

**National Park Service**

ARTICLE • RECKONING WITH A WARMING CLIMATE

# Traditional Knowledge of Changes in Winter Conditions in Alaska's Copper River Basin

Wrangell - St Elias National Park & Preserve (<https://www.nps.gov/wrst/>)

*Odin Miller, Anthropologist, Ahtna Intertribal Research Commission*



Copper River downstream of the confluence with the Tazlina River, March 2022. Changing ice and snow conditions create unexpected patches of open water and dangerous crossing conditions.

NPS/BARBARA CELLARIUS

Winter conditions play an important role in social-ecological systems in the rural Far North. Snow facilitates access to much of the landscape during the winter months, while frozen rivers and other waterbodies are highways on which people travel. Access to subsistence foods and other resources depends on the presence of snow and ice. Similar to elsewhere in Alaska and the Circumpolar North, the Copper River Basin's changing snow and ice conditions have presented a variety of challenges related to winter travel and activities such as trapping, hunting, fishing, and gathering firewood.

# Traditional Use of the Copper River Basin and Socioeconomic Changes

The Ahtna (Atnahwt'aene), a Northern Dene Athabaskan group, have a traditional territory that includes virtually the entire Copper River Basin, as well as parts of the Upper Susitna and Tanana River basins (Figure 1). Until the early 20<sup>th</sup> century, virtually all Ahtna lived a semi-nomadic lifestyle, relocating several times each year in order to make a living from the sparse landscape. Typical winter activities on the land included hunting for moose and caribou, trapping for furbearing animals, fishing on frozen rivers and lakes, and gathering firewood. Although the Ahtna traveled extensively throughout the year, travel was easiest during the winter months, when snow smoothed out the landscape and allowed sleds to be pulled, and when frozen rivers could be easily crossed. Largest among these rivers was the Copper, both banks of which were inhabited by the Ahtna.

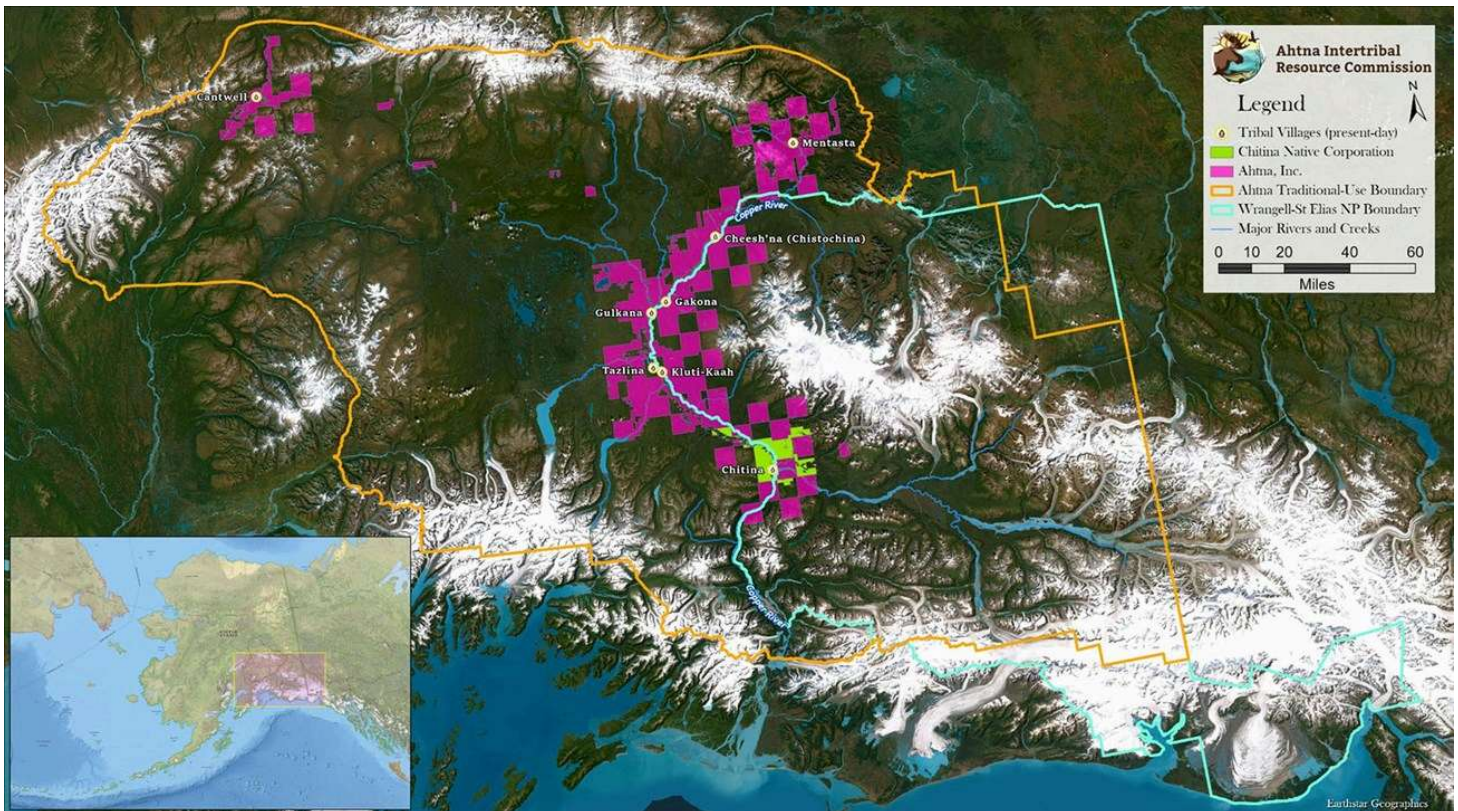


Figure 1. Map showing Ahtna Traditional Use Territory, contemporary Ahtna villages, Wrangell-St. Elias National Park boundary, and Alaska Native Corporation lands.

MAP PRODUCED BY THE AHTNA INTERTRIBAL RESOURCE COMMISSION/CASEY CUSICK

The 20<sup>th</sup> century brought a huge influx of outsiders into the region and dramatic consequent changes to Ahtna culture. Newly constructed highways provided year-round access to much of the region, while increasing numbers of Ahtna settled in permanent villages, all of which were located on the west side of the Copper River. Wage employment, heavy-handed government agents, shortages of wild food (Ahtna now had to compete with hordes of outsiders for fish and game), and the availability of groceries and other services in villages all contributed toward this trend of sedentarization (Simeone 2018). By 1950, nearly all Ahtna had settled in permanent villages or towns. Some still followed more limited patterns of seasonal migration, camping out for weeks at a time for subsistence activities, although this gradually disappeared over the following decades.

Close connection to the land and dependence on wild foods and other resources have persisted as part of Ahtna culture, however. Many nonnatives in the region also consider hunting, fishing, gathering, and trapping to be important to their lifestyles. In modern times, many of these activities take place during the summer and fall months, although winter hunting, fishing, and firewood gathering



continue. Of particular significance is trapping, since it is an activity that is practiced exclusively during the winter. From the late 1800s through the mid-1900s, trapping was one of the main sources of income for many people and families in the region. As wage employment became increasingly prominent during the latter half of the 20<sup>th</sup> century, trapping gradually declined as a primary source of income. Volatile fur prices also played a role in fluctuating trapping participation during the 20<sup>th</sup> century. Nevertheless, trapping has continued as either a main seasonal occupation or as a non-professional activity for some residents of the region. As practitioners of an exclusively winter activity, trappers depend on predictable snow and ice conditions.

## How Climate, Snow, and Ice Conditions are Changing

The Copper River Basin has a subarctic continental climate, where winter conditions have historically prevailed between October and April or May. However, the region is undergoing rapid climatic changes. The Arctic and subarctic regions are warming faster than virtually anywhere else on earth (Hinzman et al. 2005), while winter conditions in Alaska are warming faster than those of any other season (Wendler and Shulski 2009). The past few decades have seen a surge of research on climate change impacts on subsistence activities in the Far North, including Alaska, much of it focused on changing resource abundance, quality, or both.

Other research has explored how climate change is affecting winter travel. *Dangerous Ice*, a set of oral interviews conducted for Project Jukebox, an online collection of the University of Alaska Fairbanks Oral History Program (n.d.), focuses on climate-related impacts to winter travel and access on rivers and lakes in Interior Alaska. Interview respondents include subsistence hunters and trappers, scientists who study ice conditions, mushers, and recreational snowmachiners. In another study, Brown and others (2018) used a combination of geospatial data and local observations to analyze freeze-up and breakup timing (also see [Brown et al. \(https://www.nps.gov/articles/000/aps-22-1-7.htm\)](https://www.nps.gov/articles/000/aps-22-1-7.htm), this issue). They found that while breakup was occurring significantly earlier in all communities for which they analyzed data, later freeze-up dates were occurring in only some communities.

There is little published information that specifically discusses snow and ice conditions in the Copper River Basin. There are a few scattered references to snow and ice conditions in the accounts of early Euro-American explorations of the Copper Basin. Most significantly, Lieutenant Henry Allen and his party traveled up the lower Copper River in early April 1885, as ice conditions were first beginning to degrade for the season. The party then ascended and descended the Chitina and Chitistone rivers during the latter half of April and the beginning of May, as the ice was actively breaking up (Allen 1887). Allen's report contains frequent observations of the ice conditions as he encountered them. At the end of April, for instance, the party encountered ice as it descended the Chitina River:

*After having waited a few hours for the ice to go out, and realizing no advantage by our delay, we carried our boat and baggage to the north bank of the Chittyná, at its junction with the Chittystone, and went into camp. [...] An investigation showed that the ice in the Chittyná would not allow the use of a boat, and a considerable delay seemed inevitable. [...] In the afternoon, at 3 p. m., we started out with the boat well loaded, carrying, besides our own party, two men, two women, five children, twelve dogs, and the worldly possessions of all (Allen 1887: 56).*

After a descent of about 4 miles, the ice forbade further progress. But by the following day ice was no longer impeding progress, and Allen notes that: *nearly all the snow and ice in the river-bed had disappeared* (Allen 1887: 56). Similarly, Allen's account contains descriptions of weather and snow conditions during the same timeframe: *On May 4 we left camp, contrary to the wishes of our native friends, in quite a snowstorm, which turned to rain towards the middle of the day* (Allen 1887: 57).

Unfortunately, Allen's account is unable to provide broader temporal context for his observations, as it was limited to the one season of his journey. Many subsequent expeditions, such as those of Abercrombie (1900) and Powell (1909), took place during the summer months and did not attempt to ascend the Copper River. (Abercrombie and Powell both accessed the Copper River valley by traveling over the Valdez and Klutina glaciers).

Despite the wealth of oral history interviews conducted in the Ahtna region, it is difficult to find source material that specifically discusses the topic of winter snow and ice conditions. The fieldnotes of anthropologists Frederica de Laguna and Catherine McClellan contain a 1960 interview with Kluti-Kaah Elder Elizabeth Pete that includes a brief discussion of winter ice conditions and breakup timing on the Copper River:

[Elizabeth Pete]: *From November to April we can walk across the Copper River.*

[Interviewer]: *How long does it take the ice to go down the river?*

[Elizabeth Pete]: *Oh, about 10 days [...] just jam up. Then big break up comes the last. Sometimes the 5<sup>th</sup> of May; when we have an early spring, the last of April* (de Laguna and McClellan 1960: Box 7.1; 7.10.60).

Although unfortunately very limited in detail, Pete’s statement generally aligns with what today’s Elders have said about the months when the Copper River was crossable during the mid-20<sup>th</sup> century.

Interviews Conducted

Nine oral interviews were conducted with local residents who had extensive knowledge and experience with winter activities in the Copper River Basin (see Figure 2). Respondents were selected based on their experience, using a purposive sampling strategy (Bernard 2018).

Of particular interest was trapping, because it is primarily done in the winter and is thus particularly sensitive to changing conditions. As well, there has historically been a significant amount of trapping activity on the east side of the Copper River, which cannot be accessed in the winter if the river is not frozen. Eight of the nine interview respondents had either current or former trapping experience. Of these, six had trapping experience in the region dating back to the 1970s or earlier. Four interview respondents had trapping experience within the past two decades.



Figure 2. The Copper River drainage, showing major tributaries and communities mentioned in this report.  
MAP PRODUCED BY THE AHTNA INTERTRIBAL RESOURCE COMMISSION/CASEY CUSICK

People Interviewed	Approximate timeframe covered in interview	Locations described in interview
Wayne Bell	1970s – 1990s	Tazlina – Chitina
Joe Bovee	1990s – present	Copper Center – Gakona
David Bruss	1970s – present	Copper Center – Chitina, Chitina River drainage, Copper Ri
Charlie David	1970s – 2010s	Mentasta Lake area
Nick Jackson	1950s – 1970s	Copper Center – Dadina
Mike McCann	1970s – present	Chitina River drainage
Philip Sabon	1950s – 1980s	Copper Center area

People Interviewed	Approximate timeframe covered in interview	Locations described in interview
Dave Sarafin	2000s – present	Tazlina/Klutina river drainages
Ray Stickwan	1970s	Copper Center area

## Ice Conditions, Travel, and Access

A majority of respondents indicated that ice conditions were more favorable for travel in past decades compared to recent years. In the past, crossing rivers was less treacherous and could be done earlier in the fall and later in the spring. Even in midwinter, travel across or along rivers and streams tended to be more predictable, with some exceptions. But in more recent years, ice has been slower to form and quicker to break up, presumably as a result of warmer temperatures during the winter and shoulder seasons (i.e., late fall and early spring). Even during midwinter, a number of respondents have described more variable, and treacherous, ice conditions (for example, areas of open water or jumbled ice blocks on rivers). However, a few said they had not noticed a clear pattern of change in ice conditions over the years they had spent trapping, perhaps coinciding with the noisy fluctuations inherent in these climatic trends.

In the 1970s and earlier, respondents characterized crossing the Copper River as a very unremarkable feat. The river could be crossed in many places throughout its length. Wayne Bell and Nick Jackson described crossing the Copper, and traveling along its length, in the Copper Center area. In those days, people used to cross the river frequently for a variety of activities, including woodcutting and visiting family cabins on the east side. While there were still dangerous spots and areas of open water, these were easy to see and avoid, as Wayne Bell described:

**Odin Miller [OM]:** *Yeah. You never had to worry about [...] ice?*

**Wayne Bell [WB]:** *Nope. You just kind of pick your way—maybe a hole here and there but, those days, you could see [inaudible] because it was so cold. If there was open water you'd see steam coming through, you don't walk that way. And the ice was always three feet thick. I mean four feet thick, so you don't have to check the ice or nothing like that. You just don't walk where the steam coming out.*

**OM:** *You didn't have to wait for certain conditions or—*

**WB:** *No-no.*

Jackson similarly noted that the ice “used to freeze solid,” apart from open areas where streams flowed into the main river. He said that during his childhood in the 1940s and 1950s, his father had a trapline in the Dadina River valley, approximately 12 miles below Copper Center. He and his father would walk from Copper Center down the length of the river to access the Dadina.

Over the course of several decades, respondents have observed large-scale changes in ice conditions. Philip Sabon, an Ahtna Elder and a longtime trapper, who grew up across from Copper Center on the east side of the river, said that he and his family members had noted warming trends in the region for many decades, eventually leading to the river no longer freezing:

**Karen Linnell [KL]:** *When did that river quit freezing up in winter?*

**Philip Sabon [PS]:** *Oh, geez, a long time—about 20 years now.*



**KL:** *About 20 years now?*

**PS:** *It freeze once in a while. Usually freeze October month, I think. No more it. My grandpa used to say Alaska warming up back in the '30s. I don't believe him. When I find out, it's 1950. Alaska warming up. Yeah it's. I see that. Not too cold. Yeah.*

In the 1970s, later freeze-ups and earlier breakups began to shorten the trapping season ([Brown et al. \(https://www.nps.gov/articles/000/aps-22-1-7.htm\)](https://www.nps.gov/articles/000/aps-22-1-7.htm), this issue). Nick Jackson said he had noticed the changing ice conditions on the Copper River by 1970, the last year he trapped on its east side. When asked, he affirmed that this change had an influence on his decision to stop trapping there, noting that he had to pull his traps early due to degrading ice.

Ray Stickwan, who trapped with Sabon as a young adult on the east side of the river across from Copper Center, similarly said the two began to observe changing ice conditions in the late 1970s. This shortened the trapping season by making it impossible to cross until later in the winter (Figure 3):

**[Ray Stickwan]:** *Um, yeah you couldn't even go across, like later on in the '70s right there, I remember we were having trouble. And these places he's about, the river was—like I said this was like January or so and we didn't want to—we couldn't wait till spring, you know, 'cause, by the time spring comes around, trapping's over with. So we had to go over and do our trapping when we can, you know, within a couple months.*

Even when solid ice eventually does form, the later freeze-up season dates shorten the trapping season, as David remarked:

**Charlie David [CD]:** *Even, during October, used to cross that river down there. Nowadays you go down there in October to go fishing. Spear fishing.*

**Odin Miller [OM]:** *Wow. Used to be you could walk on it and now, no ice at all.*

**CD:** *Nothing. Maybe later in December when—you know. You only got one month of trapping left to do and, what's the use?*



Figure 3. Approximate locations of crossing places on the Copper River during recent years, as described by interview respondent Joe Bovee. MAP PRODUCED BY THE AHTNA INTERTIBAL RESOURCE COMMISSION/CASEY CUSICK

## Changing Snow Conditions and Travel

As with river-ice conditions, respondents described significant changes in winter snow conditions occurring since the mid-20<sup>th</sup> century. Decreasing snowpacks—especially during the early season—have hindered winter access along the snowmachine trails used by trappers and others. However, changes in snow conditions have been more inconsistent and irregular than corresponding

changes in river ice conditions. For instance, the winter of 2021-2022 began with very little snow, but ultimately saw record levels of snowfall (USDA NRCS 2022) in the Copper River Basin.

In past decades, snowfall and seasonal conditions were generally more regular, and snow could be quite deep by early November. Bell recalled that “it snowed a lot here them days,” referring to conditions in the 1970s, while McCann reported that in past decades, low snowpacks early in the season did not present problems for traveling. This suggests that conditions were more predictable, in the sense that there was rarely or never too little snow for snowmachine travel. According to Bruss:

**[David Bruss]:** *I can remember some years, before the 10<sup>th</sup> of November, where I would have to make special snowmachine trips to break trails open 'cause the snow was already three feet deep and trying to haul a sled full of traps to start with I needed a trail through that much snow to even begin so. We've had years when I've had to break trails open before the season just to have an established trail to work on but, it seems like, you know the trend has been less snow and later snow than what it was 40-50 years ago.*

Bruss also mentioned a year during the 1980s during which there was barely enough snow in the Chitina valley to ride a snowmachine and there were areas of bare ground even at the end of February, when he was pulling his traps. But he said that this is an “exception to the rule.” Bruss, who began trapping in the 1970s, did not characterize this as a change from prior conditions he had experienced. Bruss, who began trapping in the 1970s, does not characterize this as a change from prior conditions he had experienced.

As with ice conditions, the change in snow conditions was a gradual one that has taken place over the past several decades—although fewer respondents have described observing changing snow conditions as far back into the past. Stickwan described how he began to notice the consistency of the snow changing during his later years of trapping with Sabon:

**[Ray Stickwan]:** *Um, the snow was different [...] I mean we call it rotten snow. Because you know where you had the hard crust snow and stuff you're able to go across. You know and ice and stuff like that, cross those creeks and stuff like that. All over there, when it colder, right there it was easy to, uh, make trails over there but you know when you got rotten snow it's like a—there's like slushy stuff right there and you—even, that affected the snowmachines, [...] We used to have to bring a hatchet and clean out the ice in there, you know chipping the ice and stuff away there. Because the wetness, the wet snow. It was not like the dry snow on top of there before we used to have.*

*But it changed, that changed, I remember that, too right there we were trying to get over. And we had to constantly clean. Not just that the skis even. [Snow] would stick to the skis we had to bring our own wax. You know, just use wax [...] put some wax on it ['cause it] help it slide through snow better. [...] I just remember that snow changed, right there, too, [actually] the warmer it got. I mean, but like those trails, there was a lot of places turned rotten fast.*

In more recent years, some respondents have described a lack of snow, particularly in the early season, as a major problem. David even cited it as a major reason why he stopped trapping:

**Odin Miller [OM]:** *Like let's say if all of a sudden, the fur prices went up really high and it got to be worth it again. But if the weather conditions kept getting worse and worse, would there be certain changes you'd make to the trail to adapt?*

**Charlie David [CD]:** *No, I wouldn't—like I say, with the weather, you know, you depend on snow for trapping. And maybe it snows two-three times a year here, that's it. And then when it snow it snow. Like October-month. You go out, try and set your trap, and there's no snow out there. And you try to use 4-wheeler and doesn't work. [Well it's] snowmachine. I mean it, [I'd say it] really affects how you trap. The weather.*

*And, maybe end of October, around November, started raining. [...] Going away, tradition. And it's all depends on the weather. And you can't—even you change your tactic you're still be dealing with rain, no snow. You just give up.*

A related problem that has interacted with the more variable snow conditions is shrubification, or the proliferation of shrubs in areas of the forest and tundra that were previously clear. As a process that is occurring throughout the Arctic and subarctic, shrubification is closely associated with changing climatic conditions (Myers-Smith and Hik 2017). Several respondents discussed the issue, saying that increased growth of plants and shrubs has made travel through the forest more difficult during the winter months. This is potentially compounded during years with low snow cover. Stickwan said that in the past “you could see a long ways,” but that in recent decades: *And all of a sudden all of these alders like this were coming that you had to cut through*. Bruss said he sometimes has to carry a chainsaw with him trapping, which had never previously been necessary. Heavy snows can cause trees and brush to fall into the trail—a bigger problem now that the vegetation is thicker.



Open water on the Copper River north of Copper Center, March 2022.

NPS/BARBARA CELLARIUS

## Related Socioeconomic Changes

A number of socioeconomic changes occurred concurrently with the changing snow and ice conditions. The earliest and most significant of these was the abandonment of settlements on the east side of the Copper River. This took place gradually during the first half of the 20<sup>th</sup> century (Simeone and Miller in preparation)—by the early 1950s, nobody permanently lived on the river's east side. It is likely that access issues, in general, contributed to the abandonment of these settlements, since modern villages and their amenities (schools, post offices, etc.) were located on the west side of the river. Even before climate-change impacts became an issue, people living on the east bank could not travel across the river during the shoulder seasons in the spring and fall.

The increasing prevalence of year-round employment has similarly affected use of the landscape—and in particular, the east bank of the Copper—during the winter months. During the early 20<sup>th</sup> century, opportunities for wage employment were limited in rural Alaska (Reckord 1983), and trapping was one of the main sources of monetary income for many families. By the 1970s, however, year-round employment was becoming increasingly common, precluding full-time trapping for a growing number of Copper Basin residents, as Stickwan noted:

*Nobody was doing—in fact, like I said, there was so much money, from the pipeline and everybody working unions and everything else right there that it wasn't [...] financially responsible to even try to think about—if anybody, um, trapped, it was just more because they wanted to.*

Several respondents described the transition from dog team to snowmachine, which largely took place in the late 1960s and 1970s, around the time respondents first took note of changing ice conditions. One advantage of dogs is that they could sense where it was safe to cross the rivers, as Sabon explained:



*You know you gonna come back. Even nighttime. The river—they know where solid ice. I let 'em go. I trust them. Next day I see their tracks—where it's solid ice they go.*

McCann, who did not begin using a snowmachine until the 1990s, because he did not trust the technology, similarly said that dogs would stop as soon as they encountered overflow water:

**[Mike McCann]:** *Well, with a snowmachine you can run right into overflow, and then if it's cold or if you don't get it out it'll freeze up or this and that and everything but dogs won't. Soon as the lead dog gets his feet wet, he stops. [...] Yeah, they won't go into overflow unless you make 'em. You know. Yeah. If there's overflow under the snow, they'll stop. So there's a lot of advantages to dogs in a way, you know.*

However, the power of modern snow-machines enables them to speed across areas of unstable ice or even open water. Bruss noted: [...] *there's a lot of places you can cross a snowmachine that I would never try to do on foot.* For instance, Bell described having to “skip,” or hydroplane, across the overflow waters of the Copper River on a snowmachine, a crossing that would not have been possible on foot or dog team. McCann also noted that switching to a snowmachine enabled him to cover more territory. He described the process of breaking trail as being significantly easier on a snowmachine than with a dog team.

## Conclusion

Traditional knowledge suggests that climate change has had a demonstrable impact on winter access to the landscape. Elders have noted a clear pattern of decline in ice conditions during the past several decades, with obvious impacts to trappers and others who depend on frozen rivers and lakes for travel. While snow conditions have been variable, people have experienced snow as less reliable than in the past, particularly during the early part of the season. Combined, these changing conditions have made winter access to the landscape significantly more difficult.

At the same time, climate change should be regarded as part of a suite of social-environmental factors driving changing relationships between people and the landscape.

Both changing ice conditions and non-climate factors, such as technological change and the rise of wage employment, have contributed to changes in patterns of winter activities. This, in turn, has brought about further change in how local people understand and relate to the landscape.

## Acknowledgements

This article is an abridged version of a technical report (Miller 2023). The study was conducted as part of a cooperative agreement between the National Park Service and Ahtna Intertribal Resource Commission (AITRC), a nonprofit organization based in Glennallen that seeks to manage fish and wildlife resources on traditional Ahtna Athabaskan lands. Thank you to Casey Cusick, AITRC's Geographic Information Systems Specialist, for creating the maps for this article.

First and foremost, the author thanks the interview participants who generously shared the time and knowledge that made this report possible: Wayne Bell, Joe Bovee, David Bruss, Charlie David, Nick Jackson, Mike McCann, Philip Sabon, Dave Sarafin, and Roy Stickwan. Thank you to the National Park Service (NPS) Wrangell-St. Elias National Park and Preserve for providing funding for this project through a cooperative agreement with AITRC. In particular, thanks to Barbara Cellarius, the NPS Agreement Technical Representative for this project, for providing administrative support, technical assistance, and guidance on this project, as well as

reviewing and providing comments on drafts of the report. Thank you to Karen Linnell, AITRC's Executive Director, who participated in one of the interviews.

## References

**Abercrombie, W. R. 1900.**

A Military Reconnaissance of the Copper River Valley, 1898. In *Compilation of Narratives of the Exploration of Alaska*, 563-590. Washington: U.S. Government Printing Office.

**Allen, H. T. 1887.**

Report of an Expedition to the Copper, Tanana, and Koyukuk Rivers in the Territory of Alaska in the Year 1885. Washington: U.S. Government Printing Office.

**Bernard, H. R. I. 2018.**

*Research Methods in Anthropology: Qualitative and Quantitative Approaches*. 6th Ed. Walnut Creek: Altamira Press.

**Brown, D. R. N., T. J. Brinkman, D. L. Verbyla, C. L. Brown, H. S. Cold, and T. N. Hollingsworth. 2018.**

Changing river ice seasonality and impacts on interior Alaskan communities. *Weather, Climate and Society* 10: 625-640.

Also see: **Brown, D. R. N., C. D. Arp, T. J. Brinkman, B. A. Cellarius, M. Engram, M. E. Miller, and K. V. Spellman. 2023.**

Long-term change and geospatial patterns of river ice cover and navigability in Southcentral Alaska detected with remote sensing. *Arctic, Antarctic, and Alpine Research* 55(1): 2241279.

**De Laguna, F. and C. McClellan. 1960.**

Unpublished fieldnotes, MS 299. On file at Alaska State Library Archives, Juneau, AK, and Ahtna Intertribal Resource Commission, Glennallen, AK.

**Hinzman, L. D., N. D. Bettez, W. R. Bolton, F. S. Chapin, et al. 2005.**

Evidence and implications of recent climate change in northern Alaska and other Arctic regions. *Climatic Change* 72(3): 251-298.

**Miller, O. 2023.**

Winter travel, access, and changing snow and ice conditions in Alaska's Copper River Basin. Natural Resource Report. NPS/WRST/NRR—2023/2508. National Park Service. Fort Collins, Colorado.

**Myers-Smith, I. H. and D. S. Hik. 2017.**

Climate warming as a driver of tundra shrubline advance. *Ecology* 106(2): 547-60.

**Powell, A. J. 1909.**

*Trailing and Camping in Alaska*. New York: A. Wessels.

**Reckord, H. 1983.**

*That's the Way We Live: Subsistence in the Wrangell-St. Elias National Park and Preserve*. Anthropology and Historic Preservation, Cooperative Park Studies Unit, Occasional Papers no. 35. Fairbanks: University of Alaska Fairbanks.



**Simeone, W. E. 2018.**

Ahtna: *Netseh Dae' Tkughit'e'* "Before Us, It Was Like This." Glennallen, Alaska: Ahtna, Inc.

**Simeone, W. E. and O. T. W. Miller. In preparation.**

Ahtna and Wrangell-St. Elias National Park and Preserve: An Ethnographic Overview and Assessment. Technical report. Copper Center, Alaska: Wrangell-St. Elias National Park and Preserve.

**University of Alaska Fairbanks Oral History Program. n.d.**

Dangerous Ice. Project Jukebox.

Available at: <http://jukebox.uaf.edu/site7/dangerice> (accessed 15 March 2022)

**USDA NRCS [United States Department of Agriculture Natural Resource Conservation Service]. 2022.**

Alaska Snow Survey Report. Available at:

[https://www.nrcs.usda.gov/wps/cmیس\\_proxy/https/ecm.nrcs.usda.gov%3a443/fncmis/resources/WEBP/ContentStream/idd\\_607E9680-0000-CD11-913BC9FBB57CAB56/0/Alaska+Snow+Survey+Report+May+2022.pdf](https://www.nrcs.usda.gov/wps/cmیس_proxy/https/ecm.nrcs.usda.gov%3a443/fncmis/resources/WEBP/ContentStream/idd_607E9680-0000-CD11-913BC9FBB57CAB56/0/Alaska+Snow+Survey+Report+May+2022.pdf). (accessed 8 August 2022)

**Wendler, G. and M. Shulski. 2009.**

A Century of Climate Change for Fairbanks, Alaska. *Arctic* 62(3): 295-300.

## Cite article as

Miller, O. 2023. *Traditional knowledge of changes in winter conditions in Alaska's Copper River Basin*. *Alaska Park Science* 22(1): 90-101.

Part of a series of articles titled [Reckoning with a Warming Climate](https://www.nps.gov/articles/series.htm?id=30369C98-990C-EA2F-62432CED5C938737) (<https://www.nps.gov/articles/series.htm?id=30369C98-990C-EA2F-62432CED5C938737>).

**Previous:** [Using Satellite Imagery to Detect the Changing Seasonality of River Ice](https://www.nps.gov/articles/000/aps-22-1-7.htm) (<https://www.nps.gov/articles/000/aps-22-1-7.htm>).

**Next:** [Communicating Science and Inspiring Hope](https://www.nps.gov/articles/000/aps-22-1-9.htm) (<https://www.nps.gov/articles/000/aps-22-1-9.htm>).



wrangell - st elias national park & preserve

alaska

aps

alaska park science

climate change

climate change impacts

indigenous knowledge

traditional knowledge

Last updated: September 5, 2023

## Was this page helpful?

☐ Yes

☐ No



An official form of the United States government. Provided by [Touchpoints](https://touchpoints.app.cloud.gov/)  
(<https://touchpoints.app.cloud.gov/>)