



Alagnak

Aniakchak

Katmai

Kenai Fjords

Lake Clark

Vegetation Monitoring

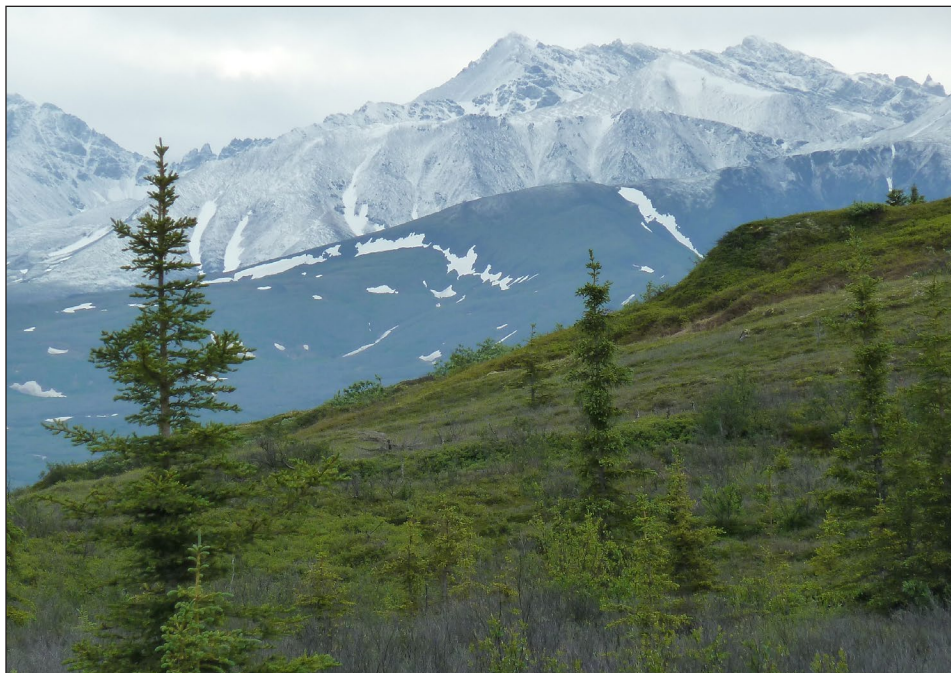
Vegetation is integral to ecosystem function, energy transfer, and element cycling. It drives ecosystem productivity, provides habitat and forage for wildlife, and food and materials for subsistence. Because vegetation responds directly to environmental drivers, it serves as a useful indicator of environmental change.

Methods

Vegetation composition and structure are monitored at the community scale using plot measurements to characterize stand structure, species composition, and selected environmental variables. Tree cores collected as part of a related study by Humboldt State University have been used to describe forest age structure and to characterize the effect of climate on the growth of white spruce. Vegetation monitoring began in 2009, and 2014-2015 marked the first five-year resurvey of forest and woodland plots in Lake Clark and Katmai National Parks and Preserves (NPPs).

Warming Drives Tree Growth ...and Beetle Activity

Warming over recent decades (1960-2010) has resulted in increased growth in white spruce, particularly near treeline in Lake Clark, where average June temperatures have increased by roughly 1.5°C (Figure 1a, d). Warmer summers have also been implicated in



NPS/A Miller

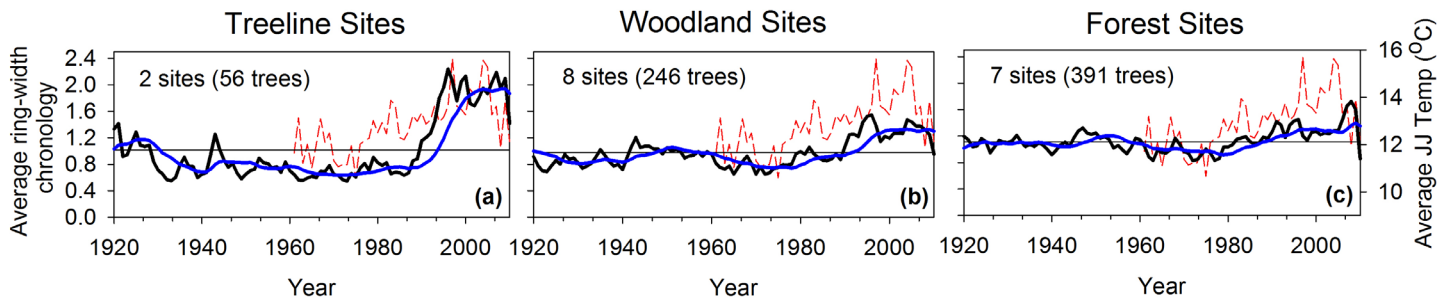
Treeline site near Snipe Lake, Lake Clark NPP.



NPS/A Miller

USFWS cooperater, Dr. Ed Berg, cores a tree at treeline, Dumpling Mountain, Katmai NPP.

Lake Clark NPP



Katmai NPP

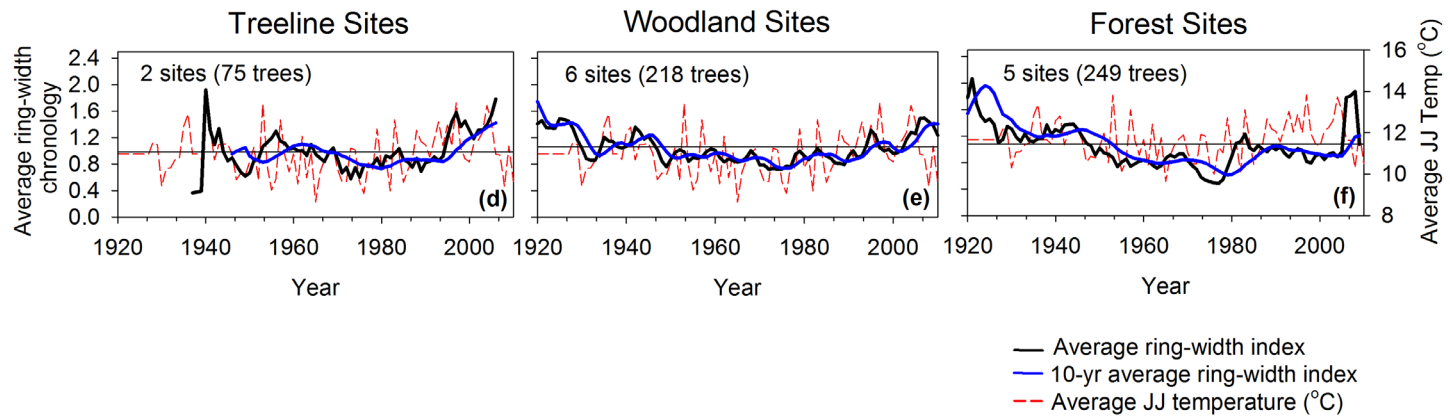


Figure 1. Annual average (black line) and 10-year smoothed average (blue line) of ring-width growth for upper treeline, open woodlands, and low-elevation closed-canopy forest sites in Lake Clark (a-c) and Katmai (d-f) National Parks and Preserves. The red dashed line in each graph represents the average June-July (JJ) temperature (°C) from COOP climate stations in Port Alsworth, and King Salmon, Alaska, respectively. Treeline growth in both parks has increased markedly over the last four decades, particularly in Lake Clark NPP, which has seen greater increases in summer temperatures (R. Sherriff, unpublished data).

the spruce beetle outbreak in Katmai and southern Lake Clark. In forest sites affected by the spruce beetle, growth has increased only slightly (Lake Clark) or has decreased (Katmai) since the 1960s (Figure 1f). In Katmai, where a flare-up in spruce beetle activity has been observed in the last five years, the number of dead trees has increased in the largest diameter classes (≥ 20 cm diameter at breast height [DBH]; Figure 2). Tree mortality has remained relatively stable in the Lake Clark stands, but both parks have shown reductions in live tree counts in the larger size classes, due in part to windthrow. An increase in live saplings (≤ 2 cm DBH) in Katmai is likely associated with the loss of forest canopy, and the resulting increase in light that could reach the forest floor (Figure 2).

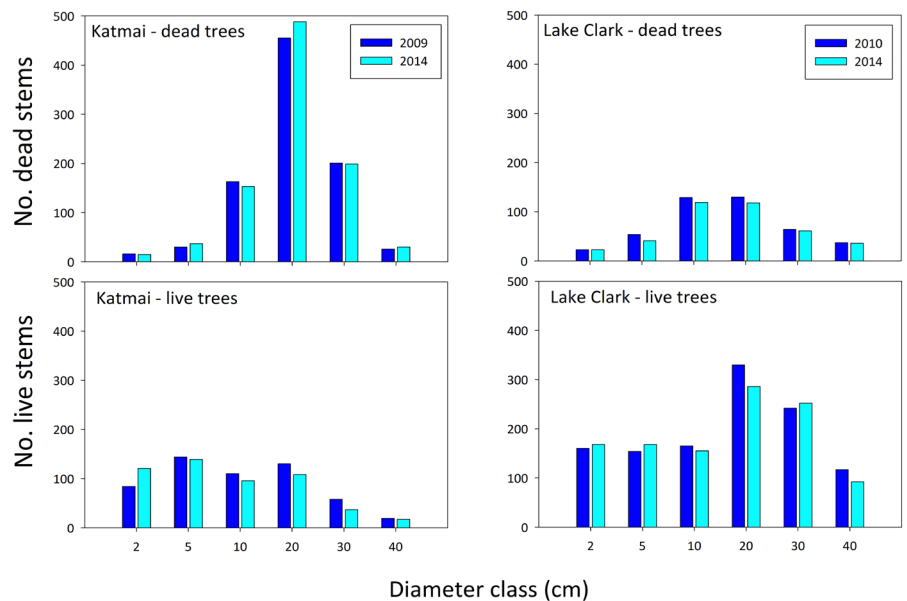


Figure 2. Frequency of live and dead white spruce in forest monitoring plots in Katmai ($n=11$) and Lake Clark ($n=13$) National Parks and Preserves. Stem counts were recorded in five diameter classes (diameter at breast height [DBH]) in 2009 and 2010. The high counts for dead trees in Katmai reflect the recent spruce beetle activity at these sites.