Resource Brief
Alaska

National Park Service
U.S. Department of the Interior

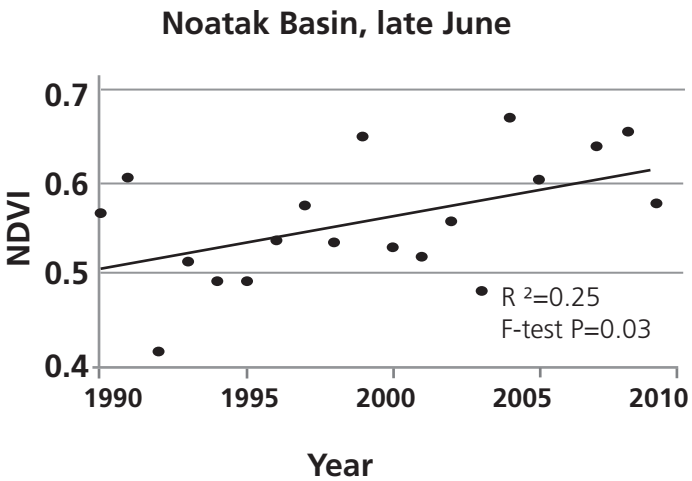
Inventory and Monitoring Program
Alaska Region

Seasonal Processes and Climate Change

Background

Seasonal processes, as defined by the Alaska Inventory & Monitoring Networks, include a number of physical and biological events that occur seasonally, such as the breakup of ice on lakes or the emergence of new leaves on plants in spring. Documenting seasonal processes can help determine the effects of large scale changes in a particular area or species. To date, relatively little is known about the various seasonal processes of many species in Alaska because of the vastness and inaccessibility of much of the state. Inventory and Monitoring networks within the Alaska region have previously identified seasonal processes as a vital sign and several networks have already begun conducting monitoring activities. *As part of the National Park Service's Climate Change Response Strategy, efforts to enhance existing monitoring programs are underway.* This multi-faceted approach integrates data collected from satellite imagery, remote cameras installed at weather stations and field observations to monitor seasonal variation in lake ice, snow cover and growing season length in Alaska's national parks.

Increased warming is expected to result in greater variation in the seasonality of vegetation, snowpack and lake ice dynamics across Alaska.



Many sites in the Arctic, including the Noatak Basin region, above, showed a significant increase in NDVI, a measure of greenness, over the period 1990-2009. The increase in NDVI reflects an increase in plant biomass that is likely due to warming (Swanson 2010).

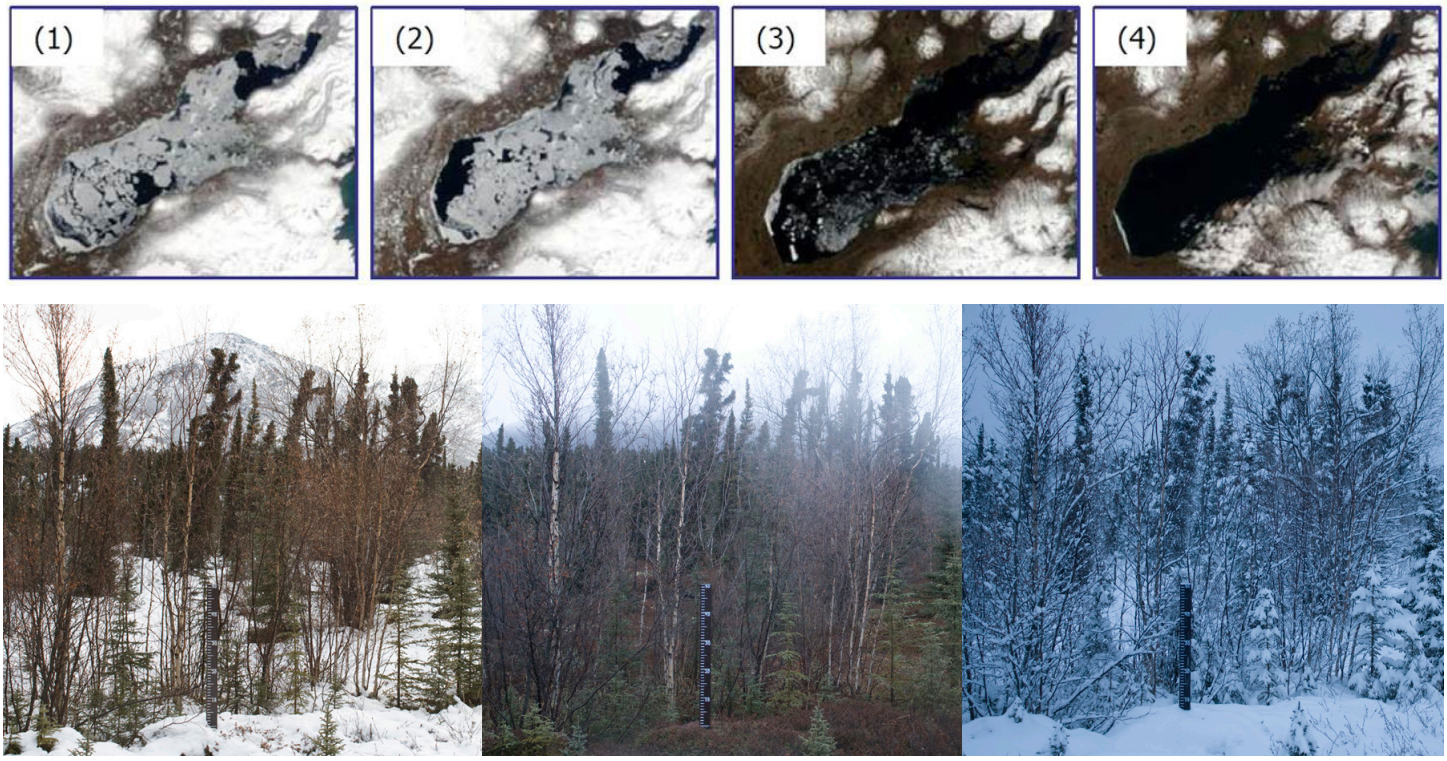
Photo: Amy Miller/NPS

A National Park Service researcher installs a remote camera on an existing weather station in Katmai National Park.

Enhanced Monitoring

Satellite imagery data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Advanced Very High Resolution Radiometer (AVHRR) are collected one to two times daily over Alaska and are currently being archived at, and distributed by, the University of Alaska – Geographic Information Network of Alaska (GINA). The high temporal resolution of MODIS and AVHRR data make them well-suited for regional-scale monitoring of seasonal processes. To date, MODIS and AVHRR data from the Southwest Alaska and Arctic Networks have been summarized over the periods of record for snow, vegetation (NDVI) and lake ice (2001-2008, Reed et al. 2009; 1989-2009, Swanson 2010; 2001-2010, Lindsay et al. 2011). Enhancements to monitoring include summarizing data for the remaining two networks. Finer-scale data are being collected at a subset of sites using remote cameras installed at weather stations. The cameras are capturing daily images that will be used to monitor snowpack development, snow melt and the start and end of the growing season. Plans are in place to install additional remote cameras at weather stations throughout the region.

Finally, field observations are being used in the Central Alaska Network to describe the seasonal events of selected tree species. NPS is working with several partners to expand a species list developed by the National Phenology Network (NPN) to include Alaskan species. Field data will be uploaded to NPN.



Photos: Chuck Lindsay/NPS

The two sets of images show examples of data that will be analyzed to better understand seasonal processes. (a) Satellite images (MODIS) from April 15 to May 10, 2005 show ice break up on Lake Iliamna south of Lake Clark National Park. (b) Images taken by a remote camera station in Lake Clark National Park provide detail on the variation of snow cover in one winter season, which is not easily detected by satellite imagery.

Putting it All Together

Increased warming is expected to result in greater variation in the seasonality of vegetation, snowpack and lake ice dynamics across Alaska (Reed et al. 2009), which in turn may affect a broad suite of ecological processes (e.g., river discharge, wildlife foraging and movement, etc.).

The networks are using multiple approaches to enhance monitoring of seasonal processes. (1) Satellite imagery (MODIS, AVHRR) is available online through web coverage (WCS) and web mapping services (WMS) hosted by GINA, and methods for calculating seasonal metrics are being automated to the extent possible. (2) Protocols and deliverables for time-lapse data collected by remote cameras are in development using established methods outlined by the PhenoCam Network, a collaborator with NPN. (3) Methods for field data collection have been reviewed for compatibility with NPN, and data uploads to NPN will commence in the near future. (4) Expansion of the National Phenology Network's species lists to more adequately address Alaskan ecosystems is planned for 2011 and will involve collaboration with U.S. Fish and Wildlife and the Alaska Natural Heritage Program.

As a result of the expanded monitoring effort in Alaska's national parks, technical reports and interpretive materials stemming from network monitoring efforts are being developed and will be distributed to park managers, interpretative staff, the scientific community and the general public. Data summaries are expected to be updated every 1-5 years.

Tracking Nature's Calendar in Alaska's Parks

Satellite imagery data collected using established protocols will be combined with new data from remote cameras and ongoing collaboration with the National Phenology Network to provide a more comprehensive understanding of seasonal processes in Alaska's national parks. Satellite imagery data focuses on broad scale snow, lake ice and vegetation cover, whereas time-lapse photos and on-site observations focus on small scale events. This expanded monitoring effort will be ongoing, and should result in improved characterization of both interannual variability and long-term trends in seasonal processes.

Lindsay, C., Spencer, P., & B. Hill. (2011). Interannual variability of lake ice phenology in southwest Alaska: Integrating remote sensing and climate data. 2011 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites. New Orleans, LA.

Reed, B., Budde, M., Spencer, P & Miller, A. (2009). Integration of MODIS-derived metrics to assess interannual variability in snowpack, lake ice, and NDVI in southwest Alaska. Remote Sensing of Environment, 113, 1443–1452. doi:10.1016/j.rse.2008.07.020

Swanson, D. (2010). Satellite Greenness Data Summary for the Arctic Inventory and Monitoring Network, 1990-2009. Natural Resource Data Series, NPS/ARCN/NRDS, 2010/124.

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