

Consequences of Rapid Environmental Arctic Change for People

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Highlights

- People experience the consequences of a rapidly changing Arctic as the combined effects of physical conditions; responses of biological resources; impacts on infrastructure; decisions influencing adaptive capacities; and both environmental and international influences on economics and well-being.
- Living and innovating in Arctic environments over millennia, Indigenous Peoples have evolved holistic knowledge providing resilience and sustainability. Indigenous expertise is augmented by scientific abilities to reconstruct past environments and to model and predict future changes. Applying the combined understanding of Indigenous and scientific experts will be important if decision makers (from communities to governments) are to help mitigate and adapt to a rapidly changing Arctic.
- Considerable discussion among diverse collaborators suggests that addressing unprecedented Arctic environmental changes requires hearing one another, aligning values, and collaborating across knowledge systems, disciplines, and sectors of society.



Ahtna Dine' Storyteller Wilson Justin's Oral Account: <https://youtu.be/gBBffAtqMsc>

Introduction

The vital signs and key indicators tracked in the Arctic Report Card since 2006 detail rapid environmental changes in the Arctic. In this essay and the accompanying [oral history](#), Indigenous, scientific, and decision-making experts collaboratively describe just some consequences of these rapid changes for people. Here, we focus on people in the Arctic while acknowledging that the changing Arctic has important impacts on people beyond the region. We also highlight the necessity of diverse, complex collaborations as one of the tools needed to advance policy solutions to the profound consequences of these changes for people.

If current rates of greenhouse gas emissions continue, Arctic people will increasingly experience in this century "extremes in sea ice, temperature, and precipitation phase far outside anything experienced in the past century and probably much longer" (Landrum and Holland 2020). People experience the consequences of these extremes not as individual events but as the composite of multiple events. Understanding the impacts of environmental shifts and extremes requires assessments of the drivers of change; their direct, indirect, and compounding consequences on human well-being, economics, and international cooperation; as well as the modifying effects of community and governmental actions from local to international scales (e.g., Fisher et al. 2020; Harper et al. 2020; Landrum and Holland 2020; Schaeffer 2021). Because these consequences and modifying effects compound over varying time periods, we do not limit our consideration to 2022 or any other particular year.

In his [oral account](#), Ahtna Dine' Storyteller Wilson Justin explains that the Arctic environment has already changed (see [17:08](#)), and we must work to overcome the colonial divide and determine together "how we're going to speak to each other in terms of not only rebuilding, but what it is we are going to rebuild" (see [17:17-17:50](#)). Similarly, Vera Kingeekuk Metcalf has led her Study of Environmental Arctic Change (SEARCH) colleagues in understanding the importance of language and knowing "when we are saying the same thing" (see also Metcalf 2021; see [14:34-15:00](#)).

Recognizing that the human consequences of Arctic environmental changes result from their compounding effects helps structure cross-cultural syntheses. Increasing temperature, diminishing ice, thawing permafrost, increasing frequency and severity of storms, wildfires, and other forces disrupt mechanisms that ensure safety, food security, and other aspects of human well-being (see essays [Surface Air Temperature](#), [Sea Surface Temperature](#), [Sea Ice](#), [Tundra Greenness](#), and [Precipitation](#)). Indigenous Knowledge holders possess specialized understanding of the Arctic and view these impacts

as part of an interconnected universe. Justin suggests that we need more holistic observations and syntheses, and Metcalf describes an Indigenous approach in which elders meet daily to share and synthesize recent environmental observations from which they predict future conditions (Apassingok et al. 2022).

Integrating diverse perspectives and knowledge systems is necessary but insufficient to mitigate and adapt to change in ways that preserve the health and well-being of people. It also is vital that we use our collective understanding to offer practical solutions to problems experienced at all levels of community, business, and government, which necessitates collaborating with experts in decision making as well as Indigenous and scientific knowledge.

As a team of Indigenous, scientific, and decision-making experts, we have begun synthesizing the human consequences of environmental change, and here we illustrate with a few brief examples how combinations of environmental changes impact human safety, food security, and health in the Arctic. Our examples are focused on Alaska, but our broader work considers the entire Arctic.

Safety. Arctic Indigenous Peoples interact intimately with their environments, and their safety depends to a large degree on knowing how to operate on land and sea (see Fig. 1). For example, the distribution, quality, thickness, and timing of ice on the ocean, lakes, and rivers drive nearly every aspect of life on Arctic coasts, from boating to whaling and seal hunting to the safety of fishing and foraging (see [12:00-12:35](#)).



Fig. 1. St. Lawrence Island Yupik butcher a bowhead whale on shorefast ice adjacent to Gambell, Alaska, circa 1960. Butchering and dividing the harvest ideally took place after pulling the whale onto the ice or, if need be, from the ice edge and boats as seen here. Increasingly, suitable shorefast ice is absent or too thin for either method, and butchering must take place entirely in the water. Credit: Francis H. Fay.

The danger and costs of whale harvesting have been driven higher by diminishing sea ice and distant military conflict. The number of days spent hunting bowhead whales in open water during fall at Utqiagvik, Nuiqsut, and Kaktovik has doubled over the past 40 years as the duration and extent of sea ice cover declined. At the same time, wave height has increased with sea ice retreat, increasing risks to hunters. The diminished sea ice and associated increases in waves have driven some villages to purchase larger boats for whale hunting but at great up-front expense. Larger boats are also more expensive to operate, doubling or tripling fuel consumption. The war in Ukraine has driven fuel costs even higher, exacerbating the local impact of ice retreat on the costs of whaling.

For walrus hunters, the increased speed and magnitude of sea ice retreat forces much longer excursions in small skiffs (see Fig. 2). Perry Pungowiyi of Savoonga, for example, reports hunters traveling as much as 100 miles from St. Lawrence Island to reach walrus during the spring harvest. In the Chukchi Sea, some seal hunting communities are hampered by decreasing duration and thinning of the sea ice cover (Huntington et al. 2016). Darlene Tocktoo Turner describes traditional on-ice hunting routes around Shishmaref as no longer safe.



Fig. 2. Yupik hunters offshore of St. Lawrence Island. February 2021. Credit: Justina Noongwook.

Changes in seasonal patterns for harvesting (see Food Security section below) have dramatic consequences for safety. Fatal falls through sea, lake, and river ice in Alaska, which disproportionately involve Indigenous People, are increasing (Fleischer et al. 2014; see essay [Lake Ice](#)). Maija Lukin from Kotzebue, Alaska has described—in powerful terms—the human costs of these tragedies (Fisher et al. 2020).

Food Security. Understanding the impacts of environmental change on Inuit food security is greatly enhanced by an Inuit holistic view considering the influences and interactions of environmental stability, resource availability and accessibility, decision-making power, culture, and health and wellness (ICC-Alaska 2015; Johnson et al. 2021; see [02:20-02:43](#)). Such understanding is being forced to evolve rapidly, however, because of shifts in the migratory patterns of Arctic animals including caribou, walrus, whales, birds, and fish (ICC-Alaska 2015). For example, bowhead whales now migrate earlier in spring and later

in fall, forcing whale hunting crews at Utqiagvik to hunt both earlier in spring to make use of more stable shorefast ice and much later into autumn to harvest the preferred younger whales that arrive later in the migration. Similarly, geese hunting is happening earlier in Utqiagvik to avoid soft snow cover in late May, while fall fishing, which relies on snow machine access, occurs later due to delayed freeze up (see essay [Arctic Geese](#)).

While access to food species is rapidly changing, laws and other policies regulating harvests will struggle to keep up (see essays [Arctic Ocean Primary Productivity: The Response of Marine Algae](#); [Partnering in Search of Answers: Seabird Die-offs in the Bering and Chukchi Seas](#)). For example, expanding legal harvesting to other species of whales will likely soon be critical to the health and quality of life of Indigenous communities, but securing permissions from international and national authorities could take decades (Fisher et al. 2020).

Human Health. As the changing Arctic environment affects the health of Arctic people, the consequences can be exacerbated by limited and compromised infrastructure (Schaeffer 2021). For example, the consequences of wildfires impact people through disturbance of the landscape and negative impacts on respiratory health. Some regions of the Arctic, such as Siberia and Alaska, have seen increasingly large areas burned in the past 40 years (York et al. 2020). Burns accelerate atmospheric warming through decreased surface albedo and increased carbon losses during combustion and subsequent permafrost thaws. Smoke compromises breathing, interrupts aviation, and interferes with traditional subsistence activities. Arctic communities typically lack air conditioning, and Savannah Fletcher described how increasing summer air temperatures in Fairbanks have required ventilating buildings with open windows, exacerbating exposure to wildfire smoke.

Access to clean water is a major health challenge across much of the Arctic (Harper et al. 2020). At the same time, climate-induced changes on land surfaces are causing dramatic shifts in the availability of water (see essay [Tundra Greenness](#)). Permafrost thaw is often implicated, and in 2022, a tundra lake near Kotzebue, Alaska, supplying freshwater to some residents abruptly drained. Nonetheless, quantitative projections of climate change impacts on drinking water in the Arctic are lacking (Harper et al. 2020).

In September 2022, typhoon Merbok demonstrated the inextricable linkage of environmental change and impacts on human safety, food security, and health. The storm—fueled by unusually warm water in the subtropical North Pacific Ocean—flooded several Bering Sea communities; damaged or destroyed homes, hunting camps, boats, and other subsistence infrastructure; and disrupted vital fall subsistence harvests (see Fig. 3).



Fig. 3. Surging Bering Sea waters, driven inland as a consequence of typhoon Merbok in September 2022, damaged one third of the homes in Golovin, Alaska. Credit: Josephine Daniels.

Future directions

The examples presented here just scratch the surface of the compound impacts to people of rapid Arctic change. As we expand understanding of how people experience dramatic environmental changes, Wilson Justin, Maija Lukin, and other Indigenous experts point us to a deeper, more soulful appreciation of the human hardships and costs. They make clear the importance of actions rooted in shared values (see [17:34](#)) and recognition of the intersectional nature of the problem, in which people are simultaneously burdened by crises of safety, food security, and health (see essay [Satellite Record of Pan-Arctic Maritime Ship Traffic](#)).

SEARCH is integrating and synthesizing the perspectives of Indigenous Knowledge holders, scientists, and policy experts with the intent of co-developing practical solutions, which could range from changes in behavior to new partnerships to policy proposals. We have learned that hearing one another, aligning values, and working in concert require new collaborations across knowledge systems, disciplines, and sectors of society. This essay resulted from a series of facilitated discussions over the course of a year among the 42 authors. Specifics of each author's contributions are detailed on the [SEARCH website](#). These complex collaborations are key to advancing timely, evidence-based, and practical solutions for communities, businesses, and governments (Kelly and Fisher 2021).

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