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

Plant Phenology Resource Brief
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Status & Trends

The phenology of flowering, leaf-out and senescence in aspen (*Populus tremuloides*) in the Central Alaska Network

The Central Alaska Network began monitoring the timing (or phenology) of flowering, leaf-out and senescence in aspen (*Populus tremuloides*) in Denali in 2005, and has started making observations in other areas of interior Alaska in the intervening years. A long period of observation is required to examine changes in the timing of these events, for example there are fascinating studies in Europe investigating plant phenology trends over more than a century. Our initial investigations suggest leaf-out in aspen is highly correlated with spring temperatures: leaf-out occurred earlier when mean daily May temperatures were higher (Fig 1). The onset of senescence was correlated with a minimum temperature being reached sometime in August and the progression of senescence was negatively correlated growing season rainfall, suggesting cold temperatures trigger the start of senescence and wet summers may speed up process of senescence. We also found the growing season length varied from year to year—for example, in one plot in Denali the longest growing observed was 114 days in 2005 and the shortest was 90 days in 2006, representing a possible 22% variability in growing season length. This represents a considerable difference in time available for growth and development among years. In this example, the difference in growing season length was mainly due to varying dates of green up, while dates of senescence were more stable. Overall, these initial observations suggest warmer springs will lead to earlier green-up and longer growing seasons, while warmer, drier summers and autumns may lead to later senescence.

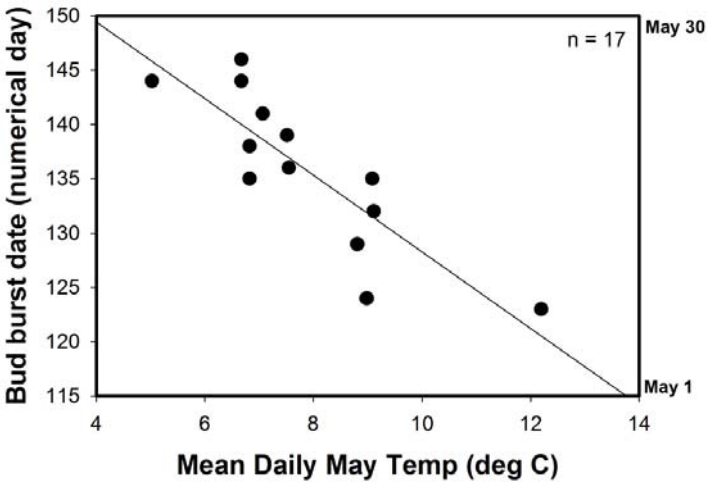

***Fig 1.** Leaf out occurs earlier when daily temperatures are warmer. This graph shows the negative correlation between mean May temperatures and the date of bud burst for aspen in the Central Alaska Network phenology plots (r = -0.86).*

Objectives

What do we want to know about phenology in CAKN?

- Are the dates of aspen flowering, leaf-out and senescence changing over time?
- What climatic variables are the most significant cues to aspen flowering, leaf-out and senescence?
- How does the phenology of aspen differ in different landscape positions and different locations in the Central Alaska Network?

Importance

Why is phenology important to study in the Central Alaska Network?

Phenology is the study of the timing of biological events, such as timing of birds migrating north to breeding grounds or when leaves emerge on trees in spring. Plant phenology in northern regions is often highly responsive to climatic variations and is one of the most sensitive indicators of climate change. There is considerable evidence global climate change is advancing the timing of flowering and leaf-out and extending growing seasons of plants at northern latitudes and high elevations. A longer growing season has important consequences for plant growth and reproduction, plant-animal interactions like herbivory and pollination, and factors interacting with climate such as carbon exchange, albedo and evapotranspiration. Understanding the exact cues (temperature, snow melt, photoperiod) triggering phenological events is key to making accurate predictions about how individual species will respond to changing environments and understanding the consequences of the changes.

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Management Applications

How can monitoring phenology help parks?

Monitoring phenology can help park managers to

1) understand what environmental cues are important regulators of phenology,

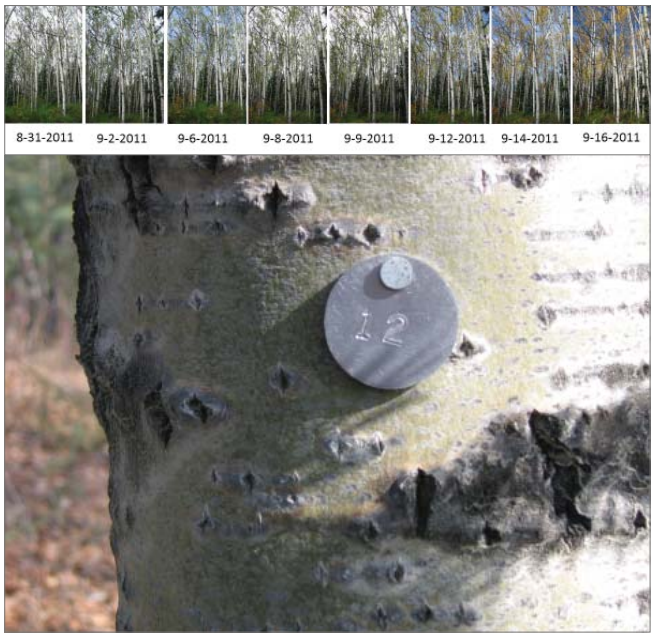
2) use this knowledge to make predictions about how phenology may change given expected climate variability, and

3) detect and analyze change over time once a long record of observations have been made. Additionally, detailed measurements of the phenology of individual plants (like we are doing) can inform larger scale remote sensing studies by serving as "ground-truthing" of remotely-sensed phenology data.

Long-term Monitoring

How do we monitor phenology in the Central Alaska Network?

The Central Alaska Network is tracking the phenology of aspen (*Populus tremuloides*) over time in three locations across the Central Alaska Network: the first location is near the headquarters of Denali National Park, the second is in Copper Center at the Wrangell-St. Elias National Park headquarters and the third location is in Fairbanks near the NPS administrative office. Each monitoring station is within 20 km of a climate station so that phenology observations can be correlated with climate data. Stations are plots or pairs of plots consisting of 12 trees which are observed each spring and fall. The Denali station has two plots, one in a flat area in mixed white spruce-aspen forest, and one on warm, dry, south-facing slope to compare phenology of aspen in different landscape positions. Technicians record the dates of snow melt, flowering (flower buds to fruit), leaf-out (leaf buds to full sized leaves) in spring and the dates of senescence (first yellow to all leaves yellow) in fall for each tree in each plot. Monitoring began in 2005 in Denali, 2008 in Copper Center and 2010 in Fairbanks.



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

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