

Special Section:

Rhythms of the Earth: Ecological Calendars and Anticipating the Anthropogenic Climate Crisis

Key Points:

- The Gwich'in calendar describes five seasons, and indicates ecological events and corresponding cultural traditions for each
- Climate change creates mismatches between environmental conditions and biological and cultural events, disrupting the Gwich'in calendar
- Changing environmental conditions can create personal risk around maintaining Gwich'in cultural traditions

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Citation:




Charlie, A., Proverbs, T. A., Hodgson, E. E., & Hovel, R. A. (2022). Shifting seasons and threats to harvest, culture, and self-identity: A personal narrative on the consequences of changing climate. *GeoHealth*, 6, e2022GH000617. <https://doi.org/10.1029/2022GH000617>

Received 31 MAR 2022

Accepted 14 OCT 2022

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Shifting Seasons and Threats to Harvest, Culture, and Self-Identity: A Personal Narrative on the Consequences of Changing Climate

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Abstract Northern Indigenous communities are experiencing rapid climate change and disrupted seasonal transitions. The Teet'it Gwich'in use a five-season calendar to measure the year, indicating the timing of seasonal events and associated cultural practices. From trapping in the spring, to fishing in the summer and fall, and hunting in the fall and winter, the Gwich'in have moved upon the land with the changing seasons. However, disrupted seasonal synchrony can disconnect cultural practices from suitable conditions, creating risks to self and culture. With warming temperatures, communities have observed slower river freeze-up in the fall and faster spring thaw, which has impacted the timing of when fishers can safely set their nets under river ice. Historically, freeze-up occurred in October, providing several weeks when fishers could set nets under ice while luk dagaii (broad whitefish, *Coregonus nasus*) traveled downriver. Today, freeze-up often begins in November, and fishing during the luk dagaii migration requires setting nets while the ice is thinner and the river is not completely frozen. This presents risks to individuals working to maintain a fundamental cultural practice. Here, Arlyn Charlie, a Teet'it Gwich'in artist whose career focuses on culture and language, uses personal narrative to explore impacts of climate change on Gwich'in culture. Arlyn notes how these changes are making the traditional seasonal calendar unreliable, and explores how changing patterns among animals and the landscape no longer provide consistent, safe harvesting conditions. With a growing risk of working on thin ice, ongoing cultural practices are threatened.

Plain Language Summary Northern Indigenous communities are experiencing rapid climate change, and this has significant implications for how communities and individuals interact with the land. Indigenous calendars have long been used to illustrate environmental changes and associated activities throughout the year; for instance, the Teet'it Gwich'in use a five-season calendar that describes seasonal events and cultural practices, such as changing river conditions, fish migrations, and associated fishing activities. However, disrupted seasonal timing can disconnect cultural practices from suitable environmental conditions, and create risks to individuals and culture. Gwich'in harvesters have historically fished for luk dagaii (broad whitefish, *Coregonus nasus*) during the downstream fish migration, by setting nets under ice when the river has safely frozen in October. Today, river freeze-up is occurring later, and fishing during the migration may require setting nets before ice has fully formed. In this article, Arlyn Charlie, a Teet'it Gwich'in artist, uses a personal narrative to explore the implications of this change on personal safety, reliance on the traditional calendar, and risk to cultural practices.

1. Introduction

Note to readers: This paper includes sections written in both narrative and technical styles. We have differentiated narrative elements by presenting them in normal font, while the technical writing is in italics.

My people have utilized the lands for thousands of years. They have spent periods of time hunting, trapping, and fishing in accordance with the changing seasons, which often dictated which animals would be hunted or trapped. The progressive onset of climate change and the changing environment has affected our ability to partake in our traditional practices.

Many Indigenous communities have created traditional seasonal calendars which reflect their deep knowledge of the land and have long been used to guide annual activities, yet these calendars are susceptible to climate change and other change driven by anthropogenic activities. These calendars track the seasons and associated environmental events, and enable communities to document cues that ensure successful food harvesting, cultural practices, and other factors (Kassam et al., 2018). However, as rapid environmental changes alter ecosystems across the circumpolar north, changes in ecological conditions and events impact Indigenous communities that hold close ties to the land (IPCC, 2014; Krupnik & Jolly, 2002). Traditional calendars become less reliable as physical conditions on the land, plant and animal distributions, and phenology experience rapid change. This creates potential for significant consequences, such as unreliable access to plant or animal harvest or dangerous conditions for travel.

These broad-scale environmental changes have pronounced local impacts for how and when northern communities and individuals can participate in activities such as fishing. Changes to Arctic sea ice, including decreased ice thickness, a shorter ice season, and less multi-year ice, have well-documented impacts for subsistence harvesting. Impacts include increased danger of falling in the water, altered or longer travel routes, and a shorter harvesting season (Green et al., 2021; Laidler et al., 2009). River and lake ice in the north is also experiencing similar changes, with associated effects on subsistence fishing and travel (Brown et al., 2018). Compounding the uncertainty caused by changes to ice, some land users have additional concerns that timing of fish migrations could shift away from what is indicated in their traditional seasonal calendars, potentially leading to lost harvest opportunities (Proverbs et al., 2020, 2021). It is becoming increasingly clear that, while global in nature, wide-reaching environmental changes can manifest in multiple, significant impacts on local subsistence fisheries.

In this manuscript, we highlight one example of the acute impacts of changing river ice on fishing practices in the Arctic, using a first-hand account from Gwich'in Territory in the lower Mackenzie River watershed. Western scientific approaches are often used to document local and global environmental trends, but narrative accounts represent a respected and long-standing method for conveying intergenerational knowledge on changing conditions in many Indigenous communities. A mixture of both approaches can be a powerful means to synthesize and understand the multiple scales and impacts of climate change. Our authorship team, composed of a Gwich'in artist and researchers from multiple disciplines, has worked together for more than 5 years on topics related to changing river conditions and associated responses in fish communities and fishing practices in Gwich'in Territory (Hodgson et al., 2020; Hovel et al., 2020; Proverbs et al., 2020, 2021). Our collaborations have involved both formal (i.e., semi-structured interviews) and informal (i.e., sharing stories while on the land together) exchanges of knowledge, and we believe that firsthand accounts are important methods to identify how rapidly changing climate conditions are impacting culture and connection to the land. Here, we use a narrative style to document the changes observed by Arlyn Charlie, an artist whose work is focused on Gwich'in language and culture and who is from Teet'it Zheh, a community on the shore of the Teet'it Gwinjik (Peel River). This account draws on personal experiences and intergenerational knowledge sharing to discuss shifts in the traditional seasonal calendar of the Gwich'in First Nation, which has a long oral tradition and was later documented in written form (Figure 1; GRRB, 2022; GSCI, 2015). All knowledge and information sharing in this manuscript, and establishment of knowledge sovereignty, is conducted with approval from the Gwich'in Tribal Council Department of Culture & Heritage.

2. Seasonal Calendars Describe Transitions Across the Landscape

The snow crunches beneath my feet as I walk, the engine of the ferry working as it crosses the river casting a low hum over the river, ice, and snow. Oddly it is not cold, and the land has a gray hue bestowed upon it from the overcast clouds of the winter season. The sun tries its best to shine through, with little to no avail, though its presence is seen, a mere glimmer of light between the layers of clouds. We the Gwich'in live up here in the north next to our counterparts the Inuvialuit, who live just a bit farther north above the treeline, near the Arctic Ocean in a land of tundra and pingos. Here, it is trees and mountains, who stand beside the Teet'it Gwinjik (Peel River) that flows from high in the watershed down to the Nagwichoonjik (Mackenzie River) then onwards to the Arctic Ocean. Though the time of nomadism, a time when we once followed the animals, is at an end, we still adhere to the traditional practices of hunting, trapping, and fishing.

For years I was privy to the stories told by my Grandparents of the times when they stayed out on the land. The countless years they moved on great journeys, venturing high into the mountain ranges or weaving the Teet'it

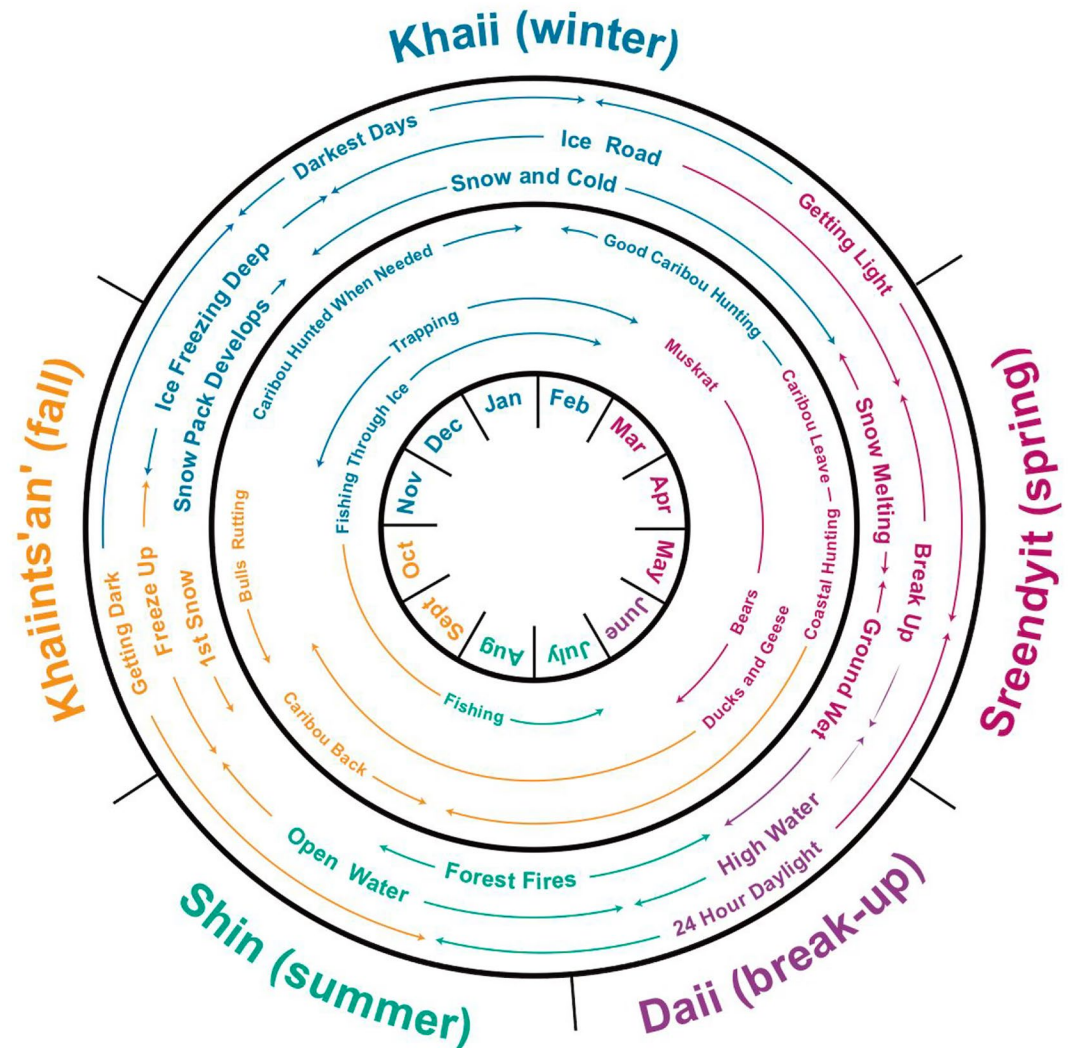


Figure 1. The Gwich'in Seasons Calendar depicts seasonal transitions and associated ecological events and cultural activities. This figure was created by the Gwich'in Tribal Council Department of Culture & Heritage, in consultation with community Elders, to document Gwich'in knowledge. Credit: Gwich'in Tribal Council Department of Culture & Heritage.

Gwinjik into the rivers above. Times have changed greatly and today I am an artist, a photographer and writer. I work with both language and culture as I believe they are the two foundations that our identity stands upon as a people, and should one fall then we lose a vital part of our identity. Today I use my skills, whether it be in writing or the act of taking photos, to capture moments of my people out on the land and document all the information I can in the hopes of saving it for the future.

For thousands of years my people have adhered to a traditional calendar, relying upon the changing seasons which dictated what they would do in that time. Khaii (Winter) was a time of trapping and traveling in the hopes of finding the caribou, one of our main sources of food. Khaii was governed by the darkest days of the year, where the sun did not even touch the horizon. Shreend'it (Spring), was the time of trapping. People would venture out upon the lakes setting traps within the muskrat push ups, the accumulation of the lake's moss for the muskrat to sit on. Daii is the fifth addition to the seasonal calendar. It signifies the thaw and movement of the river ice, which would happen sometime in May. Shin (Summer) was the time of constant sunlight, the sun circling the sky and never setting as you could always see its light. During this time, the Gwich'in people would move out along the river banks to their fish camps, and for weeks if not months they would set their nets within the eddies of the river. They would catch the running luk dagaii (broad whitefish, *Coregonus nasus*) which came first, and then sometime in July would come the sruh (inconnu, *Stenodus leucichthys*). The running fish of Shin and Khaiinst'an



Figure 2. Fishing through the ice includes rigging nets on the frozen river so that they can be submerged and then pulled to the surface to remove fish. The net is held in place by poles that are embedded into the ice and removed when the net is checked. These photos, taken in November 2021, depict Mary Snowshoe, Winnie Greenland, and William and Delores Charlie checking their net set at Nataiinlaih (8-Miles). Photo credit: Arlyn Charlie.

(Fall) is the second component of our primary food source. The practice of fishing would carry over into Khaiints'an, and for a small period of time they would pull their nets and wait for the river to freeze over and resume with a different tactic. During the time of Shin, nets were set directly in the river, but during the time of Khaiints'an, nets went under the ice, stationed by two poles (Figure 2). But as the climate constantly warms, the time it takes for the ice to freeze over is becoming progressively longer each year.

3. Challenges to Traditional Fishing Practices

There is a sensation of slight fear walking upon the ice today, the ice cracking with each step. Poles protrude from the surface of the ice, holding the nets in place underneath so that they do not float away. They are set further out onto the ice than they would be set in the water during the summer. I do not know the reason why, I have never actually set a net under ice before, though in theory I know how it is done. Multiple holes are cut into the ice, which at this time is thick from the fall freeze. Then, with a pole, the net is pulled from one end to the other and connected and tied down on both ends, along with the floats and sinkers on the net. But since I have never actually done it, it may be harder than I explain.

The nets themselves are usually set in October. At least, that is the time I could remember from prior years, but today and for the last few years it was in November that we set them. Today it is warm, as we walk. Out in the middle of the river, the water still flows northward, ripples from the ferry disturbing the water as it moves. The air is crisp and yet warm, as I walk minding my step, as if I would know where the ice is thick and where it is not. Tire tracks from a four-wheeler are imprinted in the snow, which gives some reassurance that I would not fall in, though I do not want to take any chances.

I have never actually seen nets set upon the ice while the river was still freezing; the opening in the middle, along with the unusually warm temperature today incites fear. It's November and the temperature still has not gone below -20°C , which is something that I have not seen before. It is usually cold at this time, but for the last couple weeks the land remains a constant warm temperature, giving the snow and ice a chance to thaw.

At one end of the net, a string that is attached to a pole is untied and attached to a longer string, strung out upon the ice. As the other end of the net is pulled, the long string drags along the ice. Soon the fish are revealed in the emerging netting, pulled from under the ice, and they lay upon the snow as my Jijuu (Grandmother) begins taking them out, putting them to the side before moving to the next. Looking upon the hole in the ice, into the dark water that is not as murky as in summer, the ice is roughly three inches thick. It does not take long until the net is ready to go back under and will not need to be checked again until tomorrow. During the summer, the water temperatures are high which causes the fish to drown (suffocate), however in the winter they tend to survive much longer. I do not know the exact science as to why they tend to survive longer. The poles are put in place, the net tied back and held in place. We walk back upon the ice, a sled load of fish at hand, and we return to town.

I do not stay out here as my ancestors once did, but here, out on the land, though I am but 10 km from home, is where I feel most comfortable. Though I am young, I have seen changes in my time. Winter mornings of November used to be accompanied by the ice fog which covered the roads and distorted the streetlights, now that rarely happens. The caribou used to follow somewhat of a normal pattern throughout the year, but during the last few years they have been more unpredictable. The ice is trending towards freezing later every year and yet the fish seem to still maintain their patterns of traveling back down the river each year at the same time, regardless of the presence of ice or not. Khaiints'an is my favourite time of the year because I get to come out here upon the ice to check the net, and in the evenings go and sit next to a hole in the ice, a hook hanging by string, attached to a stick, as we fish for the chehluk (loche, *Lota lota*) who bear the resemblance of a catfish. But, each year, freeze-up feels as though it happens later and later. The calendar my people once relied on can no longer accurately predict the time of animals moving, ice freeze-up and melting. Can we fix it so that it does? I do not know, everything is still moving and changing, and that change is happening rapidly today before my very eyes.

4. Anticipating Impacts of Climate Change Into the Future

I always heard about climate change growing up, but to me it was a distant thing until I traveled the river and saw the slumping of formerly permafrost hills, erosion of the banks covered in overhanging trees, and a freeze-up normally happening in mid-October now occurring in late November. It does provoke a sense of fear, much like walking upon the ice today, a fear of not knowing. Not knowing what is to come with all these changes; will we still have winter? Will we still be able to partake in fall fishing? A lot of my non-fiction pieces have revolved around the idea of fishing, whether it be in summer or winter, and I do not think I will ever grow tired of writing about it because this is a part of my life. The practice of fishing is something that I have grown up with, spending time at Dèeddhoò Gòonlii (my Jijuu's fish camp), coming out here on the ice, is something that I have done throughout my years. Though I have ventured out into the mountains to hunt the caribou, it is the cultural practice of fishing I now know more than just in theory, and can actually put into practice. Because I know my fishing practices, I know what might be lost.

One of the beliefs of the Gwich'in is that we are spiritually connected to the land. There are a lot of ways that one can define that. We have an intricate connection, so what happens out there on the land has a great effect on my people. The changing environments, unpredictable patterns of migratory animals, and the high risk one must take in order to partake in a cultural practice that we have followed for years all impact our connection with the land. There is great dependence upon a land that is changing beneath our feet and that has changed how we live. I have always felt the urge to come out here, and though I may not live as my ancestors once did, it is the summer nights when the work is done at the fish camp or pulling a sled upon the ice full of fish that I feel most at home. This year, this fishing season, I have seen how much risk my people are taking, venturing out on the ice in order to maintain a part of their identity, regardless of the formation of the ice.

I have witnessed just how much climate change is having an effect, not only my people but our cultural identity as well. The act of fishing was once, and can still be, considered a necessity, for in the past my people have spent a considerable amount of time fishing in order to gather enough food not only for themselves but also their dogs, which were once the primary way of transportation during the months of Khaii. Today fishing is still practiced in Shin and Khaiints'an. With the constantly rising cost of food in the north, fish is still considered one of our primary food sources, and thus is intertwined with our identity as a people who are spiritually connected to the land. Climate change is stripping away our ability to fish not only during Shin, but also Khaiints'an, and strips away a vital part of who we are as a people, who look at the land with great respect and dependence.

In this narrative, Arlyn Charlie, a young Gwich'in artist, documents changes to river conditions and fishing practices that he has experienced firsthand, and the knowledge that his Elders have shared. This account emphasizes the real-time impacts of climate change, and also presents evidence for difficult decisions, challenging conditions, and personal risk that come with landscape change. Arlyn illustrates concern regarding possible loss of cultural practices and uncertainty over relying on traditional seasonal cues; disruption to fishing practices presents both safety risk and loss of access to traditional foods, but similar potential disruptions may also occur with shifts in plant phenology or community composition, or modified bird and mammal migrations (e.g., Ford et al., 2021). This story provides an example of local impacts observed within a lifetime, in Gwich'in territory in the Mackenzie River watershed, but many examples exist elsewhere, on different landscapes across different social-ecological systems (e.g., Kassam et al., 2021). Further documentation and research will continue to enhance a comprehensive understanding of local impacts to habitats, organisms, and cultures, and will provide important insights into decision-making (Bastian & Bayliss Hawitt, 2022).

Discussions around changing social-ecological systems often indicate resilience and adaptation of Indigenous Peoples (Berkes & Jolly, 2001; Forbes, 2013), but the consequences of change can be high despite this resilience, as Arlyn describes. In response to the uncertainty around traditional seasonal calendars that has been created by novel environmental change in the north, Gwich'in and other Indigenous land users utilize multiple adaptive practices in order to maintain and evolve cultural land use practices. For instance, Gwich'in fishers can use different techniques to dry fish when dealing with new weather patterns, or can move to new fishing spots as rivers change and maintain flexibility around when they will fish (Proverbs et al., 2021). In other locations across the north, Indigenous land users have shifted the equipment that they use in order to access harvest areas amongst changed river conditions (Brinkman et al., 2016), fished at different times and used different fishing techniques (Chila et al., 2021), taken different travel routes than they have in the past (Laidler et al., 2009),

and used multiple sources of information about ice conditions (Green et al., 2021). However, these approaches do not fully compensate for the threats to personal safety of fishing under ice in years when the river does not fully freeze, or for the emerging risks associated with maintaining important cultural practices. Arlyn's first-hand account poses important questions regarding whether traditional seasonal calendars can be adapted for new, unpredictable environmental conditions, and how climate change threatens cultural well-being and connection to the land.

I find that the future is quite uncertain, with the land constantly changing around us. The progression of slumping on the land and warming water has caused changes and concerns for my people. The longer period of time it takes for the ice to freeze in the fall is something of concern as it affects our ability to safely practice the act of fishing. It may not be bad now, but when there comes a time where it will no longer be safe to go on the ice, what does that mean? As I walk upon the ice today, minding my step as I walk, the water still flowing down in the middle, the future is uncertain. I do not know what the next ten years will look like, let alone the next fifty. I do not know how greatly the changes we see today will affect us. It is scary, but it is of great importance that we hold onto the aspects of our identity such as fishing under the ice.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

This manuscript is a largely a narrative account that describes first-person observations and intergenerational cultural knowledge. As such, it does not include data collection or analysis, and all information is presented within the manuscript.

Acknowledgments

The authors wish to thank all Gwich'in Elders, who have shared with us knowledge on fish, fishing, and the changing landscape, and who work to maintain fishing practices and time on the land. Mahsi' choo to Mary Effie Showshoe, Alice and Ernest Vittekwa, Abraham Stewart, and Wally Tyrrell for sharing time at their camps. AC has learned to fish from Mary Effie Snowshoe, in particular. TP, EH, and RH wish to thank the communities of Teet'it Zheh, Aklavik, Tsiigehtchic, and Inuvik for welcoming us to the north. This work was supported by the Northwest Territories Cumulative Impacts Monitoring Program. Funding to support open access publication of this work was provided by the Rita Allen Foundation under agreement NS-2111-02233.

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