

Problem Statement

Because of the strong nutritional and cultural reliance on the local wild resources, rural communities within Arctic-Boreal region are particularly vulnerable to climate-driven changes in the availability of ecosystem services.

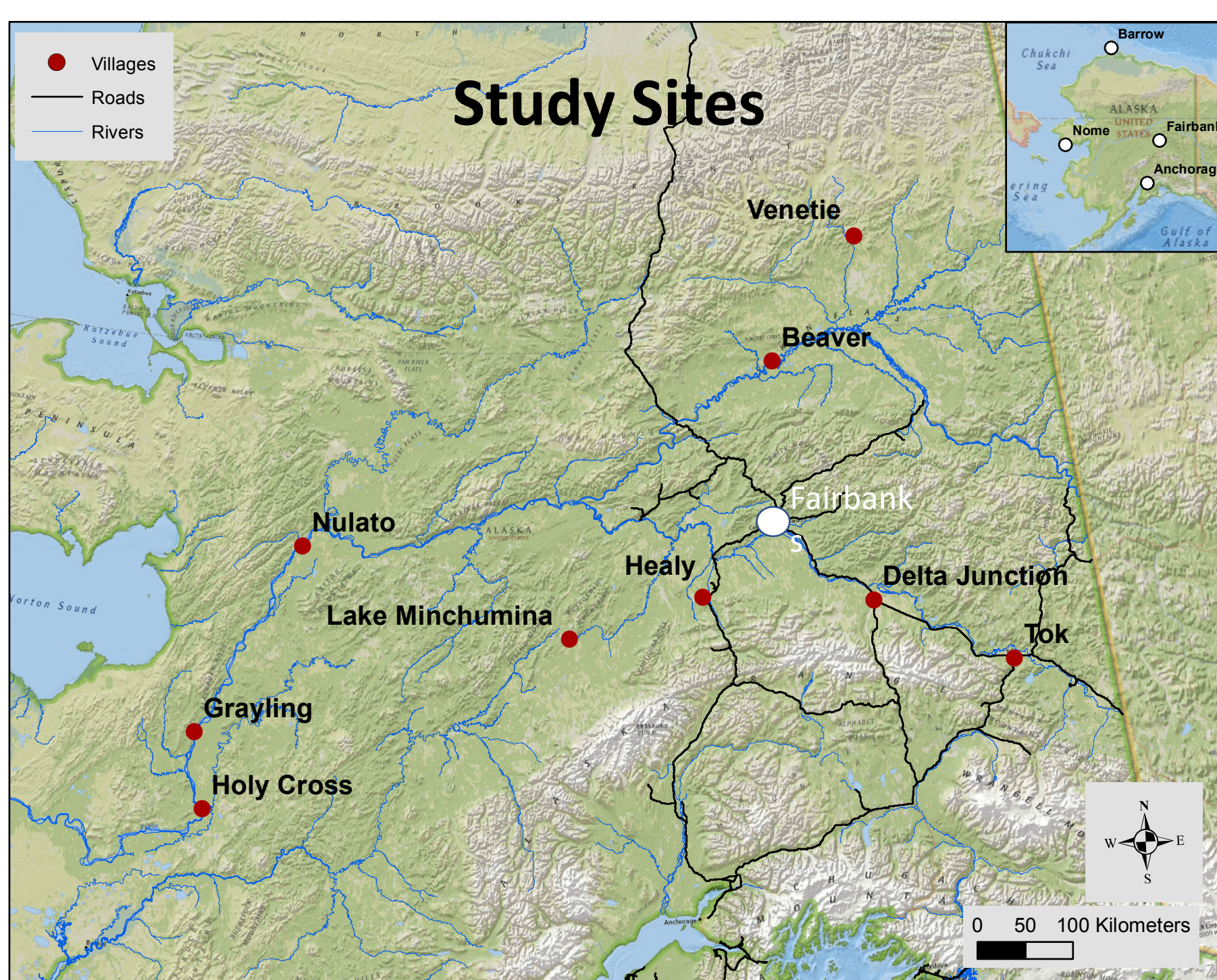
Increasingly, rural residents have expressed concern that climate change is influencing their ability to traverse landscapes and access traditional hunting, fishing, and gathering areas. Thus far, nearly all the research conducted on this topic has been qualitative. Limited quantifiable scientific data on the prevalence, biophysical characteristics, and mechanisms of disturbances have thwarted opportunities for objective evaluations and comparisons across space and time.

Photo credit: Pamela Green

Objectives

1. Collaborate with rural communities to locate, map, and describe disturbances influencing human travel and access.
2. Document biophysical characteristics and the underlying mechanisms related to ecosystem disturbances identified by communities.
3. Provide temporally and spatially-explicit products on the the frequency, duration, area, severity, and type of disturbances impacting human travel and access.

Photo credit: Coke Wallace



Methods

Our multi-step approach integrates community-based monitoring, field data collection, remote sensing, and modeling to analyze and interpret connectivity between humans and ecosystem services.

Step 1. Form community research partnerships through tribal councils or local fish and game advisory committees.

Step 2. Citizen scientists document and describe changes in travel and access for 12 consecutive months (~March 2016 – March 2017) using camera-equipped GPS units and datasheets.

Step 3. Conduct ecosystem site assessments. Record and measure disturbance site characteristics to identify cause-and-effect relationships between ecosystem dynamics and disturbances influencing travel and access.

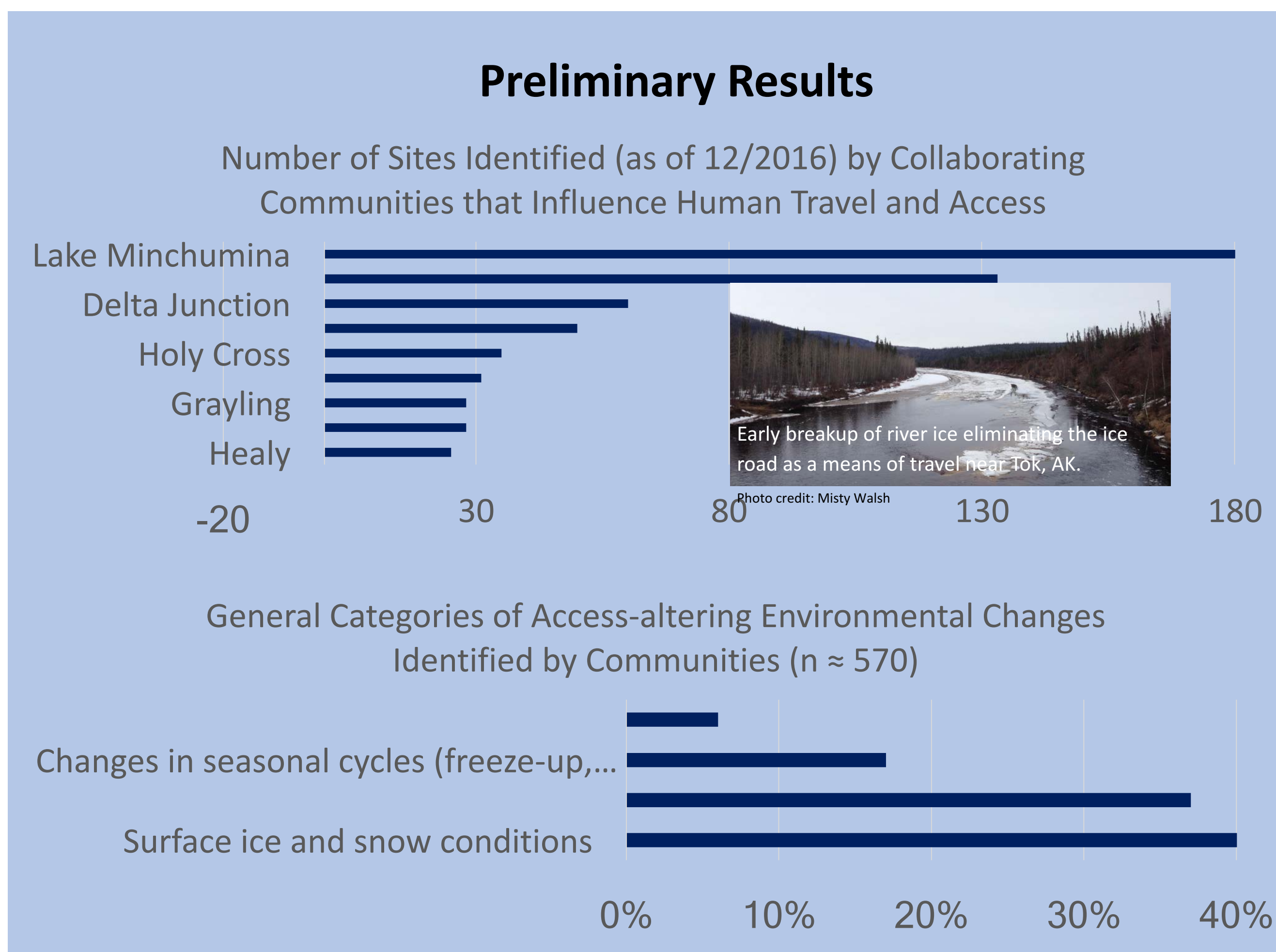
Step 4. Using remote sensing data (Landsat, high-res optical), analyze extent and trends in change of important environmental changes (river ice, hydrology, permafrost) related to disturbances.

Step 5. Model relationships between ecosystem dynamics and human travel to generate maps of rural travel networks.

UAF researchers and harvesters at preliminary meeting to discuss project goals and review data collection protocols.
Photo Credit: Caroline Brown

Landsat8 OLI image from November 2014 with dangerous open water delineated with blue outline polygon.

Example of Spring ice conditions (break up) on the Tanana River in Interior Alaska. Travel is limited during both break up and river freeze.



Preliminary Results (Cont.)

We have begun analyzing change over time (1980s to present) in ecosystem dynamics related to frequently-identified disturbances to human travel and access. Overview of efforts provided below.

Effects of freeze-up, break-up, and winter ice on access timing & travel safety

Linking local observations, weather data, and Landsat imagery, we are estimating relationships among safe travel, air temperature, and degraded river ice.

Reconstructed history of break-up initiation and completion near Beaver, Alaska, a NASA partner community.

Influence of flooding, drought, wildfire, and shrubification on terrestrial human travel and access to traditional use areas.

Increased summer precipitation resulting in high water levels and bank destabilization, restricting trail travel near Lake Minchumina, AK. Photo credit: Pamela Green

Increasing shrubification creates difficulties in locating and maintaining trails and runways, which are important for access to remote areas. Photo credit: Matt Snyder

Recent severe wildfires near Nulato have killed and destabilized trees in large patches of forest, making travel by snowmachine, dogsled, and ATV more dangerous and difficult. Photo credit: Miki Collins

Influence of thermokarst, erosion, changing water levels, plant dynamics and woody debris on summer river navigability

Riverbank erosion restricts locations for safe bank landings and increases the prevalence of submerged and floating coarse woody debris, creating hazardous conditions for river travel near Beaver, AK. Photo credit: Cliff Adams

Increased presence of aquatic vegetation makes lake travel difficult near Tok, AK. Photo credit: Matt Snyder

Future Geospatial Products

- Spatially- and temporally-explicit map of the human travel network in rural Boreal Alaska.
- Map of probability of change in human travel and access because of directional shifts in ecosystem dynamics.

Example of a geospatial product characterizing the travel network and extent of access to traditional harvest areas in the Yukon Flats, AK.
Figure credit: Ian Johnson

A map showing the travel network and extent of access to traditional harvest areas in the Yukon Flats, AK. The map includes a legend for Communities (black dots), Extrapolated Model (blue lines), Access Index (color scale from Low to High), and Max Distance From Communities (black lines). The map shows a network of travel routes connecting various communities.

Our research will contribute by:

- Providing the first regional-scale and quantitative assessment how environmental disturbances influence landscape connectivity between humans and provisional-cultural ecosystem services.
- Generating a geospatial product on where, how, and when subsistence harvesters are using rural landscapes (travel networks).
- Helping other researchers, land and resource managers, and local stakeholders connect and foster knowledge coproduction.

ADF&G collaborator working with a project participant in Grayling, AK to document travel networks. Photo credit: Caroline Brown

Changes in hydrology resulting in difficult travel conditions on trail networks near Delta Junction, AK.
Photo credit: Carl Taylor

Acknowledgements

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Citations

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