Documenting vegetational change through repeat photography in Southeast Alaska, 2004-2005

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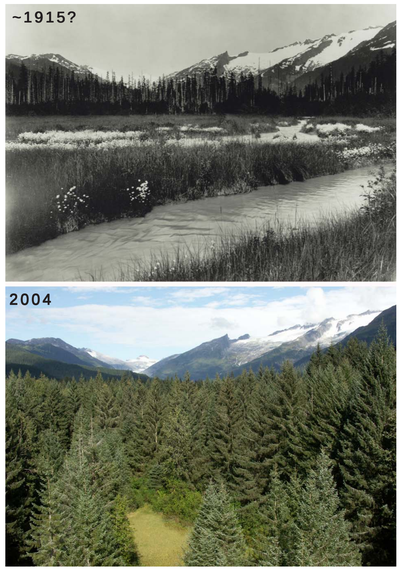
Introduction

Carefully framed re-takes of historical photographs are well suited for monitoring, documenting and interpreting vegetation change in response to natural or human disturbances.

Although little repeat photography work has been done in Southeast Alaska, the region offers excellent opportunities. Due to glacial, tectonic, climatic, and anthropogenic processes, many areas of Southeast Alaska are undergoing clear, rapid vegetation change. A good variety of air-, ground-, and water-based historical photos are available.

This project is a pilot repeat photography study of selected sites in Southeast Alaska. We are collecting historic photographs for potential re-takes, selecting and re-taking a subset of these photos, and analyzing vegetation change between photo pairs.

In year one of this two-year project, we focused on the Juneau area while gradually refining our methods. We will extend the effort to other parts of Southeast Alaska in year two.



Fluvial succession at Eagle River

The upper shot is simply labelled "Eagle River." To find the site, we georeferenced a 1910 map showing the horse tram route to a mine in the upper valley; the photopoint was likely close to that route. In ArcScene we replicated the mountain backdrop and estimated a bearing of 38º to the central peak. The intersection of that bearing line with the tram route gave us the general photopoint location.

The cotton-grass foreground indicated poorly-drained soils. On aerial orthophotos a candidate wet opening in tall spruce forest was found. On visiting we found persistent cotton-grass along the remnants of the foreground channel.

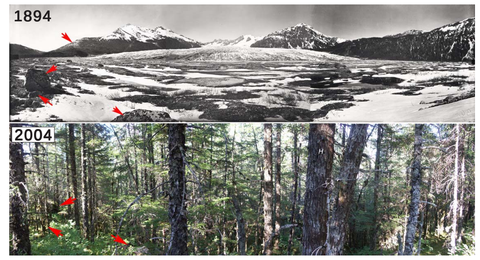
Our re-take is from the top of a ~100-foot spruce.

Above: *Winter & Pond original (no date). Courtesy of ASHL. PCA 87-1471. Dead trees in mid-distance may have been flooded by beavers.* ***Below****: August 30, 2004 re-take, confluence of Herbert and Eagle Rivers, 28 miles north of Juneau. Treetop re-take confirms match of the skyline.* ***Right****: Ground re-take employs same 38º bearing. Former outwash channel is now a damp* Sphagnum *swale.*

Primary succession at Mendenhall Glacier

The 1894 photo is a stitched panorama of three photos by William Ogilvie, first surveyor of the Yukon Territory. Locating the photopoint hinged on finding the distinctive boulders at left–now in dense forest–marked with arrows in both photos. Ogilvie was standing on a high point on a recessional moraine, viewing a glacier face that was nearly half a mile closer than it is now.

Above*: Courtesy of National Snow & Ice Data Center. Alder, lichen, and early-successional mosses invade freshly uncovered glacial till. A notable feature of the 1894 photograph is the "bare" patch on the lower left flank of Mt. McGinnis (arrow). This treeless area, visible because of the snow, may be part of a massive region-wide blowdown that occurred in 1883.* ***Below****: Our 2004 re-take panorama. The dense forest is nearly 100% spruce. One western hemlock (H) is visible just to right of center. Understory at this site (and along the length of this moraine) is predominantly oval-leafed blueberry.*



Methods

Selecting original photos

Juneau's largest photo collections are at the Alaska State Historical Library (ASHL) and the USDA Forestry Sciences Laboratory. When searching through these and other collections we sought examples of landscapes that have subsequently undergone recovery from a variety of disturbances. We worked in digital format, copying originals with flatbed and slide scanners. Alaska Historical Library images are scanned from negatives.

The best originals for repeat photography have foreground vegetational detail (identifiable species, etc.) combined with complex mountain backgrounds for ease of "triangulation" in the field. In ArcScene, this background can be replicated in advance of the field trip, locating the photopoint with confidence even in places the researcher has never visited.

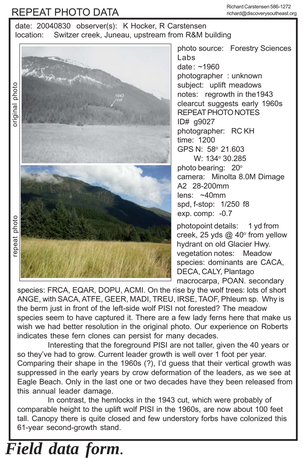
The US Navy flew the first systematic vertical aerial photography in Southeast Alaska in 1926 and 1929. They also shot opportunistic obliques. Glaciers, estuaries, and big-tree forests were a popular theme. In ArcScene, we have already replicated many of these photos, and plan re-take flights in 2005.

Field procedure

Few of our original photos were taken with intent to serve as part of a time-lapse pair, and site documentation is generally minimal. Upon arrival in the general photopoint area, we have sometimes ranged back and forth for more than an hour until satisfied that all parts of the scene line up correctly.

Our camera is a Minolta Dimage with 8 megapixel resolution, 28-200 mm zoom, and image stabilization. The original historical photo can be stored on the camera's data card. This image is then "toggled" back and forth with the actual field scene while the camera is locked on the tripod, to verify that registration of each scene element is identical.

We take GPS waypoints and record detailed instructions for future photographers. Plant species are listed, along with comments on successional patterns and other changes since the original shot. *Lack* of change is also important; see notes on the 55-year+ shield fern patches on Mount Roberts.


REPEAT PHOTO DATA

Richard Carstensen 586-1272
richard@discoverysoutheast.org

date: 20040830 observer(s): K Hocker, R Carstensen
location: Switzer creek, Juneau, upstream from R&M building

original photo

photo source: Forestry Sciences Labs
date: ~1960
photographer : unknown
subject: uplift meadows
notes: regrowth in the1943 clearcut suggests early 1960s

repeat photo

REPEAT PHOTO NOTES
ID# g9027
photographer: RC KH
time: 1200
GPS N: 58° 21.603
W: 134° 30.285
photo bearing: 20°
camera: Minolta 8.0M Dimage A2 28-200mm
lens: ~40mm
spd, f-stop: 1/250 f8
exp. comp: -0.7
photopoint details: 1 yd from creek, 25 yds @ 40° from yellow hydrant on old Glacier Hwy.
vegetation notes: Meadow species: dominants are CACA, DECA, CALY, Plantago macrocarpa, POAN. secondary species: FRCA, EQAR, DOPU, ACMI. On the rise by the wolf trees: lots of short ANGE, with SACA, ATFE, GEER, MADI, TREU, IRSE, TAOF, Phleum sp. Why is the berm just in front of the left-side wolf PISI not forested? The meadow species seem to have captured it. There are a few lady ferns here that make us wish we had better resolution in the original photo. Our experience on Roberts indicates these fern clones can persist for many decades.

Interesting that the foreground PISI are not taller, given the 40 years or so they've had to grow. Current leader growth is well over 1 foot per year. Comparing their shape in the 1960s (?), I'd guess that their vertical growth was suppressed in the early years by crow deformation of the leaders, as we see at Eagle Beach. Only in the last one or two decades have they been released from this annual leader damage.

In contrast, the hemlocks in the 1943 cut, which were probably of comparable height to the uplift wolf PISI in the 1960s, are now about 100 feet tall. Canopy there is quite closed and few understory forbs have colonized this 61-year second-growth stand.

Field data form.

Photo processing

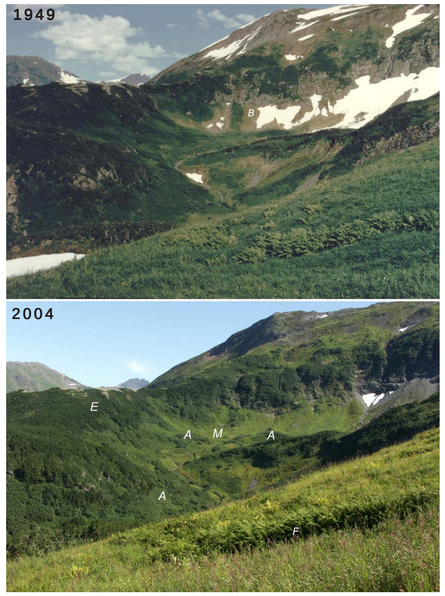
Re-takes are "fitted" to the original image in Photoshop, by importing as a semi-transparent layer over the original, where it can be scaled and rotated for exact fit.

Subalpine brush invasion, Mount Roberts

Professor Donald B. Lawrence was a pioneer of plant succession studies in deglaciated landscapes in Glacier Bay and valleys near Juneau. He also became fascinated by changes in subalpine bowls where glaciers had never developed during the recent Little Ice Age. Here, one often finds early-seral meadow communities ("M") where persistant summer-long snowpack erased forests that undoubtedly grew there during warmer pre-Neoglacial times. On the more wind-swept ridges enclosing these bowls, shallower snow depths allowed a stunted elfinwood forest (E) of ancient mountain hemlocks to persist throughout the Little Ice Age.

Don's favorite example of these processes has since become the Mount Robert's tram-landing site, hosting thousands of visitors per summer. As the climate warms and snow-free period lengthens, herbaceous meadow communities at this ~2000-foot elevation are slowly replaced by woody vegetation.

Compared to sea-level successional rates, alder invasion of subalpine meadows has been slow. But the rate may be accelerating with warming temperatures.



Above right*: Lawrence shot of "Bear Bowl", August 21, 1949. Bare late-snowbed slopes (B) supported scree-plants like partridgefoot in 2004.*

Below right*: Re-take, August 13, 2004. Foreground has lush fireweed/lupine/bluejoint community, taller than in 1949. The diagonal line of shield fern (F) has remained stable for 55 years. In the distant bowl, elfinwood stands (E) show little change. Meadow (M) is being invaded by Sitka alder thicket (A).*

Succession after mine abandonment

Mining camps can be complex sites for vegetation interpretation, as they represent many separate types of disturbance. The sites of buildings, rock piles, placer pits, roads and railroads, waste dumps, and logged areas may all be within a few hundred meters of each other. This complexity can make the photo pairs difficult to interpret, but also rich in information about succession on different disturbance types.

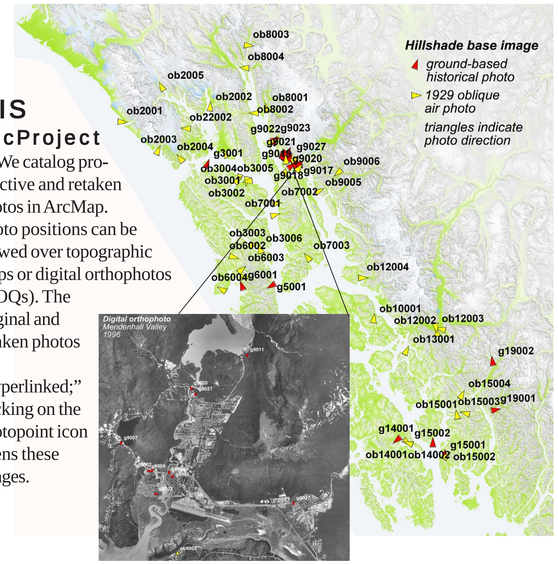
Above: *Perseverance Mine, at 1000 feet in Perseverance Basin above Juneau, operated from the 1880s to the early 1920s. The slopes of the outcrop at left have been logged (L). The floor of the valley, where Gold Creek flows in a braided channel, shows some deciduous regrowth (D) after extensive placer workings of the late 1800s. The pale, sloped piles at middle left are waste rock (W), removed from mine tunnels.*

Below*: The 2004 retake of this photo shows dense mountain hemlock growth (M) on the logged slopes. On the building sites (B), alder/willow scrub (with devil's-club, salmonberry, and goatsbeard patches and the occasional black cottonwood) predominates. The waste rock pile (W) shows a much more uniform canopy of even-aged Sitka alder—a stand that seems surprisingly young, considering the rock pile has been abandoned for at least 80 years.*

GIS

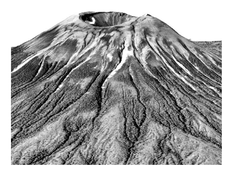
ArcProject

We catalog prospective and retaken photos in ArcMap. Photo positions can be viewed over topographic maps or digital orthophotos (DOQs). The original and retaken photos are "hyperlinked;" clicking on the photopoint icon opens these images.



ArcScene

In ArcScene, an air photo can be "draped" over a digital elevation model (DEM) to produce an oblique view of the landscape complete with forest cover. The ability to rotate these landscape scenes has helped us determine, prior to field visits, the position and bearing of both ground-based and oblique aerial photographs.



For re-takes of historical aerial obliques, ArcScene will be instrumental in planning the flight route, maximizing use of expensive air time.

Vertical 1996 NASA orthoquad, combined with digital elevation model to replicate a 1929 oblique photo of Mount Edgecumbe near Sitka.

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Southeast Alaska Wilderness Exploration Analysis and Discovery

Southeast Alaska Wilderness Exploration, Analysis & Discovery (SEAWEAD) is comprised of a small group of naturalists and educators. SEAWEAD's mission is to facilitate research-based cooperative stewardship of wild lands in Southeast Alaska.
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