Monitoring Landscape Change in Katmai National Park & Preserve Using Historical Photography

Abstract

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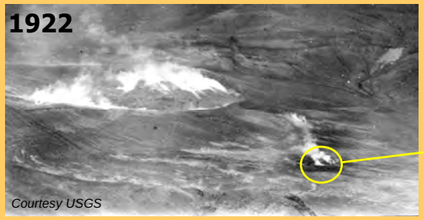
A project was initiated in 2003 to assess landscape changes in the Southwest Alaska Network of National Parks through the use of repeat photography. Some 634 historical photos dating back to 1895 were acquired for Katmai National Park & Preserve. The largest collections were from Robert Griggs expedition members (419 from 1915-1919), USGS geologists (96 from 1895-1923), Bernard Hubbard (37 from 1928-1936), and Victor Cahalane (37 from 1953-1954). During 2004–2005, 139 photos were repeated and 20 new photo-monitoring sites were established.

Katmai's landscapes reflect dynamic and interacting processes that have worked over varying time scales. Virtually overnight, the Great Eruption of 1912 transformed the Valley of Ten Thousand Smokes, buried much of the region in ash, and caused large floods and landslides. Over the years, other volcanic, fluvial, glacial, and successional processes have had other diverse effects. Elsewhere in Katmai, recent treeline expansion and glacial retreat are likely consequences of more subtle disturbance: climate warming following the Little Ice Age.

Rapid retreat of glaciers in the Cape Douglas area is evident from photos taken from 1895-1904. However, several glaciers near Novarupta that received heavy ashfall in 1912 have not retreated. Ecological succession after the 1912 eruption has been relatively quick in ash-affected areas along the coast of Shelikof Strait, but very slow on pyroclastic deposits in the Valley of Ten Thousand Smokes. White spruce and Kenai birch trees have made substantial elevational expansions in the vicinity of Lake Grosvenor and have expanded geographically in the King Salmon area where few trees existed in the early 20th century.

Plant Succession After Volcanism

Ash-affected coastal mountains near Amalik Bay in 1919 (Paul Hagelbarger) and 2005 (Jorgenson). Vegetation recovery has been rapid here compared to the Valley of Ten Thousand Smokes. Alder has re-established widely except on the thickest tephra. The presence of live alders in 1919 indicates that some vegetation survived the ashfall.



Novarupta area seen from Baked Mountain in 1922 (Walter Smith) and 2004 (Frost). Extinct fumaroles formed favorable microsites for colonizing willows, dwarf shrubs, and herbs. Exposed areas in the Valley of Ten Thousand Smokes remain barren. Nutrient-poor, excessively drained soils hinder plant growth, but conditions are ameliorated near sheltered fumarole pits.

Photos from 1935 (Bernard Hubbard) and 2004 (Frost) reveal plant succession on the Mageik Creek floodplain. New vegetation is dominated by pioneering feltleaf willows, fireweed, and bluejoint. Flooding and channel migration have kept the active floodplain barren. Pumice-mantled slopes in the background remain almost entirely barren 92 years after the eruption of nearby Novarupta.

Glacial Retreat

Unnamed glacier near Cape Douglas seen in 1895 (Chester Purington) and 2005 (Jorgenson). Among the oldest photos, the 1895 image shows the glacier near its maximal extent after the Little Ice Age. Alder has established on the young moraine, but the disturbed floodplain remains barren.

The Spotted Glacier in 1904 (Timothy Stanton) and 2005 (Jorgenson). The glacier has retreated nearly 4 miles over the last century. Alder and some cottonwood has colonized the moraine and valley center is filled by a moraine-dammed lake.

Photos of a glacial valley at the base of Mt. Mageik in 1918 (Jasper Sayre) and 2004 (Frost). The 1918 photo indicates that this glacier did not receive heavy tephra fallout from nearby Novarupta. Although vegetation is sparse on the bedrock valley floor, primary succession has been faster there than in the adjacent Valley of Ten Thousand Smokes.

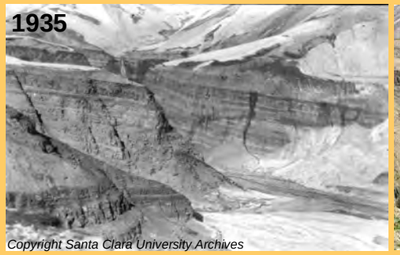
Photos of the terminus of one of the Knife Creek Glaciers in 1954 (Victor Cahalane) and 2004 (Frost) reveal glacier stabiity and plant succession after the 1912 eruption. Downwind of the Novarupta eruption, this area received heavy tephra fallout. The glacier shows little change, probably due to the insulating effect of the tephra. Willows have gradually increased.

Treeline Expansion

The Naknek River valley near King Salmon in 1918 (Paul Hagelbarger) and 2005 (Frost). White spruce and Kenai birch trees have expanded dramatically in the King Salmon area over the last century. White spruce saplings can be seen in the middle foreground of the 1918 image. No dramatic changes are evident on the floodplain.

Granite ridge at ~1000 ft south of Lake Grosvenor in 1919 (Jasper Sayre) and 2005 (Jorgenson). Dramatic expansion of Kenai birch and alder has occurred over the 86-year interval, obscuring most of the rock outcrops evident in the 1919. Crustose lichens on the rocks in 2005, but not in 1919, may be due to acid rain associated with regional volcanism, rather than expansion.

Landslides and Channel Migration



Lower Mageik Creek and the western base of Mt. Katmai in 1935 (Bernard Hubbard) and 2004 (Frost). Channel migration has modified the large landslide deposit at right and continues to renew disturbance on the floodplain. Vegetation recovery is generally limited to microsites where 1912 tephra has been stripped by slides and eolian processes.