National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

# Winter Travel, Access, and Changing Snow and Ice Conditions in Alaska's Copper River Basin

Natural Resource Report NPS/WRST/NRR—2023/2508

ON THIS PAGE
Open water on the Copper River north of Copper Center, January 2022.
Photo courtesy of Barbara Cellarius, NPS.

ON THE COVER
The Copper River in February 2022, as viewed from Simpson Hill near Glennallen, Alaska.
Photo courtesy of Odin Miller.

# Winter Travel, Access, and Changing Snow and Ice Conditions in Alaska's Copper River Basin

Natural Resource Report NPS/WRST/NRR—2023/2508

Odin Miller

Ahtna Intertribal Resource Commission
187 Glenn Highway
Glennallen, AK 99588

This study has been 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.

April 2023

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible and technically accurate. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Natural Resource Publications Management Web site (http://www.nature.nps.gov/publications/nrpm/) on the Internet. If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Please cite this publication as:

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. https://doi.org/10.36967/2298854

NPS 109/188104, April 2023

# Contents



# Tables



# Figures

## Executive Summary

In Alaska's Copper River Basin, less reliable snow and ice conditions, increasingly common in recent years, have presented challenges for winter activities such as trapping, hunting, and gathering firewood. While previous studies have drawn similar conclusions elsewhere in Alaska and the Circumpolar North, these impacts have not been explored in the Copper Basin, specifically. Data for this project were collected using a set of nine oral interviews, conducted with local residents who have extensive knowledge and experience with winter activities in the Copper River Basin. In past decades, crossing rivers was less treacherous and could be done earlier in the fall and later in the spring. During midwinter, travel across or along rivers and streams mostly tended to be predictable, with some exceptions. Over the course of several decades, people have observed large-scale changes in ice conditions. One of the most significant outcomes has been the difficulty this has created for trappers and others trying to access the east side of the Copper River during the winter months. Some Elders have noticed these changes beginning as long ago as the 1970s, or even earlier. Interview respondents have described significant changes in winter snow conditions occurring since the mid-20$^{th}$ century, although these have been more inconsistent and irregular than corresponding changes in the ice conditions. Decreased snowpacks—especially during the early season—have increasingly presented an obstacle to winter access along the snowmachine trails used by trappers and others. Additionally, several interview respondents reported that increased shrub-growth had made it more difficult to travel across the winter landscape, requiring them to cut trails through the forest—something that never used to be necessary. Finally, several socio-economic and technological factors have interacted with climate change, impacting patterns of winter use of the Copper River Basin during the past several decades.

## Acknowledgements

First and foremost, I would like to thank 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 Ahtna Intertribal Resource Commission (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 Casey Cusick, AITRC's Geographic Information Systems Specialist, for creating the maps found in this report. Karen Linnell, AITRC's Executive Director, participated in one of the interviews. Finally, I would like to thank Nina Chambers of the NPS, who created an abbreviated version of this report for the NPS's *Alaska Park Science* journal.

# Introduction

The purpose of this report is to provide preliminary data on how changing snow and ice conditions are affecting travel and access in the Copper River Basin. These winter conditions play an enormous role in social-ecological systems in the rural 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.

In the Copper River Basin, diminishing snow and ice conditions have presented a variety of challenges related to winter travel. It is difficult to point to published sources that specifically focus on the topic of snow and ice conditions in the Copper River Basin. Broadly speaking, however, many of these are similar to those elsewhere in Alaska and the Circumpolar North. Late snowfall and freezeup present challenges for winter activities such as trapping, hunting, fishing, and gathering firewood.

More particular to the region is how these changes have affected access to lands on the east side of the Copper River. While highways run most of the length of the upper Copper River along its west bank, there is only one bridge across the upper river, and no roads run parallel to the river on its east side. This means that airplane, boat (during summer months), and crossing the river ice (winter months) are the only practical ways to access this terrain along most of its length.

# Background

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 20th century, virtually all Ahtna lived a semi-nomadic lifestyle, relocating several times during the course of 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.

The 20th 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

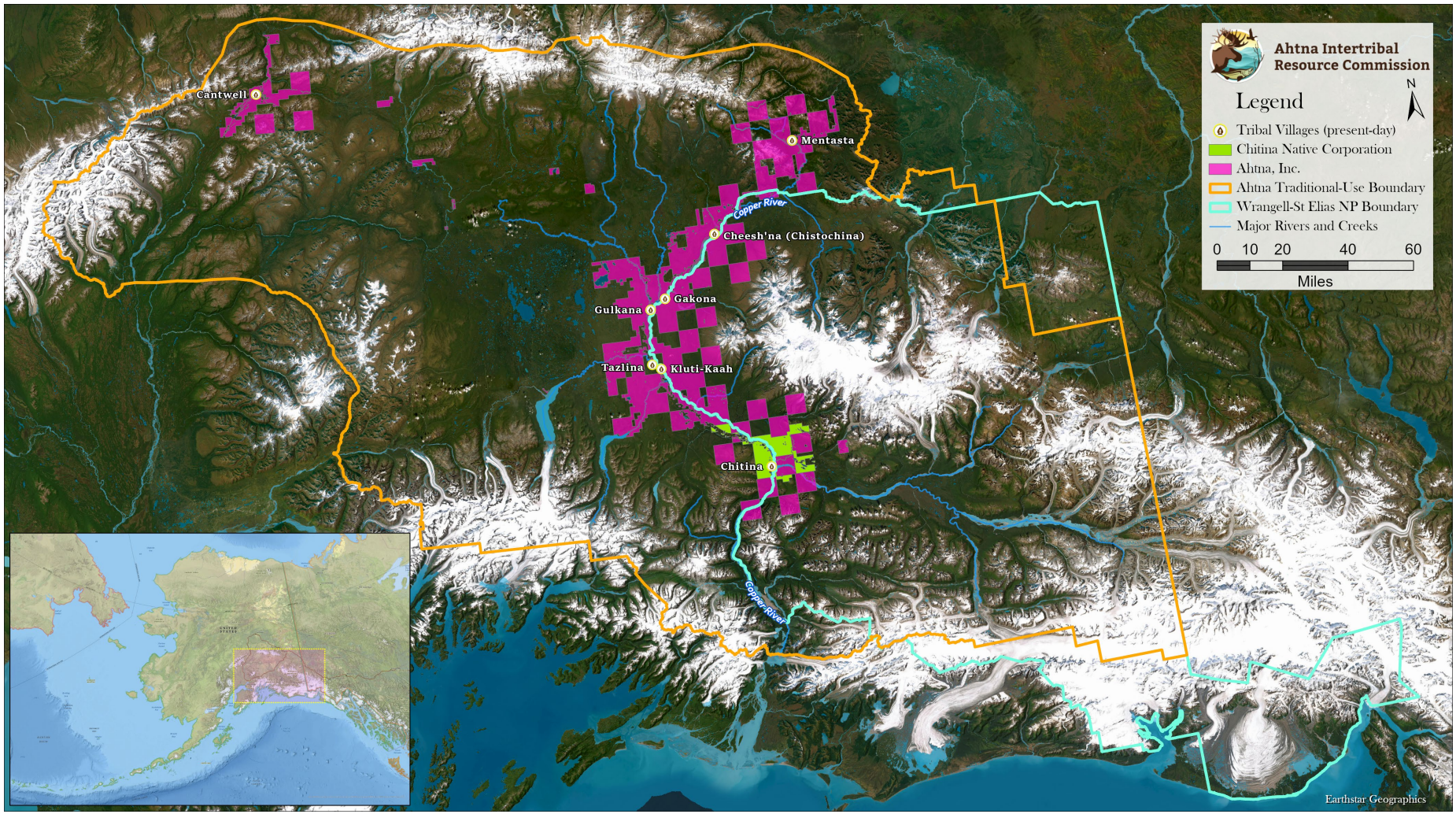


Figure 1: Map showing Ahtna Traditional Use Territory, contemporary Ahtna villages, Wrangell-St. Elias National Park Boundaries and Alaska Native Corporation lands.

in the region also consider hunting, fishing, gathering and/or 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 20th century, trapping gradually declined as a primary source of income. (Volatile fur prices also played a role in fluctuating trapping participation during the 20th 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.

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 the topic of climate change impacts on subsistence activities in the 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 freezeup and breakup timing. They found that while breakup was occurring significantly earlier in all communities for which they analyzed data, later freezeup dates were occurring in only some communities.

More generally, Herman-Mercer and others (2011) documented evidence of climate change observed by local respondents in the lower Yukon River communities of St. Mary's and Pitka's Point. Snow- and ice-related observations include thinner ice, an increasing number of open leads, and a number of lives lost due to people falling through the ice. Some respondents interviewed for the study also noted an increased number of sandbars along the river, which the authors suggest may be contributing to the increased number of open leads. In their study, Herman-Mercer and others found that there was no clear consensus among locals about whether breakup is taking place earlier than in the past.

Recently, several studies have focused specifically on how climate change is impacting access to subsistence resources. Brinkman and others (2016) examined climate impacts on both the abundance of resources and access to them, concluding that access would likely be the primary driver of decreased subsistence resource availability. In their study of nine rural Alaska communities, Cold and others (2020) specifically explored the impact of climate change on access to subsistence resources. They concluded that rural communities not connected to the road system are more vulnerable to access changes than road-connected communities. Cold and others

also note that weather forecasting and modern means of transportation such as snowmachines may have improved resilience to changing climatic conditions.

As noted above, 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. Allen 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). While Allen's report contains frequent observations of the ice conditions as he encountered them, it is limited to the one season of Allen's journey, providing no broader temporal context for these observations. 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 5th 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-20th century.

# Methods

Data for this project were collected using a set of nine oral interviews (listed in Table 1), conducted with local residents who had extensive knowledge and experience with winter activities in the Copper River Basin (Figure 2). Respondents were selected based on their experience, using a purposive sampling strategy (Bernard 2018).

Of particular interest for this project 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.

I was the primary interviewer for all nine of the interviews conducted for this project. Karen Linnell, AITRC's Executive Director, was present for one interview, during which she asked some of the questions.

Interviews were semi-directed. This means that I came to each interview with an interview guide containing a list of general questions to ask (see Appendix A). However, these questions were only intended as rough guideposts. I frequently diverged from these and asked spontaneous questions based on the direction of the conversation and the areas of interest and expertise each respondent demonstrated. At the beginning of each recorded interview, I presented respondent(s) with an informed consent form, explaining the project's terms and conditions, and asking if they were willing to agree. After transcribing each interview, I returned the transcripts to the interview respondents. This was a way of providing respondents with a record of the interview, in case they had concerns about the transcript or anything that was said, were interested in preserving the knowledge they had shared, etc. I used a content analysis technique (Bernard 2018) to analyze the interviews, developing a set of codes based on themes I identified within the interviews, and then assigning one or more codes to each passage of interview text.

Table 1. List of interview respondents who participated in this study.

| Respondent's Name | Approximate Timeframe Covered in Interview | Locations Described in Interview | Tribal Affiliation (if applicable) |
|---|---|---|---|
| Wayne Bell | 1970s – 1990s | Tazlina – Chitina | Ahtna |
| Joe Bovee | 1990s – present | Copper Center – Gakona | - |
| David Bruss | 1970s – present | Copper Center – Chitina, Chitina River drainage, Copper River below Chitina River confluence | - |
| Charlie David | 1970s – 2010s | Mentasta Lake area | Upper Tanana |
| Nick Jackson | 1950s – 1970s | Copper Center – Dadina | Ahtna |
| Mike McCann | 1970s – present | Chitina River drainage | - |
| Philip Sabon | 1950s – 1980s | Copper Center area | Ahtna |
| Dave Sarafin | 2000s – present | Tazlina/Klutina river drainages | - |
| Ray Stickwan | 1970s | Copper Center area | Ahtna |

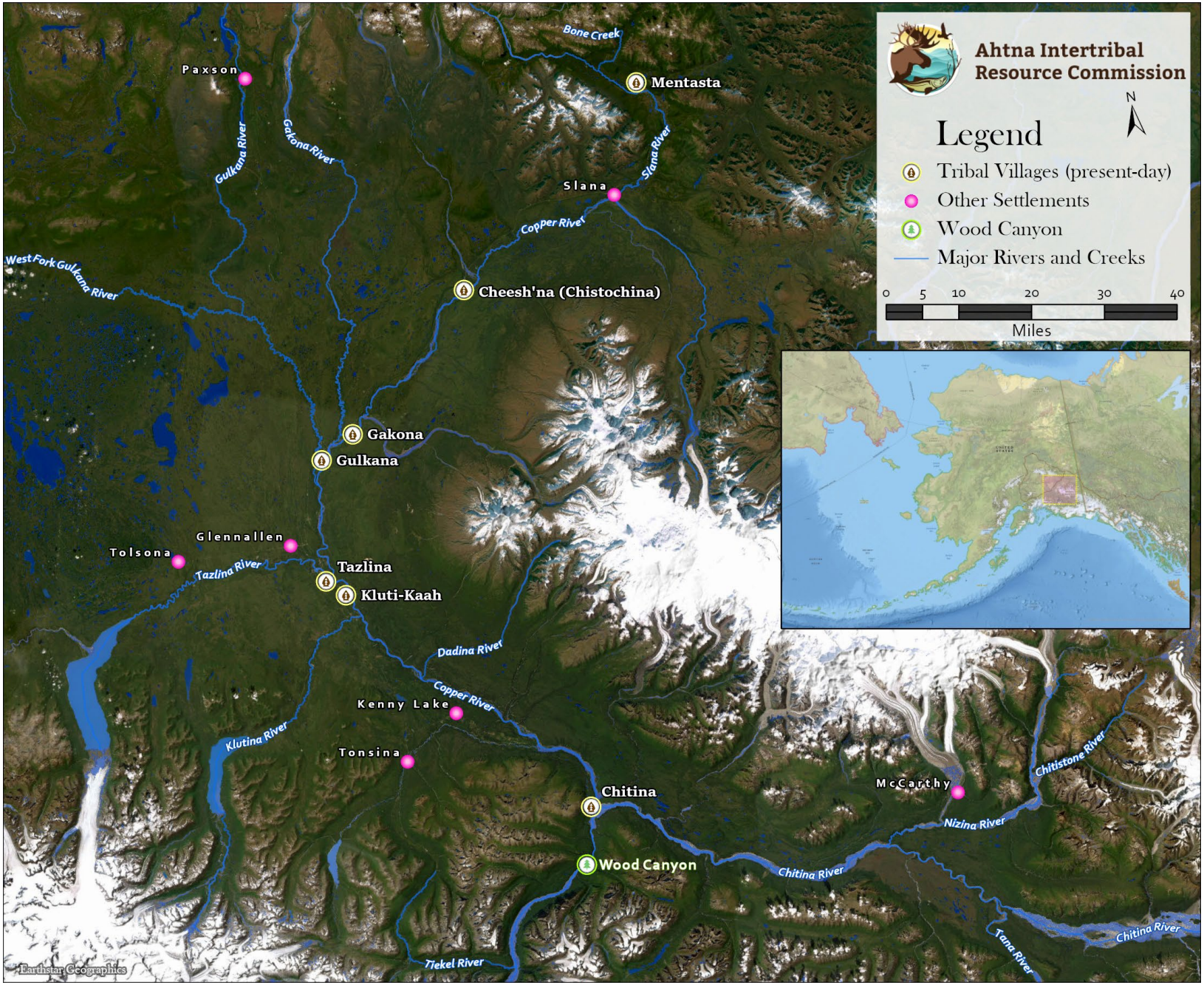


Figure 2: The Copper River drainage, showing major tributaries and those mentioned in this report.

# Results

## Ice Conditions, Travel, and Access

In past decades, a majority of respondents indicated that ice conditions were more favorable for travel, compared to recent years. Crossing rivers was less treacherous and could be done earlier in the fall and later in the spring. Even in the midwinter, travel across or along rivers and streams mostly tended to be more predictable, with some exceptions. However, a few respondents said they had not noticed a clear trend of change in ice conditions over the years they had spent trapping.

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 describes:

> **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:** OK. So it was a pretty clear path a lot of places.
>
> **WB:** Oh yeah. Yeah it's.
>
> **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.

Jackson 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.

However, longtime trapper David Bruss notes that early freezeup events, which occurred more often in past decades, would make the ice form in a way that was more erratic and difficult to negotiate:

> **[David Bruss]:** […] Even a lot of times like on the Copper River in Wood's Canyon, it would sometimes dam up in October, on a—on a—on a cold beginning. But that always eventually chews itself open and now you've got a gully of water with five- to six-foot ice walls on both sides and that never fills up. So if things froze up too fast they—it happened because everything was damming up, and then you got water running through the woods all over the place and outside of the creek banks, the riverbanks, and then when the water finally cuts its own channel through that dammed-up ice, and drops back down, now you've got hollow ice everywhere. So cold falls and fast freezeups usually made bad ice because it was […] formed by damming.

Over the course of several decades, respondents have observed large-scale changes in ice conditions. As mentioned above, one of the most significant outcomes of this has been the difficulty they have created for trappers and others trying to access the east side of the Copper River during the winter months. 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 long noted warming trends in the region, eventually leading to the river no longer freezing:

> **Karen Linnell [KL]:** When that river—uh, when did that river quit freezing up in winter?
>
> **Phillip 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.

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:

> **[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. Shit there, so we had to go over and do our trapping when we can, you know, within a couple months.

Other respondents noted changes in the river ice during the 1980s and 1990s. Wayne Bell of Copper Center also used to trap with Sabon during his youth, in the early 1970s, and frequently crossed the river without incident. However, he recalls two episodes that took place probably in the 1980s (Bell expressed uncertainty about the timeframe) when he noticed conditions starting to change. In one instance, Bell said that he was traveling between Copper Center and Chitina along the river, but on the return trip the ice had become uncharacteristically jagged, causing one of his companions to overturn his snowmachine and become pinned underneath it. Bell reported that was the last long trip he took along the river. In a later incident, Bell brought a group of kids across the river on a recreational outing. When the group tried to return, they found that the ice had dropped a few feet and the river channel was covered with overflow water. Bell said he cut trees and brush to create a runway, allowing the snowmachines to get up to speed before hydroplaning across the overflow water. Although the group was able to get safely back across the river, Bell said he has never tried to cross it since.

As recently as the early 1990s, Ahtna, Inc. Vice President Joe Bovee recalls a state timber sale that took place across the river from the community of Tazlina. According to Bovee, the company that was awarded the contract built an "ice-bridge" across the river, after which they were able to drive heavy equipment across. Bovee describes the process:

> they would cut a hole in the ice, upstream or downstream, flood it during the night; it would freeze up; they could drive trucks across there, you know for the rest of the day or week or something like that.

In the three decades since, Bovee says the number of locations that are crossable, even by snowmachine, has declined dramatically. According to Bovee, Ahtna,

Inc. has had an interest in crossing during the winter in order to develop a network of trails on Ahtna lands east of the river. However, they have been able to identify only three or four locations where it has been possible to cross in recent years. Bovee identified one crossing spot located several miles upriver of Gakona village, one at the site of Gakona village, one near Tazlina village, and one just north of downtown Copper Center (see Figure 3). This limited number of crossing places creates access problems, at least for Ahtna, Inc.'s trail construction purposes, as Bovee explains:

> **[Joe Bovee]:** And it's—I don't wanna say it's impossible but where these small areas are, it's almost impossible to get to because then once you get to those spots there's-there's no access to get to that firm crossing on the river because you have to go down the river five miles, come back, follow up along the river, which is a tedious task in itself because you could find other problems associated with that. So there's no real good access where these limited or several hard-ice, you know, firm-ice conditions […] exist, without going up or down the river, for miles—for several miles or ten miles or something like that.
>
> 'Cause like I say, I think there's some—on a more recent year I think there's a spot up there by—just south of Silver Springs, north of Copper Center. But then to get to that point, there's no place to go along the bank because it's all kind of eroded—you got these little kind of cliff-looking things now, where […] you know it's not flat and meandering around there. It's like you're fighting to get across there. And then once you get up there, to get back on the normal trail, or the historic trail, you have to cut back again, two-three-four-five miles and get back on the trail so you're doubling your time and effort and things like that.

However, Bruss reports that he still finds the Copper River crossable throughout its length:

> **[David Bruss]:** I don't have any problem crossing the Copper anywhere. 'Cause I've been running it all my life and I just—so many people, even in Copper Center have called me in the past to go with 'em 'cause they're afraid of it and it's only because they don't know.

It is worth noting that Bruss primarily describes trapping on the reach of river below Copper Center, where a preliminary analysis of remote sensing imagery by another researcher (Dana Brown, pers. comm., 3 February 2022) indicates that the ice is more contiguous than it is further upriver.

In addition to making it much more difficult to cross the Copper River, changing ice conditions have also affected travel along smaller rivers, streams and other waterbodies throughout the area. Respondents describe wetter snow conditions, more overflow, more open water, and more treacherous ice conditions.

Charlie David, a longtime trapper who has lived in Mentasta Lake since 1978, describes being unable to cross Bone Creek, a Mentasta-area water body that used to be quite solid during the winter months:

> **Charlie David [CD]:** You [used to be able to] drive across it and nowadays you can't even go across it during the winter.
>
> **Odin Miller [OM]:** During the winter, you can't go across it?
>
> **CD:** Open.
>
> **OM:** It doesn't get cold enough?
>
> **CD:** Nope.
>
> **OM:** […] When did you stop being able to-to go across it?


Figure 3: Approximate locations of crossing places on the Copper River during recent years, as described by interview respondent Joe Bovee.

**CD:** Nowadays you can't even cross it during the winter […] Ah it was ten years ago, I guess.

A few respondents emphasized that some rivers, like the Klutina, have always been difficult to navigate, and that people tended to avoid crossing them during the winter. "[…] Every river has its own personality for when it freezes up and how much overflow it has," according to Bruss. The Chitina River, for instance, typically has extensive sections of overflow as well as gravel bars that are blown clear of snow. Longtime McCarthy-based trapper Mike McCann similarly says that the Tana River, a tributary of the Chitina, has "a lot of open water on it." By contrast, Bruss says that the Copper is easier than many smaller rivers and streams to navigate because it is large and relatively stable. Warm Chinook winds do not tend to affect the stability of the Copper River in the same way they affect smaller rivers and streams, he said.

Even so, it appears that access on these smaller rivers and streams was less often an issue in the past than it has become in recent years. Bell describes a trip he made up the Tazlina River only to find that the ice had dropped when he made his way back downriver:

**[Wayne Bell]:** We also used to go up the […] Tazlina, all the way to the lake. Over there by Eureka. And you can't—the last time I went there too, what the problem was, went up there and then you go and the same thing there—Tazlina don't have no water in the winter. […] There's about four inches of water, that's all […] so you almost can't drown in it. But that was a smooth ice—you could cruise like 80-90 miles an hour going up there. But the problem with that, the last time we went is, same thing, went up there, and the ice dropped. And then, so you gotta watch, coming back, when it's a little darker, 'cause one time I got [started]—I just have to floor it and I jump over it […] because there was no way I was gonna—if I slammed on the brakes I was going in the hole. So, jump across and land on the other side, then start waving to have them go around. So, it—that was a problem up there, too.

Charlie David attributed these changes to his decision to stop trapping:

**Charlie David [CD]:** When I first came here, I could go down snowmachine across the lake. Now you can't even do that. Scare the hell out of me. A couple years ago, I was, go across the lake. Start falling behind me, I just speed up. […] Just drop. And two years ago I went, going up check Fred John trail. I was gonna go across the Slana River down there. It dropped, too, the ice—ice-shelf, they call it. Just collapse.

**Odin Miller [OM]:** Wow.

**CD:** And it's too [dangerous and I just stay in]. Sold all my traps.

**OM:** After that happened? That was, you said 10 years ago?

**CD:** [Oh what?] Three years ago.

It's too dangerous to go out anywhere nowadays unless you're on the ground. Hardly freezes. If it freeze over, it—you gotta deal with overflows. It's not worth it. Not worth your life.

Even when solid ice eventually does form, the later freezeup season dates shorten the trapping season, as David remarks:

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

**OM:** Wow. Wow. That's really. 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?

Mike McCann echoes Charlie David in noting an increased prevalence of overflow and open water during recent years. McCann, who has extensive knowledge of travel routes in the upper Chitina drainage, says that some of the crossing places he has relied on in the past are no longer safe. He says that he carries ice screws and a Come Along (a small hand-cranked winch) to pull his machine out in case he gets stuck in overflow.

David Sarafin, who has trapped on the west side of the Copper River since the early 2000s, says that his machine can power through a certain amount of overflow, although if there is too much he has to find routes around the streams and lakes that are along his route. Sarafin says that the amount of overflow on rivers and lakes does not necessarily correlate to the temperature patterns during the winter months:

> **[David Sarafin]:** Oh, [overflow] can happen at 30 below. […] There's a lot of different factors going on driving it, I think. Also, it happens more if you have a rainy fall where the ground gets saturated, and then for months or, there can be more groundwater seeping down towards the lake and helping to drive water on the lake surface. […] Some years where we've had very dry late summer or fall and the ground's dried out much more, it seems like I haven't had as much overflow in those years, but then it also relates to, you know if you get the weight of the snow—how much snow you're getting, too.

McCann similarly mentions hitting overflow even during cold weather conditions.

While acknowledging that river ice is slower to freeze in recent years, Bruss says that the quality of the ice is generally better than it used to be during past decades. In the past, when cold snaps were more prevalent, the ice would form quickly during the fall months. This would sometimes cause it to dam up while freezing, creating flooding outside of river channels and causing the ice to be poorly formed during the rest of the winter. By contrast, he says that slowly forming ice tends to be more regular and predictable.

## Changing Snow Conditions and Travel

As with river-ice conditions, respondents have described significant changes in winter snow conditions occurring since the mid-20th 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 recalls that "it snowed a lot here them days," referring to conditions in the 1970s, while McCann reported that in past decades, early-season snowfall never used to present problems for traveling. According to Bruss:

> **[David Bruss]:** [...] I can remember some years, before the 10th 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-to start with I-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-to-to work on but, it seems—it seems like, you know the trend has been less snow and later snow than what it was 40-50 years ago.

On the other hand, Bruss also mentions 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 says that this is an "exception to the rule." Bruss, who began trapping in the 1970s, does not characterize this as a change from prior conditions he had experienced.

Sarafin similarly mentions a more recent series of winters in which there was very little snow. He says that during the past two decades of his trapping in the Copper River Basin, it has been difficult to discern a trend in the amount of snowfall:

> **[David Sarafin]:** Ten years ago, maybe there were prob'ly three or four years in a row where we hardly had any snow through the winter. Um, but then you get some random thing that dumps two feet. And like this year [the winter of 2021-2022] […] we could have been saying, 'yeah, we're not getting much snow anymore,' and now we got like this record amount of snow still out there right now, so […] I can't say there's any trend one way or the other on that.

It appears that even in the past there were occasionally years in which there was not an abundance of snow early in the season. Jackson says he remembers one year during the 1950s when it did not snow till after Christmas, but says that once it finally did finally snow, the snow was very heavy. Based on respondents' recollections, however, it appears these occurrences were quite rare in the past.

McCann indicates that too much snow, as in the winter of 2021-2022, is undesirable because it makes snowmachine travel difficult: "So last year I didn't make it out to my cabin at all—I didn't set a trap last year." Bruss notes that too much snow is hard on the animals that trappers target. The reasons for this were not discussed at length, but it appears that too much snow makes it difficult for many furbearers to hunt for small prey animals, such as voles, that burrow under the snow.

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 describes 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 s—the ice in there, you know chipping the ice and stuff away there. Because the wetness, the wet snow. Shit there 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. Shit there, 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.

McCann, referring to conditions in more recent decades, has also described the snow becoming heavier and wetter.

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

> **Odin Miller [OM]:** Like let's say if-if all of a sudden, the fur-prices went up really high and it got to be worth it again. And, but the weather conditions kept getting worse and worse, what, 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, "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. Even heavy snows can create problems, as they can cause trees and brush to fall into the trail—a bigger problem now that the vegetation is thicker.

## Related Social-economic Changes

Along with changes in snow and ice conditions, both of which are a direct result of climate change, several related changes have impacted access and use patterns on the east side of the Copper River and elsewhere. The earliest and most significant of these changes is the abandonment of settlements on the east side of the Copper River. This took place gradually during the first half of the 20th century (Simeone and Miller in preparation)—by the early 1950s, nobody permanently lived on the river's east side. Interview respondent Philip Sabon said he spent childhood living on the east side of the river, across from Copper Center, and that his was one of the last families to move across to the west side of the river. Because this decline of settlements on the river's east side occurred during the early 20th century, it would not have been driven by climate change. However, 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 20th 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 notes:

> **[Ray Stickwan]:** 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.

Interview respondents Jackson, Bell and Stickwan all trapped on the east side of the Copper during their youth and/or young adulthood, but eventually stopped trapping and became involved in wage employment. This change has no obvious connection to changing snow and ice conditions, although it is possible that changing conditions played a role in driving this transition to year-round employment for some trappers. (As noted above, Jackson and David both cited changing ice conditions as a reason for giving up trapping, although for David this occurred only recently). At the very least, it can be said that the interaction between changing ice conditions and the decline of trapping resulted in a significant decrease in the use of lands east of the Copper.

Finally, 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 explains:

> **[Phillip Sabon]:** 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.

McCann said that if he needed the dogs to cross an area with overflow, he could give commands for them to do so and that they would obey.

Ray Stickwan says that early snowmachines, from the 1960s and 1970s, were very heavy: "they just like go through the snow instead of on top of the snow." While crossing the river during his trapping trips with Sabon, Stickwan recalls tying long wooden poles to the fronts and backs of the machines, apparently to keep them from sinking in case they punched through the ice. Stickwan describes some of the other challenges associated with the old machines:

> **Ray Stickwan [RS]:** Bad thing was the snowmachine back then they weren't very reliable. They'd break down all the time. You know, like I was telling you, we had to bring a whole bunch of extra parts.
>
> **Odin Miller [OM]:** Did you ever have to walk back?
>
> **RS:** Oh, yeah sometimes. We had to—you know, or just [had to go across] where […] we couldn't make it back across. We walked across the river, in some places that were—we just left the machine over there. The next day we had to […] go back over there and bring it back over […].

NPS/Barbara Cellarius

Changing ice and snow conditions create unexpected patches of open water and dangerous crossing. This photo is of the Copper River south of its confluence with the Tazlina River in March 2022.

The power of modern snowmachines enables them to speed across areas of unstable ice or even open water. Thus, Stickwan's recollection of walking across the river would likely not have been necessary on a more recent, faster snowmachine. As Bruss notes, "[…] there's a lot of places you can cross a snowmachine that-that I would never try to do on foot." For instance, Bell describes having to "skip," or hydroplane, across the overflow waters of the Copper River on a (more recent) snowmachine, a crossing that would not have been possible on foot or dog team.

Despite their shortcomings, even early snowmachines provided trappers with the advantage of being able to cover more territory. Bruss notes that snowmachines, unlike dog teams, enabled him to cover the necessary distance to make single-day trapping trips viable:

**[David Bruss]:** And once I got out of high school and I wanted to trap full time and try to make a living at doing that, I realized that in this area at least, I couldn't do it with dogs, without having cabins all over the place because you have to cover so much country to catch enough stuff and not catch too much, you know to hurt the populations of things. Um, I just couldn't do that by myself with dogs, so I um—I started out right out of high school with a couple Elans[1] and—with snowmachines but they were so ____. You know they're breaking down all the time and very undependable compared to now and—so it definitely wasn't easy and I had some pretty serious mishaps and—at times with different things and a number of times walking out for many miles.

McCann similarly notes that switching to a snowmachine enabled him to cover more territory. He also describes the process of breaking trail as being significantly easier on a snowmachine than with a dogteam.

[1] Elan is a brand of snowmachine.

## Discussion and Conclusion

Data collected for this project suggest that climate change has had a demonstrable impact on winter access to the landscape. Respondents 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, respondents have characterized them 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.

These conclusions could potentially be extended and complemented if they were paired with environmental data. For example, Dr. Dana Brown, a researcher at the University of Alaska Fairbanks, is currently conducting a study that is using remote sensing data to evaluate changes in ice-cover along the Copper River. In a future study, this kind of data could be synthesized with traditional-knowledge data—such as that found in this present study—to provide a comprehensive picture of the change that is occurring.

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. As discussed above, 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 change, in turn, has brought about further changes in how locals understand and relate to the landscape.

This question of relationships to a changing landscape cannot be fully addressed here, but warrants further exploration in future research. For instance, it is possible that the overall decrease in river crossing has contributed to a loss of local/traditional knowledge about how to safely cross the river. On the other hand, respondents indicate that crossing the Copper used to be a very straightforward action that would have required little specialized knowledge or expertise. As the decades have gone by and the climate has warmed, then, it is possible that the nature of crossing the river has changed into something that now requires more knowledge, skill and expertise than it used to—knowledge that may also, at times, be actively used in decisions to *avoid* crossing the river. Bruss, who indicated that he still frequently crosses the river, has noted that locals have often asked for his help guiding them across. It appears that many others, however, have simply stopped crossing the river because the conditions are risky, as respondents such as Bell have described. Non-climate factors (the decline of settlements on the Copper River's east bank and a decrease in professional trapping) have likely obviated the need for as much river crossing as what took place in the past.

More broadly, winter travel conditions may be changing in a rapid way to which people cannot easily adapt. Snow and ice conditions that once could be easily interpreted now seem to be dangerous and unpredictable. As noted above, Charlie David cites this danger as a reason for quitting trapping. Similarly, Wayne Bell suggests an unanticipated event, in which the ice of the Copper suddenly sank and was covered by overflow, as the reason he stopped crossing the river during the winter months.

Additional research could explore whether changing snow and ice conditions have been a primary factor driving trappers' decisions to quit the activity. While lack of snow and ice may have driven David's decision to quit trapping, other trappers interviewed were either still trapping

or had quit several decades earlier. A comprehensive survey of current and recent trappers could explore the degree to which changing conditions are impacting decisions to continue or quit trapping.

Finally, this project did not directly address the question of land ownership/management changes and any possible effects these may have had on trapping or other activities on the east side of the Copper River. These lands have been managed predominantly by the National Park Service (NPS) since the late 1970s—around the time many interview respondents for this project stopped trapping. (Prior to 1978, these federal lands were managed by the Bureau of Land Management.) A smaller amount of land on the east side of the Copper River–including much of the area along its bank–has been owned by Ahtna, Incorporated since the 1970s. Future research could explore whether land-status changes have had any impact on use of the east bank.

This current endeavor should be regarded as a starting point, rather than an exhaustive investigation of the topic. There are several important limitations to this project that are worth acknowledging. Perhaps the most significant of these is the limited number of interviews covering parts of the timeframe considered by this project (approximately 1970 – present). Only nine respondents were interviewed for this project, providing a dataset that is inherently modest in scope. On the one hand, at least six of these respondents have considerable experience (through trapping or otherwise) with the subject of crossing the Copper River. On the other hand, much of this experience is several decades old, dating back to the 1970s and 1980s. Only three respondents (Bruss, Bovee and David) were able to provide first-hand detail on crossing the Copper River, itself, since the 1990s—an unfortunate paucity considering that such detail is directly at the heart of this study's area of concern.

That said, the lack of direct information on recent river-crossing experience may be a notable data-point in and of itself. As reported above, a few interview respondents indicated that in the past, crossing the river used to be very commonplace and done for all kinds of activities. Yet this evidently changed since the 1960s and 1970s. The lack of recent experience by interview respondents crossing the river in the winter, then, likely reflects a general pattern of decline in locals crossing the river during the winter. While it has been relatively easy to identify older people who crossed the Copper several decades ago, it appears that it is far more difficult to point to people with recent such experience—probably because crossing the river has become far more tentative and dangerous.

The situation with trapping is similar. Eight of the nine interview respondents described trapping experience, but only four of them (Bruss, David, Sarafin and McCann) had trapped within the past three decades. While there are still trappers active in the Copper Basin, local reports suggest that their number has declined considerably during the past few decades. Trappers that still use the east side of the river (upstream of the Chitina River Valley) on a regular basis are even more difficult to identify.

A final limitation worth noting is the fact that all of the interview respondents for this project were men. This reflects the fact that trapping has been a male-dominated activity—a fact that was particularly true in past decades and is still the case today to a large extent.

Notwithstanding these limitations, I am not aware of any previous ethnographic documentation has focused on snow and ice conditions in the Copper River Basin, specifically. As such, this project plays an important role in beginning to fill this gap in the record.

## Literature Cited


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. 2018. Research methods in anthropology: Qualitative and quantitative approaches. 6th Ed. Walnut Creek: Altamira Press.

Brinkman, T. J., W. D. Hansen, F. S. Chapin III, G. Kofinas, S. BurnSilver, and T. S. Rupp. 2016. Arctic communities perceive climate impacts on access as a critical challenge to availability of subsistence resources. Climate Change 139: 413-427.

Brown, Dana R. N., Todd J. Brinkman, David L. Verbyla, Caroline L. Brown, Helen S. Cold, and Teresa N. Hollingsworth. 2018. Changing river ice seasonality and impacts on interior Alaskan communities. Weather, Climate and Society 10: 625-640, https://doi.org/10.1175/WCAS-D-17-0101.1.

Cold, H. S., T. J. Brinkman, C. L. Brown, T. N. Hollingsworth, D. R. N. Brown, and K. M. Heeringa. 2020. Assessing vulnerability of subsistence travel to effects of environmental change in Interior Alaska. Ecology and Society 25(1): 20. https://doi.org/10.5751/ES-11426-250120.

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.

Herman-Mercer, N., P. F. Schuster, and K. B. Maracle. 2011. Indigenous observations of climate change in the lower Yukon River basin, Alaska. Human Organization 70(3): 244-52.

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.

Myers-Smith, I. H. and D. S. Hik. 2017. Climate warming as a driver of tundra shrubline advance. Ecology 106(2): 547-60. https://doi.org/10.1111/1365-2745.12817.

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/cmis_proxy/https/ecm.nrcs.usda.gov%3a443/fncmis/resources/WEBP/ContentStream/idd_607E9680-0000-CD11-913B-C9FBB57CAB56/0/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. https://doi.org/10.14430/arctic149 (accessed 7 March 2023)

# Appendix A: Interview Guide

Please talk about your background.

Who are your parents, and where is your family from?

When did you first come to this area (if applicable)?

Please describe the main subsistence activities you have participated in over the years. What does a typical year of subsistence look like for you now? What did it look like [20 years ago]? [40 years ago]?

Which of these activities did you do in lands across the river (i.e., lands that are currently part of Wrangell-St. Elias National Park)?

During what years did you participate in these activities?

What time of year did you participate it these activities?

Could you please indicate on the map where you have engaged in each of these activities?

What equipment did you use to access parklands (Snowmachine, dog team, etc.)?

Please talk about how snow and ice conditions have impacted your ability to cross the Copper River, in particular [if applicable]

What kind of conditions do you look for in order to feel safe crossing the river?

In years past, what time of year did you used to cross? What was the ice usually like at this time?

Has your ability to cross during these times changed? If so, during what times of year can you no longer cross? When did you notice this starting to change?

If your ability to cross has changed, did it change gradually over a number of years, or abruptly, in just a year or two?

What is the ice typically like now during the times when you can cross, or used to be able to cross?

How did these changes affect the way you participated in these activities?

Are there particular strategies or alternatives you have developed to adapt to these changes?

Please talk about how changing ice conditions have affected your travel on smaller waterbodies in the park area?

What are some of the main rivers, streams and/or lakes that you have used in the park?

In years past, what time of year did you used to travel on these? What was the ice usually like at this time?

Has your ability to travel on these during these times changed? If so, during what times of year can you no longer use these waterbodies? When did you notice this starting to change?

What is the ice typically like now during these times?

How did these changes affect the way you participated in these activities?

Are there particular strategies or alternatives you have developed to adapt to these changes?

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 190/188104, April 2023

**National Park Service**
**U.S. Department of the Interior**

**Natural Resource Stewardship and Science**


**Natural Resource Stewardship and Science**
1201 Oak Ridge Drive, Suite 150
Fort Collins, Colorado 80525

www.nature.nps.gov