



Central Alaska Network

Denali NP & Pres. • Wrangell-St. Elias NP & Pres. • Yukon-Charley Rivers N Pres.

Permafrost Resource Brief

November 2013, no. 43

Status & Trends

Monitoring permafrost in the Central Alaska Network

Permafrost condition and characteristics are dynamic, diverse, and vulnerable to changes in climate across the Central Alaska Network (CAKN). Permafrost is ground that remains permanently frozen for more than two years, and it influences much of Alaska's landscape.

The permafrost monitoring program is still under development in the Network,

and protocols are currently being finalized. In 2012, permafrost index sites were established at Andrew Creek Flats in Yukon-Charley Rivers and on the Copper Lake Trail in Wrangell-St. Elias. In 2013, additional index sites were installed in the Toklat Basin in Denali. In addition, ongoing and intensive monitoring is occurring at the Eight-Mile Lake permafrost observatory just outside of Denali. Measurements of thermal state and carbon flux are documented continuously at the station.

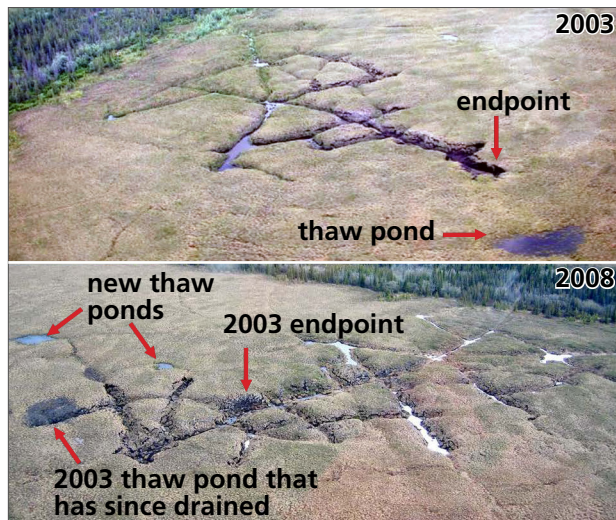
The National Park Service (NPS) is currently working with partners at the University of Alaska Fairbanks to integrate NPS vegetation, soil, and climate data along with other data sources into landscape-scale models that describe the distribution, temperature, and active layer thickness of all NPS lands containing permafrost. Initial results from the

models show a shift in Denali from 7.7% of park land above 0° C in the recent past (1951-60) to 16% of park land unfrozen currently to 93% unfrozen in the future (2091-2100). In Wrangell-St. Elias, approximately 75% of the park is underlain by permafrost. Of that, 23% of it is currently within one degree of freezing (-1° C).

Objectives

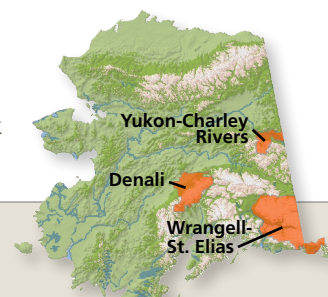
What do we want to know about permafrost in CAKN?

- Monitor permafrost condition by monitoring the abundance and distribution of thermokarst and other permafrost-related terrain features in index areas
- Detect broad-scale trends by monitoring temperatures in existing boreholes



The growth and change of a thermokarst at Wigand Creek in Denali is shown. The ice-wedge polygons that once occupied the area give way to new thaw ponds each year.

Permafrost is being monitored in all 3 network parks



Importance

Why is permafrost important in the Central Alaska Network?

Permafrost underlies millions of acres of NPS land in Alaska. These areas of permafrost are vulnerable to thawing because much of it, especially in CAKN parklands, is within a few degrees of freezing and contains ice-rich material near the surface that could thaw with warming. This would in turn lead to major reconfigurations to the landscape. The formation of thermokarst terrain has the potential to partially or completely alter ecosystems. In lowlands, a shift from boreal forests to shrubby wetlands or grasslands

often occurs with concurrent changes in bird and animal populations.

Information about the extent and temperature of permafrost in Network parklands is limited because of a lack of borehole observations within the parks. Current inventory and monitoring efforts are addressing these information needs. Monitoring the spatial extent and condition of permafrost and thermokarst in network parks will provide information about what may be one of the most important drivers of landscape change in the next century.

Management Applications

How can monitoring permafrost help protect parks in CAKN?

- Understand changing hydrology and resulting shifts in landscape and ecosystem due to melt
- Understand and adapt to visitor experience and infrastructure changes due to melt and resulting landscape changes

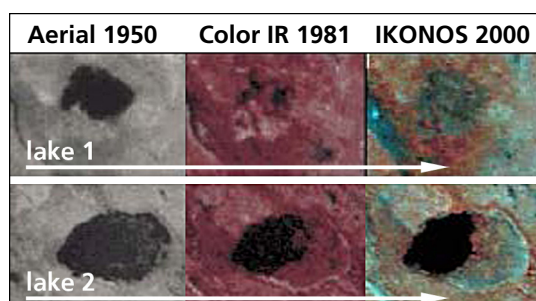


Long-term Monitoring

How do we monitor permafrost in the Central Alaska Network?

Permafrost is monitored at two scales in the Network—at a local, ground-level scale and at a remote, landscape-level scale. Monitoring efforts focus on three indicators, which include the thermal state of permafrost, the physical state of permafrost including thermokarst, and carbon pools within permafrost as well as hydrologic carbon export from permafrost.

Index sites are established to conduct ground-level monitoring of thermal and physical states. At each index site, periodic measurements of active layer depth, surface temperatures, local topography, and vegetation characteristics are taken.



In addition, repeat photography is used to visually document the changes happening at the index sites. Soil probes are also now co-located with some climate monitoring stations to monitor thermal state, and atmospheric and hydrological carbon flux is being monitored at the Eight-Mile Lake permafrost observatory.

At the landscape-level, efforts to inventory and model the thermal state of permafrost in CAKN are currently underway. Additional remote sensing based landscape-level monitoring of permafrost's attributes will be implemented as funding resources allow.



left to right: thermokarst in Denali NP, loss of wetland habitat across 50 years captured by remote sensing techniques; ground-level carbon flux permafrost monitoring



CENTRAL ALASKA NETWORK

USING SCIENCE TO PROTECT OUR PARKS

THE CENTRAL ALASKA NETWORK (CAKN) IS ONE OF 32 NATIONAL PARK SERVICE INVENTORY AND MONITORING NETWORKS. EACH NETWORK EXISTS AS PART OF A NATIONAL EFFORT TO BETTER UNDERSTAND AND MANAGE PARK LANDS USING SCIENCE-BASED INFORMATION.

In order to focus this effort, 270 national park units with significant natural resources were grouped into 32 regional networks.

The Central Alaska Network is made up of 3 parks: Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National

Preserve. Together, these 3 parks contain over 21.7 million acres and makeup 25% of all the land in the National Park Service. They represent a great diversity of climate and landform, from temperate coastal rainforests to glaciated mountain ranges. What they share in common are their largely wild and unaltered landscapes.

In order to track the condition of our parks, Central Alaska Network scientists have chosen 34 key indicators, or "vital signs," to represent the overall health of the network. Each vital sign falls into one of 4 categories: animal life, physical environment, human use, or plant life. Underlying these 4 vital sign categories is a focus on habitat change.

CAKN VITAL SIGNS:

Animal Life

Arctic Ground Squirrel
Bald Eagles
Brown Bear
Caribou
Dall's Sheep
Freshwater Fish
Golden Eagles
Moose
Passerines
Peregrine Falcons
Ptarmigan
Small Mammals
Snowshoe Hare
Wolves

Physical Environment

Air Quality
Climate
Fire
Glaciers
Land Cover
Permafrost
Shallow Lakes
Snow Pack
Soundscape
Streams & Rivers
Volcanoes & Tectonics

Human Use

Human Populations
Human Presence/Use
Natural Resource Consumption
Trails

Plant Life

Exotic Species
Insect Damage
Plant Phenology
Subarctic Steppe
Vegetation Structure/Composition

CONTACT US AT: (907) 457-5752, 4175 GEIST ROAD, FAIRBANKS, ALASKA 99709

OR VISIT: [HTTP://SCIENCE.NATURE.NPS.GOV/IM/UNITS/CAKN](http://science.nature.nps.gov/im/units/cakn)