Resource Brief
Alaska

National Park Service
U.S. Department of the Interior

Inventory and Monitoring Program
Alaska Region

Arctic Network Central Alaska Network Southeast Alaska Network Southwest Alaska Network

Glaciers and Climate Change

Background

Approximately one fourth (4.6 million acres) of Alaska's glaciers occur within the boundaries of national parks. Most of Alaska's glaciers have been receding over the last century. Recent findings suggest the rate of recession has significantly increased in recent years (Arendt, Walsh, Harrison, 2009). The effects of melting glaciers are not yet fully understood; however, given the tremendous amount of water stored in glaciers, there will likely be significant changes to the productivity of fresh water flow systems, vegetation and coastal marine ecosystems.

As part of the Climate Change Response Strategy developed by the National Park Service in September of 2010, the Alaska Region has enhanced existing glacier monitoring efforts. These enhanced efforts are outlined here and include extent mapping and volume change analysis for glaciers within all Alaska Inventory and Monitoring networks. In addition, the project will include detailed descriptions and analyses of a select group of focus glaciers within each network.

> Recent findings suggest the rate of recession has significantly increased in recent years (Arendt et al, 2009).

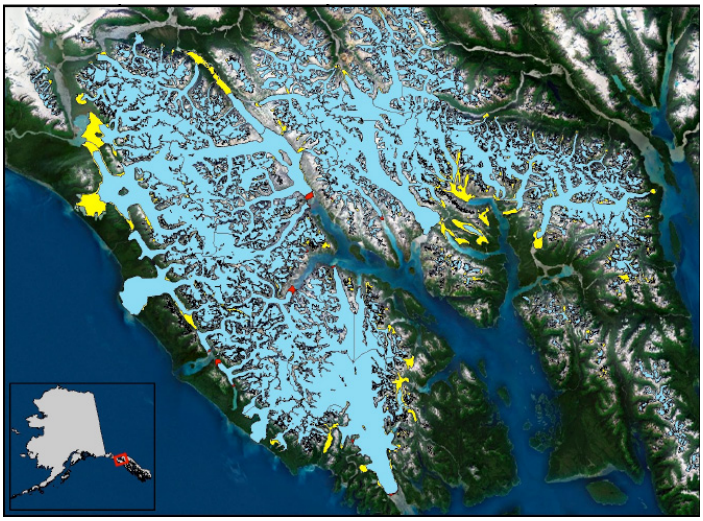


Image: NPS Glaciers First Progress Report, 2011

Changes in glacier area between the 1950 and 2010 in Glacier Bay NPP. Red areas show advances, yellow areas show retreat, and blue areas signify no change.

Photo: Luke Rosier/NPS

An NPS researcher records a GPS waypoint at an exposed mass balance stake on the Harding Icefield in Kenai Fjords National Park.

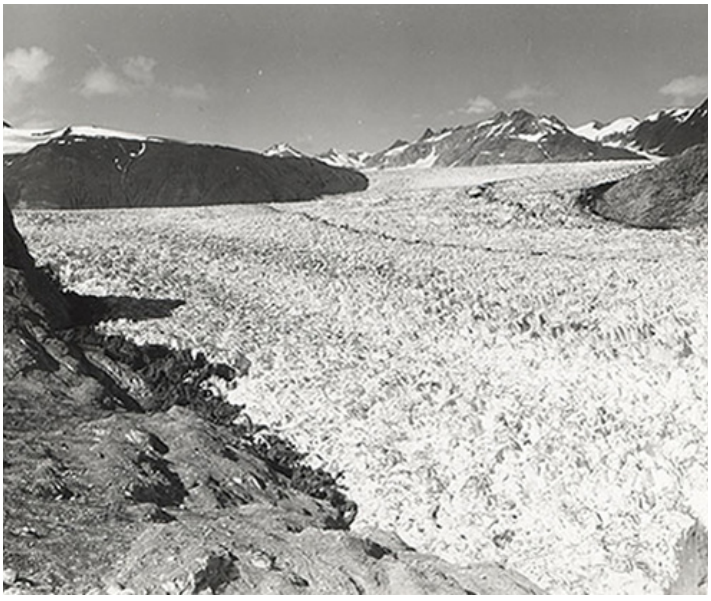
Enhanced Monitoring

Long-term monitoring of glaciers is a multi-tiered approach involving partners at individual parks, the Geophysical Institute at University of Alaska Fairbanks and Alaska Pacific University. This glacier study will take place over the next several years and will measure glaciers in three primary ways: changes in extent (area) for all glaciers, changes in glacier volume for all glaciers with available altimetry data and an interpretive-style description of one to three focus glaciers per park unit.

Extent mapping is being conducted for two time periods using 1950s era USGS quadrangle maps and latest available satellite imagery (Landsat). Maps containing both outlines will be created and compared for each glacier in Alaska's national parks. Data sets describing the physical characteristics of each glacier (length, width, slope, area, elevation) will also be developed. This extensive data set describing glaciers within Alaska's national parks is unique and will have widespread applications.

Volume change analysis is being conducted on glaciers within parks using existing altimetry data. Altimetry data is an elevation profile, which is collected via aircraft and accurate to ± 30 cm, along the center flowline of glaciers. Based on the altimetry data for a given glacier, elevation for the entire surface of the glacier is being projected using best available Digital Elevation Models (DEMs). Volume change will be calculated for glaciers with multiple

Photos: GLBA/NPS (1950 image), Bruce Molnia/USGS (2004 image)

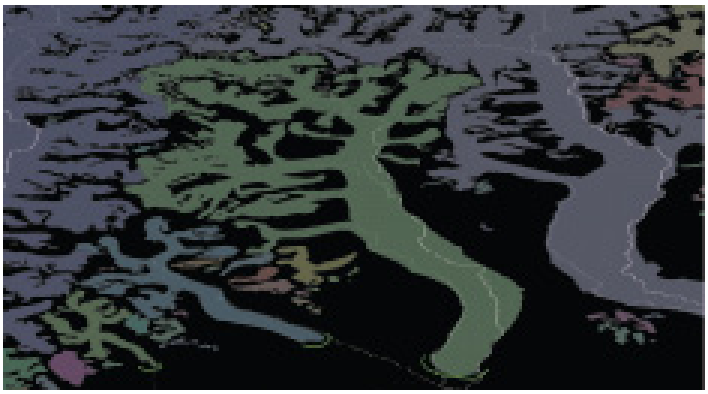


Muir Glacier in Glacier Bay National Park is one of approximately 20 focus glaciers being analyzed and described as part of the enhancements to glacier monitoring in Alaska's national parks. The two images show Muir Glacier in 1950 (l) and in 2004 (r).

elevation profiles, which have been obtained at various times from mid-1990s to current. Glacier volume change can then be projected beyond this suite of measured glaciers to larger regions that exhibit glaciers with similar physical characteristics.

The focus glaciers, of which there are approximately 20 located throughout the parks, have been studied extensively over time and are collectively representative of the diversity of glacier types in Alaska's national parks. Researchers will combine existing data with new analyses to provide detailed time lines and summaries of focus glacier status and trends. The detailed discussions of focus glaciers will provide information to be used in understanding how these glaciers may be responding to a changing climate. Project findings and focus glacier discussions will be summarized in a technical report. This information will also be developed into an interpretive publication that will take the form of a detailed, illustrated guide to glaciers in Alaska's national parks.

Image: NPS Glaciers First Progress Report, 2011



Extent mapping product: Individual polygons for each glacier in Alaska's national parks are the end result of combining assembled imagery (or digital maps) and digital elevation models with a basin delineation alogorithm. (from Toklat and Ruth Glaciers, Denali National Park and Preserve)

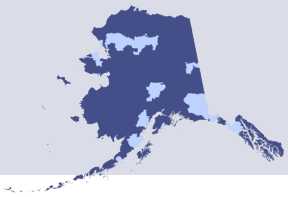
Initial Results

The first progress report for "Alaskan National Park Glaciers: Status and Trends" was provided by principal investigators to NPS program managers in September 2011. Year one results include extent mapping of all glaciers in Denali and Glacier Bay National Parks and Preserves, surface elevation changes for select glaciers in Glacier Bay and focus glacier research on several glaciers in Glacier Bay.

Notable initial results include the following:

- Glaciation in Glacer Bay diminished by 11% (from 53.5 to 48.4% coverage) between 1952 and 2010.
- Denali lost 8% of its glacier cover (16.9 to 15.5% coverage) between 1952 and 2010.
- The vast majority of glaciers in both parks have shrunk considerably, mainly by terminus retreat, in that time.
- Laser altimetry indicates that 13 of 16 glaciers studied in Glacier Bay National Park and Preserve exhibit thinning over the study period (1994-2011).

Principal Investigators: Anthony Arendt and Chris Larsen (Geophysical Institute, University of Alaska Fairbanks), Michael Loso (Alaska PAcific University)

Literature cited: Arendt, A., Walsh, J., Harrison, J. (2009). Changes of Glaciers and Climate in Northwestern North America During the late Twentieth Century. Journal of Climate, 22, 4117 - 4134. doi:10.1175/2009JCLI2784.1

Program contact: Bruce Giffen
(907) 644-3572
Bruce_Giffen@nps.gov
http://science.nature.nps.gov/im/units/akro/