Arctic Rivers Storylines: Community Workshops Summary Report

Cooperative Report: Study Funded by the National Science Foundation, the University of Colorado, Boulder, and the U.S. Geological Survey

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Images of workshops in Elim, Aniak, and St. Mary's, Alaska (left to right, top to bottom). Photographs by R. Toohey, K. Musselman, and J. Bacon

Arctic Rivers Project Storylines: Community Workshops Summary Report

USGS Cooperative Report: Summer 2024 Community Workshops

Executive Summary

The Arctic Rivers Project is a collaboration among the U.S. Geological Survey (USGS), the University of Colorado, Boulder (CU), the National Center for Atmospheric Research (NCAR), the Yukon River Inter-Tribal Watershed Council (YRITWC), and additional partners[1]. Over the past three years, the project has worked with an Indigenous Advisory Council to develop models of potential future climate, river flow and temperature, and fish growth rates across Alaska with the goal of addressing community concerns. Now that these models are complete, we are working to learn more about *specific* concerns in *specific* communities to develop community-based Storylines of change (see project Venn diagram below). Storylines are descriptive narratives which help to build a more complete picture of environmental changes and their affects by combining the results of computer models with the lived experiences of community members. To create Storylines, we will *weave community knowledge, observations, and priorities with our model results with the goal of creating products that are useful for community adaptation planning.* Our project team has learned community knowledge, observations, and priorities through community workshops and semi-structured interviews. This report is intended to communicate the results of workshops held in Aniak, St. Mary's, and Elim, Alaska, to workshop participants and other interested community members.

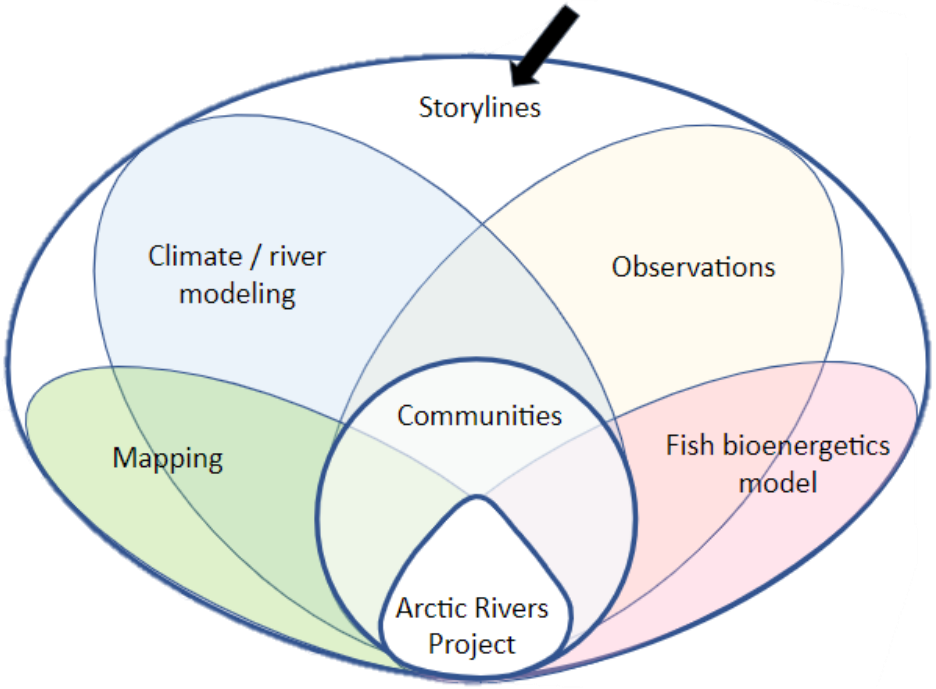


Figure 1. *Arctic Rivers Project Scope*

[1] Additional partners include the Institute for Tribal Environmental Professionals, University of Saskatchewan, and University of Waterloo

Introduction

Members of the Arctic Rivers Project team held workshops in the communities of Aniak, St. Mary's, and Elim, Alaska, in July of 2024. The goal of the workshops was to learn from community members about significant environmental and weather events they have experienced in the past and the affects those events had on the community. These workshops were the first step to creating Storylines, a key objective of the Arctic Rivers Project. Storylines are descriptive narratives that help to build a more complete picture of environmental changes and their effects by combining the results of computer models with the lived experiences of community members. The second step of developing Storylines involved conducting follow-up interviews with community members who participated in the workshops and any other interested community members. Following approval from the University of Colorado's Institutional Review Board, these interviews were conducted in January and February 2025. The results of the interviews will allow us to learn more about the effects of change on each community and how community members are responding. This report is focused on the results of the workshops while work is ongoing to analyze the interviews. The timeline below (Figure 2) shows the Storylines project phases.

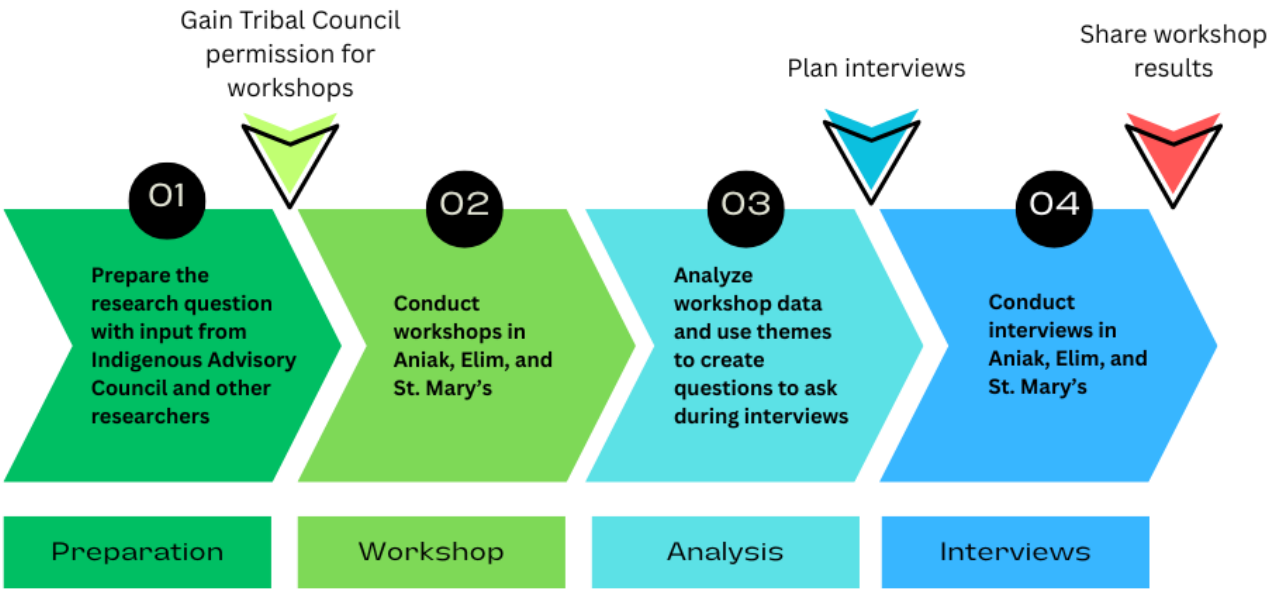


Figure 2. *Storylines Research Process*

Community Workshops

Members of the communities of Aniak, St. Mary's, and Elim, Alaska, participated in workshops held by the Arctic Rivers Project team. The workshops focused on discussions of past and present impactful weather and environmental events, as defined by the workshop participants, that have occurred in the community. Three workshops were held in each community for a total of nine workshops. Eighty-two community members participated in total: 25 from Aniak, 31 from St. Mary's, and 26 from Elim. Each workshop began

with the facilitator asking the group to describe major impactful weather or environmental events they have observed or been told about in their community. As these events were described they were written on a whiteboard at the front of the room by the co-facilitator. In the discussion that followed, participants were asked to describe these events in detail including the timeframe they occurred and how common or uncommon the events were. Next, workshop participants were asked to think about the impacts those events had on them, their friends and family, and community. Participants were asked to write each impact on a sticky note. They were encouraged to consider impacts on subsistence resources or access to those resources, and impacts on travel, health, or safety. Workshop participants then catalogued these concerns on the white board, on a spectrum from "least concerned about" to "most concerned about". To close the workshop, participants were asked to think about the future and describe their hopes and priorities for their community in the face of continued environmental change. Some of these hopes included the return of commercial fishing, cheaper prices for gas and groceries, more opportunities for youth, continuation of their subsistence lifestyle, more environmental and water quality monitoring, better infrastructure for storm protection, and improved salmon populations to allow for subsistence fishing again.

Information shared by workshop participants was captured in an audio recording of the workshop, by a note taker, and through the sticky notes that workshop participants wrote themselves. The transcribed workshops were coded for reoccurring themes and themes which relate to models developed by the Arctic Rivers Project. The themes were combined within each community and ranked by the number of workshops in which they were discussed and where they were placed on the scale of concern. Significant environmental events noted in each workshop were compiled, with duplicates removed, for each community to compare to the climate models and generate an understanding of what types of environmental events are common or of concern in each community. Workshop themes and events identified by workshop participants were used to develop interview topics for follow-up, one-on-one interviews with workshop participants and other interested community members to provide more detail on how individuals and the communities are preparing, responding, and adapting to extreme events.

Community Workshop Results

Workshop participants described several impactful events sustained by their community and environmental changes they have observed over the past several years. In Elim, participants described the impacts of Typhoon Merbok (September 2022). In St. Mary's, participants described the impacts of the East Fork Fire (June 2022). Aniak workshop participants discussed the impacts that recent unusual winter freeze and thaw cycles have had on the development of their ice road and localized flooding. When the information shared across workshops from all three communities was combined, several themes emerged: **Traditional Knowledge, Community Health, Weather Patterns Over Time,**

Subsistence, and **River Ice** (Table 1). The following pages describe results from each community when all three workshops that were held in each community are combined (Ebanks and Herman-Mercer, 2025).

Table 1. Definitions of workshop themes

THEME	DEFINITION	EXAMPLE QUOTE
Traditional Knowledge	Traditionally rooted ways of knowing, sharing, and being with community, honoring by being in relations.	"It's all stories, what we used to do in the past, the way we used to do things, it's, you know, it's a story now." -Workshop participant, St. Mary's
River Ice/Travel	River freeze and thaw pattern changes, and the related changes and stresses that unusual river ice freeze quality has on people's abilities to travel.	"Usually our ice road is in by the first week of January, but the last few years the ice road hasn't been in until the beginning of February, end of January." -Workshop participant, Aniak
Subsistence	Hunting, gathering, and fishing discussion that emphasized the importance of access to and protection of resources that sustain life on the river.	"When it's moist like this, raining, we can't even dry our fish. They spoil." -Workshop participant, Elim
Weather Patterns Over Time	Acknowledgement of the visible changes to weather patterns and system regularity that affect communities.	"The older folks today, they used to be able to tell them what's going to happen with the weather, but now they say they can't." -Workshop participant, St. Mary's
Community Health	How local people can come together to solve problems that might affect quality of living and contentment.	"I believe that if we could somehow rally all our tribal councils statewide, river-wide, everything, it takes a lot of effort and it starts with one tribe, and if we could do this, then we could get that attention down there that's just talking about it." -Workshop participant, Aniak

Aniak Workshop Results

Themes that emerged during the discussions held as part of workshops in Aniak Included **cost of living, subsistence, community, travel, flood protection,** and **increasing temperatures.** Workshop participants observed that the **cost of living** was rising in Aniak and that purchasing food from the store when they were unable to get subsistence resources was expensive. **Subsistence** as a theme consisted largely of discussion of changes to plant growth that overcrowded known and traditionally used berry patches. A workshop participant shared that "you can still go find a good patch but it's going to take a longer time." The theme of **community** included discussions around community members' willingness to step in and assist when others were in need, especially relating to subsistence. **Travel** was a large point of discussion across all three workshops, with the ice road posing concerns as workshop participants described ice freeze-up in recent years as inconsistent and travel by plane as expensive. **Flood protection** provided by the Aniak dike was a common theme of discussion, and a slight concern for some who expressed worry about the erosion on the farthest ends of the structure. This theme also included discussion surrounding floodgate structures that were needed to help minimize the flooding from the airport snowbanks, which have intensified flooding in town. Lastly, **increasing temperatures** were discussed consistently across workshops, with participants highlighting the changes and inconsistency in temperature patterns. A workshop participant shared that "it'll get pushing 40 (F) degrees, you know, for several days. And that's mid-January."

Figure 3. *Workshop in Aniak. Photo Courtesy of Keith Musselman*

Table 2. Events and timing identified by workshop participants in Aniak. The results were combined from three workshops.

Timing	Event
2015	Low water levels, more fires
2020	Large lightning fire
2020	Fishing closures due to spawn depletion
2022	Record snowfall
2022	River not freezing well and breaking
2024	Aniak river is darker than usual
1990s	Major flooding from ice damming
no date given	Mass vegetation increase
no date given	Increased population of beavers
no date given	Wetter, heavier snowfall
no date given	Sewage and oil pollution in the river
no date given	Fewer berries typically, but more after fires
no date given	More extreme rain or dry spells
no date given	Permafrost thawing
no date given	Inconsistent temperatures and late fall
past 10 years	Excess, early rain in winter months causing meltdown
past 10 years	Less snow
past 10 years	Increased humidity
Past 3-4 years	High river water
recent years	Delayed ice road
recent years	More salmon
Since 2020	Rising summer temperatures
Since 2020	More erosion
no date given	Donlin Mine

Figure 4. Events and impacts from all three Aniak workshops, transcribed directly from sticky notes and arranged from least concern (top) to most concern (bottom) and arranged by the number of workshops where the topic was mentioned.

LESS CONCERN

MORE CONCERN

ONE WORKSHOP		TWO WORKSHOPS	THREE WORKSHOPS
Breathing affected due to smoke, evacuation of elders and children	Water gets too dirty and closures of fishing	Heat, high temps	Higher gas prices/economic challenges
			More moose, beaver, and other animals
			High water, log debris
			Subsistence closing/opening
			Berries lost from vegetation increase
		Snow helps the vegetation, berries, make lower water during summer, dryer summers and more fires. Affects permafrost	
		High water causes low count of salmon	
Pike predation as a result of warmer temperatures in winter	Trawlers in the Bering Sea bycatch	Rising temps, excess rain in winter causing dangerous travel	Less travel during winter, due to rain during mid-winter, affects ice road travel to haul wood, hunting & fishing, winter fun
Property damage flooding	Sewage draining into river	Warm stream temp in pre-spawn mortality e.g., 2019	Erosion, channel changes
Mining-Ruin our hunting and fishing area	Dike needs to be extended for a better protection barrier	Bank full flows are decreasing, off channel habitat is becoming less, vegetation encroaching	
Loss of housing	Fire	Less fish	
More enforcement of fishing regulations		Barge unloading fuel, lots of oil sheen	
Not enough rain some years dry land	Smaller fish	Less berries from less snow-Impacts the people's nutrition	
Will permafrost thaw release toxins from abandoned mines like red devil? Impacts to fish health?	Less snow, hard to travel, black bears were killed due to lack of snow over dens in winter	Winters are late and spring break up earlier	
More berries from nitrogen from fire fertilizer	Less subsistence from warmer weather		
Benefit-Burn less heating fuel	Glare ice/black ice		
Potential impacts to lagoon in Aniak	Community infrastructure		
Quality of life/mental health, can't get outdoors to walk, ski, snow machine	Overcrowding of red salmon by restricted fishing chance of spreading disease		
Used to be more salmon-less salmon	Salmon combat fishing, lot of people out fishing at once		
Less snow-Low water impacts the salmon runs/hunting			

St. Mary's Workshop Results

Themes that emerged from workshops in St. Mary's included **subsistence, ice/snow, travel,** and **community.** The theme of **subsistence** occurred in discussions of moose hunting and population changes, and fishing challenges. Changes in how fish are both caught and prepared, as well as the roles of youth were of high importance to workshop participants. One participant shared their frustration, saying "we can't go hunting yet, there's no snow on the roads. We can't go back; we can't go if there's too much water on the ice." The theme of **ice/snow** was present in discussions of changes in break-up, snowpack, and freeze-up. Emphasis was placed on changes over time, with participants noting less dramatic break-up, less snowpack through the winter, and a much less consistent freeze of the river. One workshop participant shared that "the 90's was the last time you saw those big snowbanks." **Travel** impacts and concerns were brought up across workshops surrounding the environmental conditions that make it harder to travel through multiple seasons. **Community** was an important theme that came up often throughout workshops. A workshop participant shared that "it's really bad, it hurts, it saddens us, it affects us, and we see it, and we have no way of teaching our kids anything like that… That's our natural disaster." The Tribe's Environmental Protection Agency (EPA) Indian General Assistance Program (IGAP) funded program was discussed as part of this theme, as well as community togetherness and involvement, and mutual working, along with generational differences and a highlight on youth impacts.

***Figure 5**: Workshop in St. Mary's. Photo courtesy of Jennifer Bacon*

Table 3. Events and timing identified by workshop participants in St. Mary's. The results are combined from 3 workshops.

Timing	Event
Jun-22	East Fork Fire
Sep-22	Typhoon Merbok
Early 1980s	Fewer berries
Early-mid 1980s	Homes flooding
Few years ago	High water levels preventing the weir from being put in
Late 1980s	No snow all winter
Past 20 years	Warmer, wetter, less snowfall winters
Past 3 years	Cold, cloudy summers
Past 5 years	Some very hot and dry conditions
Past 7-8 years	closing of subsistence fishing
recent years	Hotter summers with floating fish
Since 1980s	Spring breakup slower
Since the 1950s-60s	General warming
no date given	Permafrost melt causing landsliding, houses shifting, hill slides
no date given	Fewer migratory birds, mosquitoes, and fish other than salmon
no date given	No snowpack for winter hunting
no date given	Fishing done by July
no date given	Changing subsistence cycles by regulators (fish, moose, flies)
no date given	Lessened ice thickness
no date given	Trawlers dumping bycatch
no date given	Disasters in other countries having traveling effects
no date given	Continual changing conditions - can't predict
no date given	Less snowpack and snowmelt causing lower river levels in the spring and summer
no date given	Limits on tundra foraging due to the ice layers
no date given	Changes in population and spread of caribou, moose, and beaver
no date given	Windstorms and changing tides in coastal areas
no date given	More diseased fish
no date given	Closing of Mission school
no date given	Lack of jobs

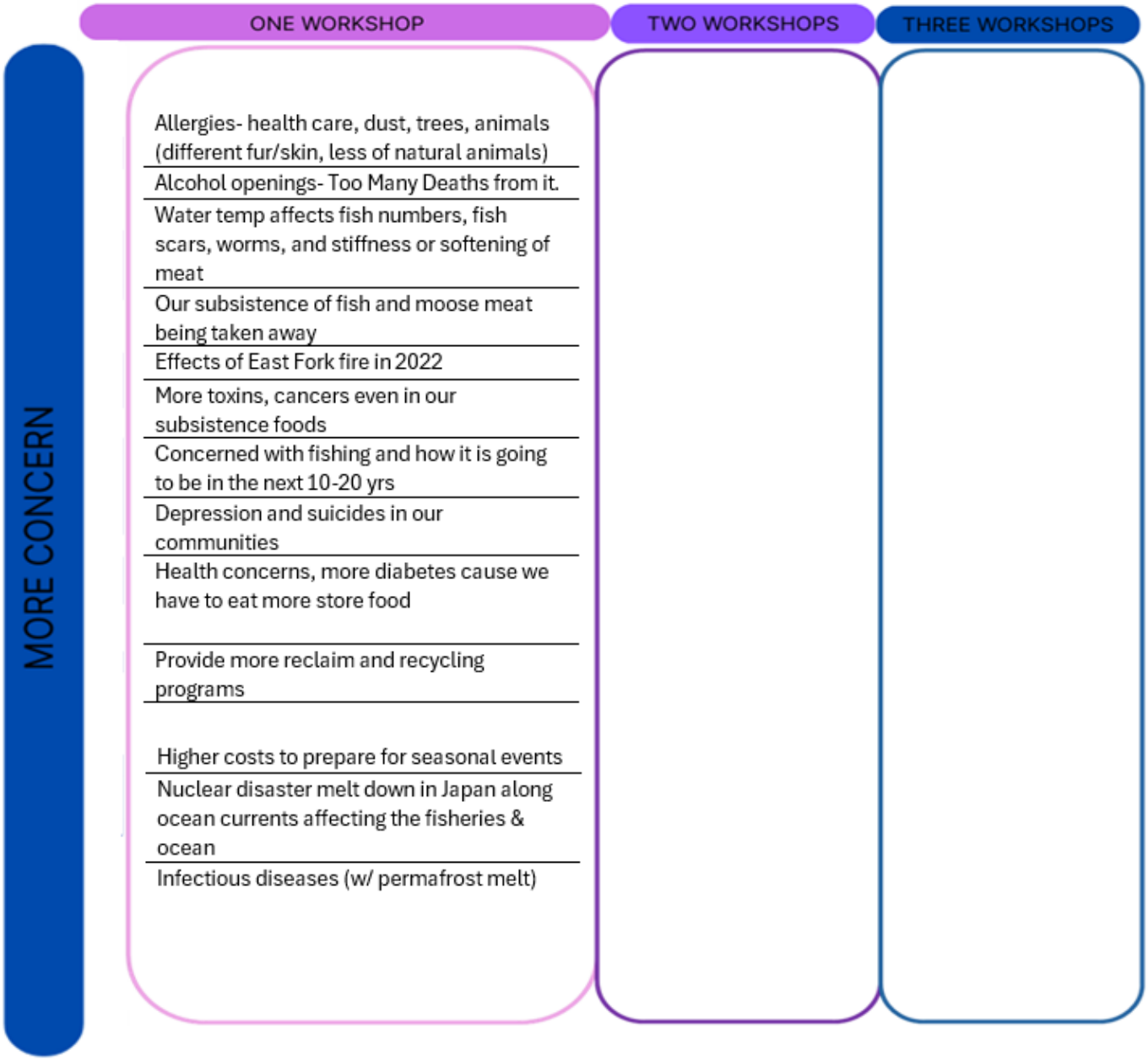
Figure 6. Events and impacts from all three St. Mary's workshops, transcribed directly from sticky notes and arranged from least concern (top) to most concern (bottom) and arranged by the number of workshops where the topic was mentioned.

LESS CONCERN

MORE CONCERN

ONE WORKSHOP		TWO WORKSHOPS	THREE WORKSHOPS
Cold summers, less garden growth	Snow decrease		
Sick moose	Fire retardant on berries		
Society- taking too much			
Jobs/resources	Less time to ice fish due to more water on top of ice (warmer winter)		
Traveling to gather subsistence	Testing of rain/snow water and what contaminants we might have	Later freeze up & slow, early breakup	Closing subsistence fishing
Driftwood coming down the river has lessened the last few years	Floods	Ice thickness in winter (6' to 4')	Fish health
More storms throughout the year	More moose all over, even down river	Not as many fish	Wildfires
Timing of harvesting berries, fish, & animals	Having to change our hunting and fishing equipment	Predicting weather- sudden changes, new animals, depleted animals	Subsistence activities taught to our children
Travelling on the river in the summer and winter	Missing the foods we grew up eating- fish prepared different ways!	Subsistence way of life	Berries- some years there are many, some years few
More cooperation within the community for all age groups	Partnership among tribes and community members	Winters are getting warmer	Nothing to do for younger ones
Food gathering		Cost of living- no housing, under paid jobs, counting on more public assistance	Starvation in winter
No commercial fishing			
Bigger families then - no need now!			
Wind			
Permafrost-changing River channels			
Brush- willows- new growing growth			

Figure 7. Events and impacts from all three St. Mary's workshops, continued from Figure 6.



Elim Workshop Results

The themes of discussions held during workshops in Elim included **storms, the uranium mine, river freeze, rainier seasons, time, subsistence, and traditional knowledge.** Discussion of **storms** were largely about Typhoon Merbok and the impacts and increasing unpredictability of storms, but also included infrastructure protection planning, such as moving roads further away from bluffs. The **uranium mine** was an important topic to many participants, with one sharing; "That small mine up there, it's going to just take everything from us." Workshop participants expressed worry over the impacts to the river and fish if the mine is opened due to the potential for contamination. The theme of **river freeze** included what participants described as notable changes in the timing of freeze-up of the river. Participants recalled the river freezing around the months of September and October in the past, but in recent years have observed the river freezing in November. The theme of **rainier seasons** included discussions by participants about their observations of a large inconsistency in both amount and timing of rain. This inconsistency was described as having large implications for subsistence, with one participant sharing that "Even right now it's kind of wet out for drying fish. Growing up... I don't remember us having so much problems drying our fish." A theme of **time** ran through many of the workshop discussions and refers to the rapid changes and pace with which workshop participants have witnessed changes in the environment and day to day life. Discussions that included the theme of **subsistence** described many challenges, such as changes in humidity that make it harder to reliably dry fish, mentioned above. Lastly, **traditional knowledge** was largely emphasized in workshop discussions regarding people's ties to land and the adaptability it takes to live and thrive. There was a special emphasis on cultural strengths during discussions of traditional knowledge.

Figure 8. *Workshop in Elim. Photo Courtesy of Ryan Toohey*

Table 4. Events and timing identified by workshop participants in Elim. The results have been combined from 3 workshops.

Timing	Event
Since 1920s and 1930s	Loss of crabs
50 years ago	Snow levels as high as roofs
1980, 2021	Rainfall almost every day in the summer
1980s -1990s	"Bering Sea Bonanza" lowering fish populations
1993, 2004, 2005, 2011	More fifty-year storms
2011	Ice jam formed new channel
2017	Dead sea life
2023	Rivers freezing later
Sep-22	Typhoon Merbok
Feb-23	Inconsistent timing of storm surge
2017, 2019	Warm summer, killing spawning fish
2022 - present	Less fish in the ocean
About 2-3 years ago	Iditarod and Iron Dog races on bare tundra
Past 10 years	Too wet to dry fish during the summers
Past 10-20 years	more invasive species
Past 10-20 years	Warmer weather all year
Past 20 years	Less snowfall in winter causing less flow in fivers during spring and summer
Past 20 years	More tree and willow growth
Past 5-10 years	Ocean freezing later (late November)
Past 5-10 years	Snow coming later (January instead of November or December)
Past 5-6 years	High snowfall in March which melts quickly
Past 6-7 years	Rain during the winter
recent years	Ponds drying out and filling with vegetation
recent years	Thin ocean ice making crabbing dangerous
recent years	Beatle kill on spruce bark
recent years	Commercial fishing getting harder
recent years	Very dry June causing few berries to grow
recent years	More moss growth making land harder to walk on
recent years	Lower caribou population
no date given	40 days at -40° freezing rivers and killing fish
no date given	Interior fires
no date given	Storms are stronger
no date given	Birds disappearing
no date given	Warmer and stronger winds

Figure 9. Events and impacts from all three workshops combined, transcribed directly from sticky notes and arranged from least concern (top) to most concern (bottom) and arranged by the number of workshops where the topic was mentioned in Elim.

	ONE WORKSHOP		TWO WORKSHOPS	THREE WORKSHOPS
LESS CONCERN	Heat: can't really help/contain			
	Harmful Algal blooms		Later Snow	
	High River temp			
	Extra dry June			
	Iditarod on Tundra			
	Driftwood in next creek			
	Trees changing/willows overgrowing			
	More white worms in salmon		Rainfall almost every day in summer	
	40 days of -40 degrees		A lot more bears last couple of years	
	Land harder to walk over			
	Reduced commercial fishing			
	Not as cold			
	Radionuclides in rivers			
	Warmer winds			
	More travel to catch caribou			
	Storms impacting ice			
MORE CONCERN	Intense fires	Less fish	Storm surge	Ocean and rivers not freezing on time
	Ponds drying out, filling with vegetation	Low rivers	Rising water levels (ocean and river)	More rainfall during winter
	Spruce bark beetle kill	Too wet to dry fish		
	Invasive species	Less snow		
	Cigarfish mortality event	Birds disappearing		
	Coastal Erosion	Freshwater (drinking)		
	Global Warming affecting our rivers fish, game, berries	Sand from Merbok		

Conclusion

While each community faces unique specific threats from extreme weather and environmental events, several effects and topics were common across all three communities. There are shared observations of changing weather patterns over time, inconsistent river ice, effects on subsistence resources as well as concerns about community health and loss of traditional knowledge (Figure 9). However, the workshop participants in Aniak, St. Mary's, and Elim also shared hope for the future of their communities, the importance of traditional knowledge in adapting to the future, and a belief that they can work together to make positive change.

Figure 10. *Workshop themes*

Next Steps

We are deeply grateful to the communities of Aniak, St. Mary's, and Elim for welcoming us and to the community members who participated in workshops. Information, knowledge, and experiences shared with us during community workshops helped us learn about the types of environmental and weather events being experienced in western Alaska and gave us perspective on the impacts workshop participants are facing.

Themes described in this comprehensive report were used to develop a list of topics that allowed us to learn more about how community members in Aniak, St. Mary's, and Elim are responding to the changes they are witnessing and experiencing through in-depth interviews. Information from the workshops was used to formulate open-ended interview questions and interviews were conducted in each community in January and February 2025. By spending more time these communities and with community members hearing stories about their experience of environmental changes, members' insights and experiences may be used to develop potential strategies for Aniak, St. Mary's, and Elim to respond to potential future changes projected by the project's models. Vignettes can combine the experiences, preparation, responses, and longer-term adaptations to the impactful weather and environmental events (for example, Typhoon Merbok, East Fork Fire, Winter Melt events) that interview participants shared with us with the likelihood of these events occurring in the future from the modeling projections completed by our project. Comparisons between members' observations and modeled results can help inform community responses and adaptation to potential future environmental changes.

Left to right:

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Left to right:

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St. Mary's, AK

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Alie Minium, Keith Musselman, & Nicole Herman-Mercer

Aniak, AK

Figure 11. *Workshop Facilitators*

References:

Ebanks, D.V., and Herman-Mercer, N.M., 2025, Data from July 2024 Community Workshops conducted in three villages in Western Alaska: Aniak, Elim, and St. Mary's: U.S. Geological Survey data release, https://doi.org/10.5066/P135OCUP.