items such as bread and milk, make it unsustainable to rely on these items for daily sustenance (Brower & Hepa, 2010).

Institutional barriers, funding limitations, and the shift to a non-nomadic lifestyle hinder AN resilience and adaptation to new ecological threats (Kofinas et al., 2010). Institutional barriers like the 1971 Alaska Native Claim Settlement Act and historical U.S. Fish and Wildlife fishing, hunting, and land management regulations neglect the needs of Indigenous Peoples and limit their ability to respond to rapid ecological changes (Behe et al., 2020; Rogerson, 2022). Successful resilience and adaptation to climate change requires co-management between ANs and state and federal governments instead of the current limited cooperative agreements. Co-management would allow ANs to collaborate

# The Land

Alaskan Field of Flowers

The Alaskan Wilderness

Alaska From Above

Grouping of Whale Bones

A Whale Bone Arch

Muktuk or Maktak (Whale Meat)

Ice Cellar

Snow-Swept Landscape

# Wildlife

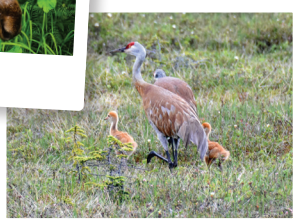
Black Bear

Sea Otter

Moose

Bald Eagles

Catch of Salmon



Sandhill Cranes

# Community

*Family Togetherness at the Nalukataq (The Spring Whaling Festival)*

*Blanket Toss at the Nalukataq*

*Working Together at the Nalukataq*

*Blanket Toss at the Nalukataq*

*Serving the Community at the Nalukataq*

*Excitement in the Next Generation at the Nalukataq*

*Whaling Captain Herman Ahsoak and His Umiaq*

*At the Messenger Festival*

### Example of the Impact of Climate Change on Newtok Residents

An example of climate change physically separating Alaska Natives from their ancestral homes is the small Yup'ik village of Newtok. Built along the Ninglick River, the village has been heavily impacted by erosion, melting permafrost, sea rise, and storm surges for decades (Kaminski, 2023). Their ancestors lived in the region of Newtok for more than 2,000 years and consist of five tightly knit villages bound by many shared traditions that have been passed down over generations.

In 1994, the people of Newtok voted to relocate 9 mi away to an area called Mertarvik (Alaska Department of Commerce, Community, and Economic Development, n.d.). In 2019, relocation finally began with one half of the approximately 300 people moving to the new area. The relocation has been estimated to cost over $100 million; however, there are still not enough homes available in Mertarvik to move the remaining people left in Newtok (Alaska Department of Commerce, Community, and Economic Development, n.d.).

After Typhoon Merbok in 2022, the remaining residents of Newtok are more desperate to escape from the deteriorating village due to the storm and ensuing flood waters that have further damaged the critical infrastructure of the village. Relocated villagers have expressed sadness about moving away from their ancestral home, family, and friends, but they are also happy to be able to live in a safer place (Kim, 2019).

with the government and make decisions that incorporate traditional native knowledge, science, values, and management practices (Behe et al., 2020). Within a co-management framework, regulations that rarely reflect the way of life of ANs could be replaced with holistic environmental policy that can support initiatives such as food sovereignty (Inuit Circumpolar Council Alaska, 2020b). A refocus on enculturation and a shift back to AN perspectives can also be beneficial to improve mental health resiliency by minimizing the stress of climate change. In addition, promoting the benefits of the healthy management of acculturation can help bolster mental health and resiliency to future climate change stress (Bell et al., 2010).

Agatha Napoleon described their resiliency and ability to adapt despite facing a breakdown of their society:

> It's not like we sit at home all depressed… we're pretty happy people. We go out and gather whatever we can do and just be grateful for what we have and learn to adapt and work. We are adapting as much as we don't want to. (A. Chang, personal communication, July 3, 2023)

## Action: What Are Local Organizations Doing?

### Work of the Alaska Wildlife Alliance in the Yukon–Kuskokwim Delta

The Yukon–Kuskokwim (Y–K) Delta is one of the largest river deltas in the world. Its 18 million acres support one of the largest and most diverse aggregations of waterfowl and shorebirds, critical spawning and rearing grounds for Pacific salmon, and a heterogeneous landscape integral to a number of terrestrial and marine species such as caribou, moose, wolves, walruses, ringed seals, and migratory whales. The Y–K Delta is also home to >40 vulnerable Yup'ik and Athabascan communities that live a mostly subsistence lifestyle and rely on the stewardship of these species. Some coastal villages, such as Newtok, have drawn international attention as they erode into the Bering Sea because of a warming climate, but more than 7 million acres that are likely to salinize, flood, or be subsumed by rising seas and permafrost thaw by the end of this century have been largely ignored (Jorgenson & Roth, 2010).

In the larger picture of the Y–K Delta, the landscape is clearly changing and highly vulnerable to catastrophic loss. Even as the boreal forest is invading eastern portions of the delta, the Bering Sea is inundating western portions of the delta (Juday et al., 2015). The middle of the delta is experiencing tundra fires caused by lightening. The recent 150,000-acre East Fork Fire in the Y–K Delta is the largest tundra fire on record in an area where large fires were rare just a couple of decades ago. In this larger context, the ecological changes in the Asqinaq are manifestations of changes being seen elsewhere in the Y–K Delta.

As such, there is an opportunity to develop adaptative, nature-based solutions that are transferable to other areas and communities in the Y–K Delta. Adaptation at this scale is novel, and there is a need to develop spatially scalable solutions. The Asqinaq may be an ideal project area to demonstrate novel solutions as it has approximately 45 mi of coastline along the Bering Sea and the Asqinak Mountains provide 1,250 ft of elevational relief. Success will ultimately be measured by how much land can be saved from eroding into the sea and by enhancing the productivity and diversity of those lands that remain.

With support from the Coastal Resiliency Program of the National Fish and Wildlife Foundation, the nonprofit Alaska Wildlife Alliance has partnered with the Native Village of Paimiut and a multivillage Environmental Consortium in Chevak, Scammon Bay, and Hooper Bay to develop a climate vulnerability assessment for 250,000 acres in the Asqinaq, "a place of calmness and beauty" on the Bering Sea coast of the Y–K Delta. This project is in collaboration with tribal partners, municipalities, state and federal agencies, and local academic institutions to:

- Gather information garnered through Western science and Indigenous knowledge on ecological changes and climate change projections in the project area.
- Share the information with decision makers and communities, and identify specific vulnerabilities through direct community engagement.
- Provide resources on nature-based adaptation strategies that resist (until a point), accept (until a point), or direct foreseen ecological changes.
- Support local decision makers in prioritizing replicable nature-based solutions that provide wildlife habitats while building resilience around coastal communities.
- Develop pilot projects that demonstrate the feasibility of selected climate adaptation strategies with metrics of success to ultimately be replicated elsewhere on the Y–K Delta.

Throughout this partnership, the Alaska Wildlife Alliance and AN partners will not treat nature, wildlife, or Indigenous Peoples as objects of study but as interconnected components that define ecological health and cultural resilience that must be maintained in our rapidly changing climate. Some of the

project leaders are on native village councils and work with a local municipality in the Asqinaq to conduct on-site workshops that will engage residents first through listening sessions and later through the resist-accept-direct framework to encourage outside-the-box thinking on nature-based climate adaptations. The aim of this project is to develop a climate vulnerability assessment for the Asqinaq that will identify place- and nature-based solutions for the benefit of both this community and wildlife.

### Alaska Native Tribal Health Consortium

The Alaska Native Tribal Health Consortium (ANTHC, n.d.a) has been working to increase the resiliency and adaptation capabilities of AN communities to climate impacts through their partnership with the National Oceanic and Atmospheric Administration. The Climate Initiatives Program at ANTHC was created to establish a baseline understanding of Alaskan tribal climate change challenges and responses, forming an Alaska Tribal Climate Change Advisory Group to ensure that climate change efforts in the state are led and prioritized by AN people (ANTHC, n.d.a).

The Climate Initiatives Program houses the Center for Environmentally Threatened Communities and the Center for Climate and Health. Through the Center for Environmentally Threatened Communities, ANTHC helps the 144 Alaska communities threatened by erosion, flooding, and permafrost degradation (ANTHC, n.d.b). ANTHC has supported >50 communities with 150 projects totaling $50 million to provide capacity building and technical assistance for communities to protect-in-place, retreat, and relocate to new community sites (ANTHC, n.d.b). The Center for Climate and Health assists AN communities to better understand and adapt to climate change with a focus on health. The program also works to inform decision makers about emerging climate threats, provide technical support and guidance, and educate students and the public (ANTHC, n.d.b).

In a draft summary document, ANTHC captured the unmeet infrastructure needs in AN villages due to climate change. They found that at least $4.3 billion will be required to proactively address the damage to infrastructure in the 144 AN communities threatened by a combination of erosion, flooding, or permafrost thaw. Over the next decade, there is an $80 million annual gap in funding needed to address threats to infrastructure and to avoid compounded expenses from future disaster response. Additionally, primary barriers to protecting infrastructure were identified as funding shortfalls and lack of agency coordination, local capacity, and technical assistance. They also found that inequitable regulatory barriers and program design have inhibited tribes in Alaska from participating in federal climate adaptation programs that would assist in relocating communities or addressing infrastructure damage from climate change (ANTHC, 2023).

*An example of increased coastal erosion, which elevates the threat of flooding, ecosystem disruption, and food system damage.*

## Conclusion

To survive in one of the harshest places in the world, ANs needed to be resilient and adaptable to ecological shifts. An important factor in their success is the unity of their community. Their tenacity and strength as a cohesive community is illustrated in the arduous task of whale hunting. When asked about the biggest strengths of his community, Herman Ahsoak says, "It is the unity of the people and how they work together. It takes everyone to get the whale back to shore. We all have to work together" (G. Bare, personal communication, February 3, 2023).

The ability of ANs to successfully be resilient and adapt has been obstructed by the rapid ecological and socioeconomical shifts accelerated by climate change, acculturation, and institutional barriers. As part of a larger and more complex system, ANs need to be able to co-manage and bring forth Indigenous knowledge and practices to successfully adapt to the changing world and climate. The U.S. federal government can improve federal and state government support for AN communities to address climate change by creating a single funding source based on risk, removing programmatic barriers to equity for small tribal and rural communities, and creating a whole-of-government implementation framework to address environmental threats.

### What Can We Do? What Action Can We Take to Help?

In a visit to the ANTHC offices in Anchorage, Max Neale, senior program manager of the Center for Environmentally Threatened Communities, asked that NEHA bring more awareness to the climate impacts on AN communities. Climate change is impacting and threatening the lives and livelihood of AN people. Immediate action is needed to support and create safe, healthy, and sustainable communities that are resilient to climate-related threats now and in the future (U.S. Government Accountability Office, 2022). The ecological changes in Alaska are far-reaching and have impacts beyond the state. Melting glaciers and the subsequent sea level rise are impacting global coastal areas (U.S. Geological Survey, n.d.).

Federal, state, and local government understanding of Indigenous perspectives and engaging in co-management is needed to successfully address climate change impacts in Alaska and internationally. AN resident Shari Fox Gearhead states, "Careful attention to one's surroundings is still essential to staying safe and also bringing food home. Ice still matters, to Inuit, Inughuit, Inupiat, and to the world." Whether or not we live in Alaska, this message is important for us all, and we need to work in unity to be successfully resilient and to mitigate and adapt to the impacts of climate change. Perhaps it is best summed up by Herman Ahsoak: "If you take care of nature, nature will take care of you" (G. Bare, personal communication, February 3, 2023).

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## References

Alaska Department of Commerce, Community, and Economic Development. (n.d.). *Newtok Planning Group.* https://www.commerce.alaska.gov/web/dcra/PlanningLandManagement/NewtokPlanningGroup/NewtokVillageRelocationHistory/NewtokHistoryPartOne.aspx

Alaska Department of Environmental Conservation. (2023). *DEC tribal relations*. https://dec.alaska.gov/commish/tribal/

Alaska Federation of Natives. (2018). *Erosion and Alaska Native communities*. https://www.nativefederation.org/wp-content/uploads/2018/12/AFN-AKDayErosion-December2018-ONLINE.pdf

Alaska Native Epidemiology Center. (2017). *Statewide data diabetes and demographics*. http://anthctoday.org/epicenter/healthData/factsheets/Diabetes_Demographics_01_05_2017.pdf

Alaska Native Health Board, & Alaska Native Epidemiology Center. (2004). *Final report on the Alaska Traditional Diet Survey.* http://anthctoday.org/epicenter/publications/Reports_Pubs/traditional_diet.pdf

Alaska Native Language Center. (n.d.). *Languages: Iñupiaq*. https://uaf.edu/anlc/languages-move/inupiaq.php

Alaska Native Tribal Health Consortium. (n.d.a). *Center for Environmentally Threatened Communities one-pager*.

Alaska Native Tribal Health Consortium. (n.d.b). *Climate Initiatives Program one-pager*.

Alaska Native Tribal Health Consortium. (2023). *Summary of the draft document—Unmet needs of environmentally threatened Alaska Native villages: Assessment and recommendations*.

Alaska Sea Grant. (2015). *Sea ice and rising ocean temperature facts and discussion*. University of Alaska Fairbanks. https://seagrant.uaf.edu/topics/environmental-hazards-alaskas-coasts/sea-ice-ocean-temperature/ocean-temperature-facts.php

Behe, C., Dorough, D.S., & Ferris, S. (2020, September 3). *Indigenous food sovereignty in the Arctic.* Cultural Survival. https://www.culturalsurvival.org/publications/cultural-survival-quarterly/indigenous-food-sovereignty-arctic

Bell, J., Brubaker, M., Graves, K., & Berner, J. (2010). *Climate change and mental health: Uncertainty and vulnerability for Alaska Natives.* Alaska Native Tribal Health Consortium, Center for Climate and Health. https://anthc.org/wp-content/uploads/2016/01/CCH-Bulletin-No-3-Mental-Health.pdf

Bennett, T.M.B., Maynard, N.G., Cochran, P., Gough, R., Lynn, K., Maldonado, J., Voggesser, G., Wotkyns, S., & Cozzetto, K. (2014). Indigenous Peoples, lands, and resources. In J.M. Melillo, T.(T.C.) Richmond, & G.W. Yohe (Eds.), *Climate change impacts in the United States: The third national climate assessment* (pp. 297–317). U.S. Global Change Research Program. https://nca2014.globalchange.gov/downloads/low/NCA3_Full_Report_12_Indigenous_Peoples_LowRes.pdf

Berner, J., & Furgal, C. (2005). Human health. In C. Symon, L. Arris, & B. Heal (Eds.), *Arctic climate impact assessment* (pp. 863–906). Cambridge University Press.

Borenstein, S. (2022, December 5). December serving up baked Alaska and warming most of Arctic. *Associated Press*. https://apnews.com/article/science-alaska-weather-arctic-fairbanks-7087d796e414f8d0985c942da85d9bd5

Brower, H., Jr., & Hepa, T. (2010, March 26). *Subsistence hunting activities and the Inupiat Eskimo.* Cultural Survival. https://www.culturalsurvival.org/publications/cultural-survival-quarterly/subsistence-hunting-activities-and-inupiat-eskimo

Centers for Disease Control and Prevention. (2021). *Regional health effects—Alaska.* https://www.cdc.gov/climateandhealth/effects/alaska.htm

Chapin, F.S., III, Trainor, S.F., Cochran, P., Huntington, H., Markon, C., McCammon, M., McGuire, A.D., & Serreze, M. (2014). Alaska. In J.M. Melillo, T.(T.C.) Richmond, & G.W. Yohe (Eds.), *Climate change impacts in the United States: The third national climate assessment* (pp. 514–536). U.S. Global Change Research Program. https://nca2014.globalchange.gov/downloads/low/NCA3_Full_Report_22_Alaska_LowRes.pdf

Climate Adaptation Science Centers. (n.d.). *Glacier change impacts to Alaska's coastal ecosystems.* U.S. Geological Survey. https://www.usgs.gov/programs/climate-adaptation-science-centers/glacier-change-impacts-alaskas-coastal-ecosystems

Cook Inletkeeper. (2020, March 19). *Just transition, Alaska Native food sovereignty: Resiliency in action.* https://inletkeeper.org/2020/03/19/nativefoodsovereignty/

Evengard, B., Berner, J., Brubaker, M., Mulvad, G., & Revich, B. (2011). Climate change and water security with a focus on the Arctic. *Global Health Action*, *4*(1), Article 8449. https://doi.org/10.3402/gha.v4i0.8449

Fienup-Riordan, A. (1986). The Real People: The concept of personhood among the Yup'ik Eskimos of Western Alaska. *Etude/Inuit/Studies*, *10*(1–2), 261–270. https://www.jstor.org/stable/42869549

Fienup-Riordan, A. (2007). *Yuungnaqpiallerput / The way we genuinely live: Masterworks of Yup'ik science and survival.* University of Washington Press.

## References


Gearhead, S.F., Holm, L.K., Huntington, H., Leavitt, J.M., & Mahoney, A.R. (Eds.). (2013). *The meaning of ice: People and sea ice in three Arctic communities*. International Polar Institute Press.

Gray, S.T., Markon, C.J., Berman, M., Eerkes-Medrano, L., Hennessy, T., Huntington, H.P., Littell, J., McCammon, M., Thoman, R., & Trainor, S. (2018). Alaska. In D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, & B.C. Stewart (Eds.), *Impacts, risks, and adaptation in the United States: Fourth national climate assessment* (Vol. 2, pp. 1185–1241). U.S. Global Change Research Program. https://doi.org/10.7930/NCA4.2018.CH26

Huntington, H.P., Quakenbush, L.T., & Nelson, M. (2016). Effects of changing sea ice on marine mammals and subsistence hunters in northern Alaska from traditional knowledge interviews. *Biology Letters, 12*(8), Article 20160198. https://doi.org/10.1098/rsbl.2016.0198

Inuit Circumpolar Council. (2022). *Circumpolar Inuit protocols for equitable and ethical engagement*. https://iccalaska.org/wp-icc/wp-content/uploads/2022/06/EEE-Protocols-LR-1.pdf

Inuit Circumpolar Council Alaska. (2020a). *Alaskan Inuit Food Sovereignty Initiative*. https://iccalaska.org/our-work/alaskan-inuit-fsi/

Inuit Circumpolar Council Alaska. (2020b). *Food sovereignty and self-governance: Inuit role in managing Arctic marine resources*. https://www.culturalsurvival.org/sites/default/files/FSSG%20Report_%20LR%20%281%29.pdf

Jorgenson, M.T., & Roth, J.E. (2010). *Landscape classification and mapping for the Yukon–Kuskokwim Delta, Alaska*. U.S. Fish and Wildlife Service.

Juday, G.P., Alix, C., & Grant, T.A., III. (2015). Spatial coherence and change of opposite white spruce temperature sensitivities on floodplains in Alaska confirms early-stage boreal biome shift. *Forest Ecology and Management*, *350*, 46–61. https://doi.org/10.1016/j.foreco.2015.04.016

Kaminski, I. (2023, January 23). Could the Alaska government be on the hook for climate refugees? *Hakai Magazine*. https://hakaimagazine.com/news/could-the-alaska-government-be-on-the-hook-for-climate-refugees/

Kim, G. (2019, October 28). 'Happy and sad at the same time': After decades-long wait, Newtok residents begin the move to Mertarvik. *KTOO*. https://www.ktoo.org/2019/10/28/happy-and-sad-at-the-same-time-after-decades-long-wait-newtok-residents-begin-the-move-to-mertarvik/

Kofinas, G.P., Chapin, F.S., III, BurnSilver, S., Schmidt, J.I., Fresco, N.L., Kielland, K., Martin, S., Springsteen, A., & Rupp, T.S. (2010). Resilience of Athabascan subsistence systems to interior Alaska's changing climate. *Canada Journal of Forest Research*, *40*(7) 1347–1359. https://doi.org/10.1139/X10-108

Krupnik, I., Lang, M.A., & Miller, S.E. (2009). *Smithsonian at the poles: Contributions to International Polar Year science*. Smithsonian Institution. https://doi.org/10.5479/si.097884601X.0

Martínezcuello, F. (2023, June 9). Hooper Bay residents weigh in on fishing closures: 'It's like taking away food from our table.' *KTOO*. https://www.ktoo.org/2023/06/09/hooper-bay-residents-weigh-in-on-fishing-closures-its-like-taking-away-food-from-our-table/

Maxwell, L. (2022, April 11). Telling Alaska's story: Putting the seal to good use. *Alaska's News Source*. https://www.alaskasnewssource.com/2022/04/12/telling-alaskas-story-putting-seal-good-use/

National Oceanic and Atmospheric Administration Fisheries. (2022, August 23). *What's behind chinook and chum salmon declines in Alaska*? https://www.fisheries.noaa.gov/feature-story/whats-behind-chinook-and-chum-salmon-declines-alaska

National Research Council. (2003). *Cumulative environmental effects of oil and gas activities on Alaska's North Slope*. The National Academies Press. https://doi.org/10.17226/10639

Nicu, I.C., & Fatorić, S. (2023). Climate change impacts on immovable cultural heritage in polar regions: A systematic bibliometric review. *WIREs Climate Change*, *14*(3), e822. https://doi.org/10.1002/wcc.822

Office of Minority Health. (2020). *Obesity and American Indians/Alaska Natives*. U.S. Department of Health and Human Services. https://minorityhealth.hhs.gov/obesity-and-american-indiansalaska-natives

Rantanen, M., Karpechko, A.Y., Lipponen, A. Nordling, K., Hyvärinen, O., Ruosteenoja, K., Vihma, T., & Laaksonen, A. (2022). The Arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment*, *3*, Article 168. https://doi.org/10.1038/s43247-022-00498-3

Redwood, D.G., Day, G.M., Beans, J.A., Hiratsuka, V.Y., Nash, S.H., Howard, B.V., Umans, J.G., & Koller, K.R. (2019). Alaska Native traditional food and harvesting activity patterns over 10 years of follow-up. *Current Developments in Nutrition*, *3*(11), Article nzz114. https://doi.org/10.1093/cdn/nzz114

Rogerson, R. (2022, November 13). U.S. Fish and Wildlife Service releases draft of its first Alaska Native relations policy aimed at increasing trust. *Anchorage Daily News*. https://www.adn.com/alaska-news/2022/11/13/us-fish-and-wildlife-service-releases-draft-of-its-first-alaska-native-relations-policy-aimed-at-increasing-trust/

State of Alaska. (n.d.). *Alaska kids' corner: Economy*. https://alaska.gov/kids/learn/economy.htm

Thomson, E. (2019). Preserving traditional life-ways. *First Alaskans*, *Spring 2019*, 20–27. https://www.akwildlife.org/news/preserving-traditional-lifeways

Travel Alaska. (2023). *Alaska Native culture*. https://www.travelalaska.com/Things-To-Do/Alaska-Native-Culture

U.S. Climate Resilience Toolkit. (2023). *Tribal nations*. https://toolkit.climate.gov/topics/tribal-nations

U.S. Geological Survey. (n.d.). *How would sea level change if all glaciers melted?* https://www.usgs.gov/faqs/how-would-sea-level-change-if-all-glaciers-melted

U.S. Government Accountability Office. (2022, May 18). *Alaska Native issues: Federal agencies could enhance support for native village efforts to address environmental threats* (GAO-22-104241). https://www.gao.gov/products/gao-22-104241