Documenting Vegetational Change Through Repeat Photography in Southeast Alaska 2004-2005

1914

Photograph by Winter and Pond. Alaska State Library, historical collections

2005

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Contents

Introduction 3

Personnel
Funding
Files

Methods 4

Photo Sources
Photo Choice
Photo Formats
Filenames and Photo Information
Equipment
Field Sites
Finding Photo Points
Taking Repeat Photos
Locating and Re-taking Aerial Obliques
Photo Archives
Photo Processing
Analysis
ArcMap Project

Select Results 10

Future Directions 29

Introduction

"The Camera Fiend" - Photo by Case and Draper, Juneau, Alaska. Alaska State Historical LIbrary Photo Collections.

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 collected and catalogued historic photographs from several regions of Southeast Alaska, then selected and re-took a subset of these photos.

Our repeat photos include both ground-based and aerial images, and they present information about vegetation change in response to a number of disturbance types, including:

- Uplift/rebound
- Long-term climate change
- Deglaciation
- Fire
- Townsite abandonment
- Mine-related disturbances
- Logging

The results of our project are available in this report, which includes our methods, our collection of photo pairs with analysis, and ideas for further study and for educational applications. Also available is a read-only version of our GIS project, which includes not only our repeats but many more photos we identified as good candidates for repeats. In addition, information from this project is being made available on the Internet, through the USDA Forest Service Forestry Sciences Lab PNW Research Station website.

Personnel

Field Principals: Richard Carstensen, Katherine Hocker, Terry Schwarz (Southeast Alaska Wilderness Exploration and Discovery)

Administration: Cheryl van Dyke, SEAWEAD

Agency Personnel: Michael Shephard, Erin Uloth and Dustin Wittwer, USDA Forest Service, State and Private Forestry.

Funding

This project was a cooperative agreement between the USDA Forest Service, State and Private Forestry, and 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.

Files

The full results of this project, including maps, aerial orthophotos, and historical and repeat photos are available as an ArcReader file (free ArcReader software will be included). For more information on obtaining high-resolution versions of photos, contact Richard Carstensen or Kathy Hocker.

Methods

Photo Sources

Our photos were obtained from a number of public and private collections here in Alaska, including:

Alaska State Historical Library

This institution provided the bulk of our "potential" ground photo pool. We researched photos both on the Alaska State Library's Web-based digital collection and in person at the Historical Library. Included at ASHL are the large and comprehensive Winter and Pond and Case and Draper collections from the early 1900s, as well as a number of more obscure collections such as the Flamen Ball photos, taken on a 1909 tourist trip through Southeast.

Forestry Sciences Laboratory

The Juneau offices of the FSL own hundreds of historic photos of the Tongass, many of which have been used in Forest Service publications.

Sheldon Museum, Haines

The Sheldon Museum generously allowed us complete access to their extensive photo collection during our August, 2005 photo trip.

Klondike Gold Rush National Historical Park

The knowledgeable staff at the KGRNHP allowed us access to their collections, which include some of the earliest (pre-1900) photos taken of northern Southeast.

Isabel Miller Museum, Sitka

The Isabel Miller Museum collection contributed some excellent photos of the Sitka area.

National Snow and Ice Data Center

This institution holds hundreds of glacier photos, including many from Southeast Alaska. Their beautiful, large-format digitized copies of 1890s photos by William Ogilvie are particularly intriguing.

USDA Forest Service, Geometronics

This mapping division provided us with high-resolution digital copies of hundreds of outstanding oblique aerial photos taken by the US Navy in the 1920s.

Photo Choice

Of the many kinds of ecological change in Southeast Alaska, the best documented by historical and repeat photography has been post-glacial succession. We therefore chose to de-emphasize (though not ignore) photography of plant re-establishment on deglaciated terrain, and to give greater weight to other successional patterns that have not been addressed locally by repeat photography. Glacial retreat is of course, however, indirectly linked to many of these other processes such as fluvial dynamics or coastal uplift—and as such is certainly represented in our photos.

In searching for candidates for repeat photos, we considered the following primary criteria:

- Clarity and detail of vegetation and other features in the original photo (does the photo show identifiable species? Does it show a disturbance from which vegetation has subsequently recovered?)
- Ease of re-locating the photopoint (does the photo include landscape features that can be aligned to pinpoint the photographer's location?)
- Current status of the photopoint (has the desired view been obscured by buildings or dense brush?)
- Documentation (did the photographer record date, location, vegetation, and other relevant notes?)

Very few photos meet all of these criteria (In fact, the only ones in our collection that do are the 1940s shots of the subalpine region on Mt. Roberts, taken by ecologist Donald Lawrence). However, many of our photos meet at least three of the four.

Photo Formats

Whenever possible, we obtained high-resolution digital copies of photos directly from the holding institutions. If digitized copies were not available, we scanned photos ourselves, using flatbed scanners and slide scanners. We stored our historic photos as TIF files.

After considering the merits of film vs. digital, we chose to work strictly in digital format for this project. While our high-end digital camera does not produce the resolution of film (particularly the large-format images of some early photographers) we feel that the advantages of digital photography (ease of editing, flexibility in the field, portability) outweigh the slight differences in photo sharpness.

File Names and Photo Information

We developed a filename system for potential and repeat photos that was based on the USDA Forest Service's 21 ecoprovinces (also called "biogeographical provinces") of the Tongass National Forest, with slight modifications by David Albert for the Nature Conservancy. Each photo was given an ID when added to the collection.

The first letter(s) in a photo's ID – "g" or "ob" identify the photo as ground-based or aerial oblique. The next two numbers represent the ecoprovince, from 03 (East Chichagof) to 23 (Northern Lynn Canal). The remaining numbers identify the individual photo. For

many photos we also added text "tags" as mnemonics for photo location or subject.

As we wrapped up the project, some photos were culled because better photos of the same subjects had been found, or because they were determined to have limited value. This meant that the final list of photos is not a continuous numerical sequence.

Permission for the use of most historical photos requires acknowledgement of the holding institutions and photo ID numbers. For photos we scanned ourselves, we added this information as file tags, viewable by right-clicking the file icon and bringing up "properties" and "comments." We also kept track of original photo sources and numbers, along with photo subjects, dates, photographers, and miscellaneous notes, in a spreadsheet. Eventually, this spreadsheet data was added to the ArcMap project.

Equipment

For almost all of our repeat photos, we used a digital camera purchased specifically for this project. This Konica Minolta DiMage camera has 8 megapixel resolution, 20-200 mm zoom, and image stabilization. When we separated to cover more area in a repeat photography trip, we also used a Panasonic DMC FZ10, 4M, 12x zoom with image stabilization.

We marked our photopoints as GPS points, using a Garmin ETrex and a Garmin III+.

Field Sites

During our first summer, we worked in the Juneau area. Juneau is well-documented with historical photos, and we had opportunities to re-take shots of a number of different disturbance types while we refined our field techniques.

In August 2006, we began taking aerial oblique photos. Our first flight was August 7 (Gastineau Channel and Taku River), during which we took four photos and tested our methods. Additional, longer flights on August 10 and 11 provided 14 more repeat photos of Admiralty Island and Lynn Canal.

In late August, we traveled to Haines and Skagway, where we worked at the Sheldon Museum and the Klondike Gold Rush National Historic Park to collect and catalog potential photos, then re-took several of these.

In September, we traveled to Sitka and worked with the Isabel Miller Museum to collect photos, then re-took several of these.

There is great potential for further air-based repeat photography; especially in northern Southeast where post-glacial and post-uplift succession is striking and visible from great distances. Contact us for proposed flight routes for additional repeat photography.

Finding Photo Points

In only a few of our many photos were the actual photo points documented. Some were taken from sites that are still popular as photo points today. Most, however, required some detective work – a combination of computer-based methods and ground-pounding – to find. (See below for a description of how we found photopoints for aerial obliques).

Computer Techniques

Early in the project, we discovered that we could use the program ArcScene to help narrow our search for photo points. By creating a terrain model, draping an orthophoto over the model, and then shifting the view angle and distance until mountain backdrop lined up correctly, we could usually find a photo's bearing with fair accuracy, and its location along the bearing within a few hundred meters.

In the summer of 2005, we discovered that the internet-based program Google Earth (**http://www.googleearth.com**) was almost as helpful as the ArcScene replications in re-locating photopoints. Using the program's "zoom," "rotate," and "tilt" features, we could create virtual landscape views similar to our ArcScene replications (see sidebar in "results" section).

Orthophotos were also useful in narrowing our search for specific sites. By studying landscape features such as meadows, copses, trails, and buildings in the orthos, we could pinpoint likely photo sites along the photo bearings.

Ground Techniques

After finding the general photopoint area for a given photo, we went to the site and searched for foreground landmarks to line up our repeat photos. Sometimes the photopoint became obvious as soon as we arrived in the field, but other times it took an hour or so of wandering, photo in hand, before we settled on a site.

We carried copies of the original photos with us in the field, but also uploaded historic photos into our digital camera, so that we could toggle between the historic view and the modern view in our tripod-mounted camera, when we reached the point of making fine adjustments.

In many cases, it was impossible

to take a meaningful repeat photo from the exact location of the originals (due to plant growth, road or building construction, river movement, or other events). In such cases, we noted the discrepancies and aligned our photos as best we could, sometimes taking repeat photos from the same photopoint and supplementing them with additional photos from a nearby point that more clearly showed the view in question.

In other cases, when we directly compared original and repeat photos we found that we had been further off the photopoints than we had thought. This was particularly true of aerial obliques, which, due to the variables of speed and altitude are difficult to exactly replicate. We discovered, however, that even poorly-aligned aerial photo pairs still provided a wealth of information, particularly when landmarks were annotated to make comparison easier.

Taking Repeat Photos

Our repeat photography methods evolved as the project progressed, and they sometimes varied with photo type and location.

Photography

Few of our original photos were taken with intent to serve as part of a documentary pair. Fewer yet are accompanied by technical details such as lens size. Once we reached the estimated photopoint, we spent some time working on correctly re-framing the shot.

We draw a "cross-hair" grid onto the field copy of the original photo, and compared this to the superimposed grid in the camera viewfinder It was never possible to exactly match every element of the original composition. Cropping and slight rotation could be done at the processing stage. But the more care taken in the field, the less information is sacrificed to these trimming operations.

After approximating the view as closely as possible with the camera zoom adjustment, we "backed out" to a wider lens setting and took a second repeat, in case our attempt at exact match proved mistaken in the processing stages.This led to some significant foreground distortions in some of our photos; because of this factor and because rapid foreground vegetation change had made many shots impracticable, the most meaningful comparisons in many of our photos are in the middle distances and backgrounds.

When we had settled on a photopoint, we took GPS waypoints, and recorded detailed instructions for future photographers. We took vegetation notes as well, along with comments on successional patterns and other changes - or lack of changes - since the original shots.

Most repeat photography projects have taken place in more open environments than Southeast Alaska. Here, except on wet or perennially disturbed soils, succession converts most of our open habitats into dense brush or forest in a few decades, presenting challenges to the repeat photographer who needs horizons for triangulation. One partial solution is to climb a tree to "regain" the original background view and assure that the location is correct - our Eagle River photo (#g09022) is an example. Aerial oblique photos, of course, have a great advantage here.

Where practical, we used a tripod for maximum stability, though a number of our photos (including all of the aerial obliques, of course) are hand-held.

We took all photos at the camera's highest-resolution setting. Except where lighting conditions demanded some manual adjustments, we took our repeat photos using the camera's "automatic" mode.

Locating and Re-taking Aerial Obliques

One of the treasures of our historic photo database is a collection of nearly 250 highly-detailed aerial oblique photos taken by the US Navy in 1926-1929 during vertical imagery flights for mapping purposes (see sidebar, p. 22). These photos also presented a particular challenge, as there was little documentation to help us find the photopoints.

We made extensive use of ArcScene replications (see "computer techniques" above) in searching for these photopoints, which allowed us to extrapolate. Once the landscape in the original photo has been replicated in ArcScene, the XYZ position (latitude, longitude, elevation) of the photopoint can be calculated, and uploaded to an ArcMap project that serves as navigational guidance for the repeat photography flight. This photopoint merely represents a "best guess" position along a confirmed bearing-and-inclination line from plane to photo-center. That is, we are certain of the compass direction and elevational dip of the photo, but not of the exact position along that line.

However, because the foreground is not as important in these photos as it is in ground-

based shots, we found we could use the camera's zoom to match the original scene without being overly concerned about foreground distortion.

For aerial repeat flights, we prepared ArcMap flight routes designed to allow us to efficiently move from photopoint to photopoint. Actual flight routes varied with weather and pilot agenda (some of our repeat flights were "piggybacked" onto other missions by a volunteer pilot).

In the air, we worked with a laptop computer showing our real-time GPS position(using the "GPS Support" toolbar in ArcMap). Comparing our real-time position to the pre-determined photopoint allowed us to guide the pilot to the desired location. As there was not time to use the upload-and-toggle feature in the camera, we relied on hard copies of the historical photos for positioning. On each photo, we drew "crosshairs" to indicate the centerpoint. As we flew to each projected photopoint, we familiarized ourselves with the location of the photo centerpoint.

As we approached the projected photopoint, we began comparing the view with the historical photo, centering the viewfinder crosshairs as closely as possible to the centerpoint on the original photo. As the correct alignments developed, we began taking photos, continuing past the estimated photopoint. If the altitude or angle appeared to be significantly off, we sometimes made an additional pass. Later, we chose the best-aligned photos.

One great advantage of retaking aerial obliques is efficiency - we could, after some prep work, take a large number of photos in a short time.

From our re-take flights, we gleaned the following tips:

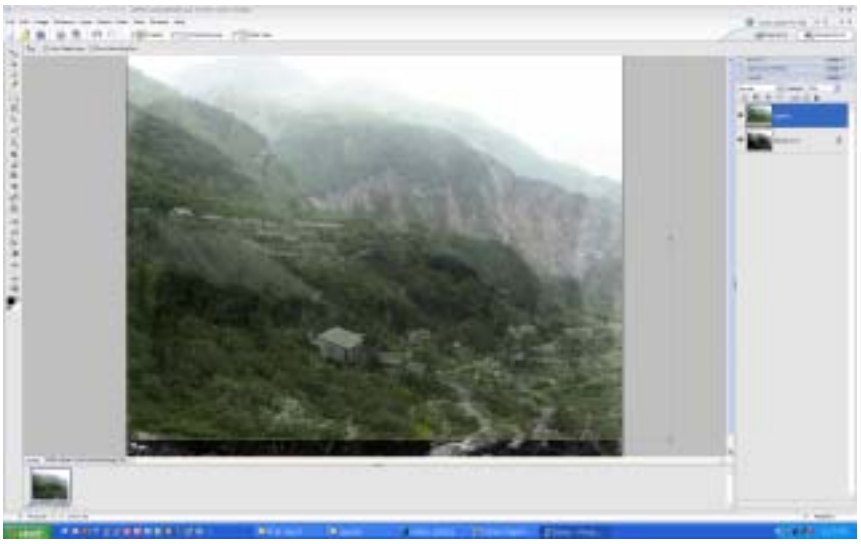
- Having two field workers along on photography flights is useful; one person is the principal photographer and the other runs the laptop/GPS setup, communicates with the pilot, and serves as backup photographer.
- An ideal airplane for this process has wheels rather than floats (faster climb rate for repositioning), is narrow (so a rear-seat photographer can easily reach either window), has opening windows (or at least a long, opening right-side window so front- and back-seat photographers can work simultaneously), unscratched windows for when opening them is not advisable, and a cigarette lighter that accepts a power inverter for extended laptop use.
- Our camera's "continuous shoot" feature, which we had thought might be a benefit in aerial repeats, was not very useful. The camera takes two to three photos per second, which in a distant shot, does not represent a significant change of perspective. When the rapid-fire sequence is over, the camera is locked up for several seconds as the images are stored, meaning that by the time it is ready to shoot again, the plane may have passed out of ideal range. Better to take one photo every two seconds or so.

Photo Archives

We downloaded our repeat photos from the digital cameras to laptop computers. For each photo, we preserved the original JPEG, and saved a TIFF archival copy. Photos were arranged by ecoprovince, as within our ArcMap project (see below). All photos and maps are backed up on hard drive.

Photo Processing

As many of our repeat photos were not taken from precisely the same photopoints as the originals, arranging them to make the most direct comparison for analysis was a challenge. One of the most



Right: A modern photo of the Perseverance Mine, Juneau, is laid over a historic photo in Photoshop Elements. The modern photo layer is shown at 50% opacity, so the historic photo is also clearly visible. The modern photo can now be slid over the historic photo so that the ridgelines align, allowing direct comparison of landscape elements.

successful methods we discovered for aligning and comparing photos involved the program Photoshop Elements. This photo-editing software allows the layering of photos on top of one another and the manipulation of layer opacity.

To align a photo pair, we first opened copies of the repeat and historical photos, and saved them as "working" files in Photoshop format (this step was to protect the archived copies). We then used "cut" and "paste" to import a copy of the historical photo into a layer on top of the repeat photo background layer. By reducing the opacity of the historic photo layer, we could, in effect, see *through* the historic photo to the repeat photo. We could then scale and rotate the historic photo so that stable features such as ridgelines, shorelines, and buildings lined up as closely as possible.

For the most part, we manipulated only the scale and angle of the photos to align them; we did not distort them. However, in the case of a couple of the aerial obliques, because of differences in angle between originals and repeats, slight vertical distortions allowed the photos to be compared more easily. In all such cases, the original copies were left undistorted.

Once the two photos had been scaled and aligned as closely as possible, we created a new image file (TIFF) that included both photos adjacent to each other for comparison. We discovered early in the project that these pairs were most easily compared when stacked vertically, so all of our pairs are saved this way.

Analysis

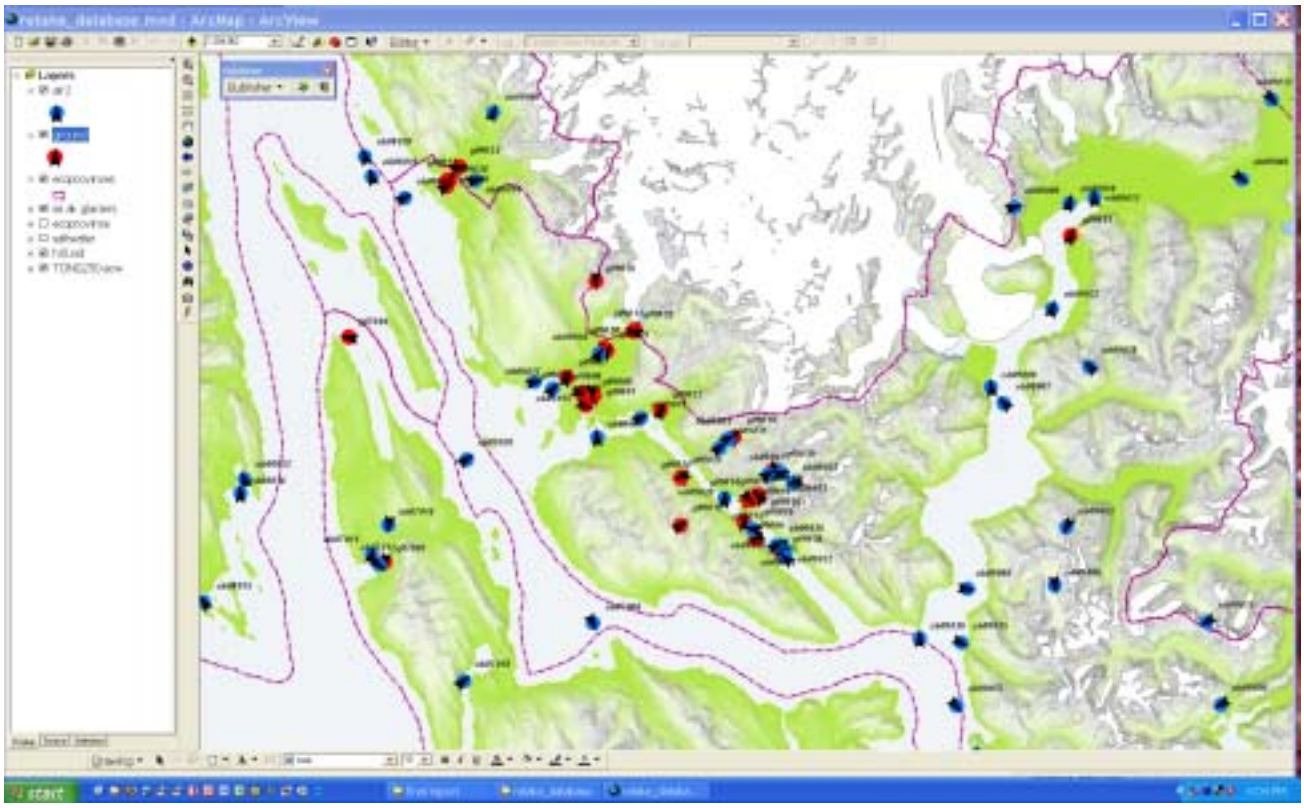
For each photo pair, we completed a brief narrative that included information about the disturbance shown in the original photo, notes on present-day vegetation, and analysis of the vegetation change shown. A select subset of some of our most intriguing photo pairs is included in the "results" section of this report.

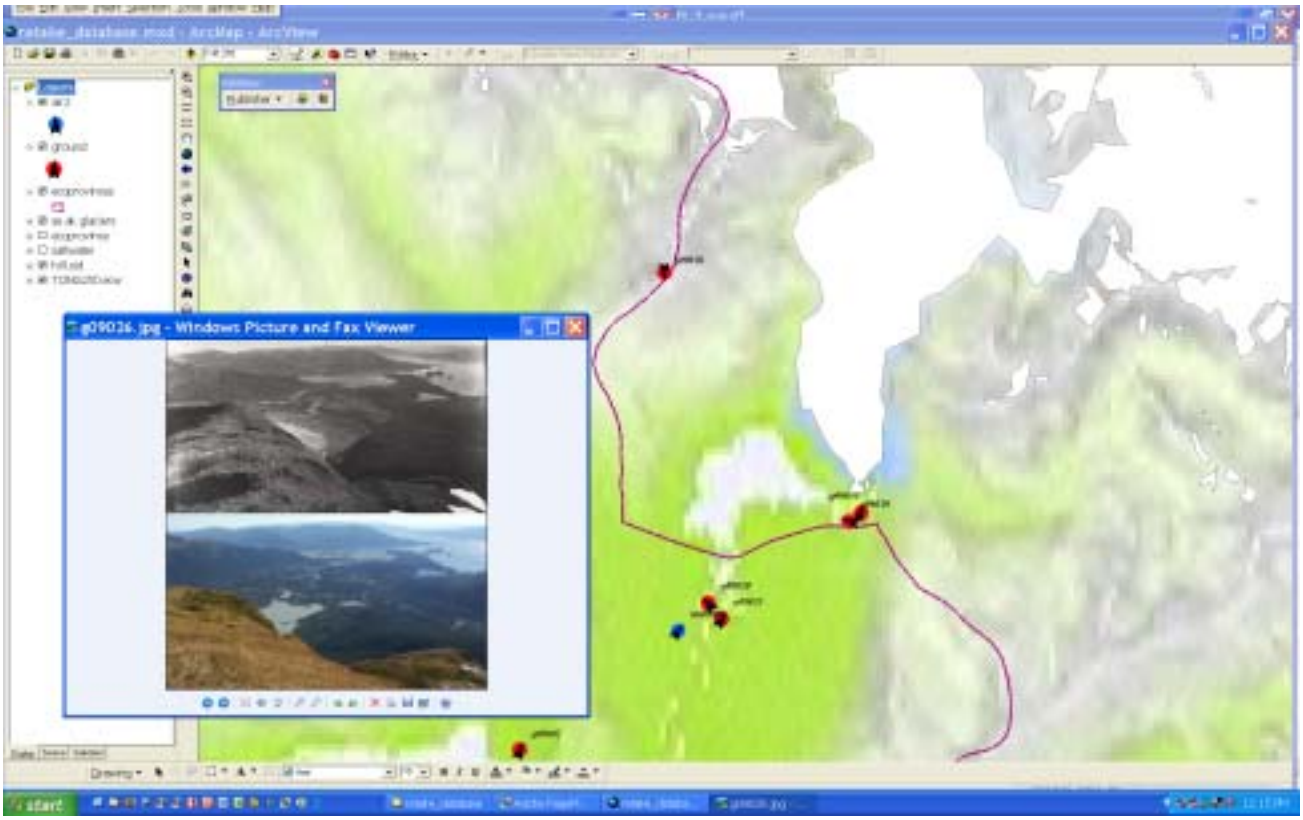
By its nature, the project was broad in scope, not focused on any particular type of change, but as it progressed, some themes emerged. These themes are outlined in the "future directions" section of this report.

ArcMap Project

For photo organization and presentation, we chose to create a spatial database within the program ArcMap. This program proved well-suited to the project,

Below: ArcMap view of potential and repeat photos in the Juneau area. Ground-based photos are designated with red symbols, aerial photos with blue. Arrows point in the directions of photo bearings.





allowing us to link photos and photo data to georeferenced photopoints, as well as to export our information in an interactive form (ArcReader).

Our resulting project – and the ArcReader version we created from it – allow users to find photos by location on a map or orthophoto, view potential photos or potential/repeat pairs, and search for photos by a number of categories including date, source, and subject.

In the ArcMap project, each photo is represented by a datapoint that includes a directional arrow representing the actual (in the case of repeated photos) or estimated (in the case of potential photos) bearing. Each point is labeled by photo number, and is linked to data fields with photo information. Points are also hyperlinked to their photos, so that turning on the "hyperlinks" feature and clicking on a point brings up the original photo or the photo pair represented by that point

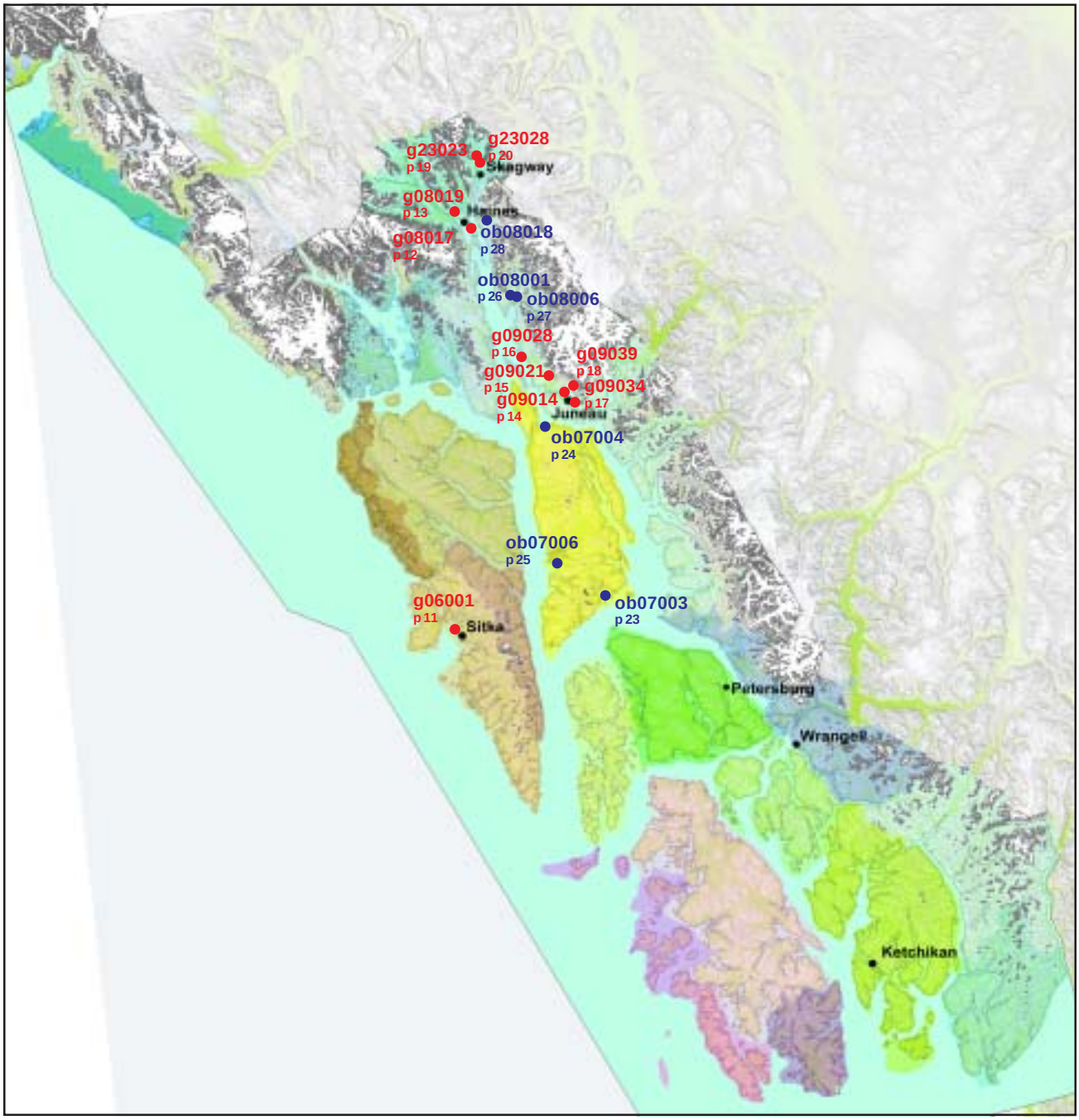
TheArcReader version of our project - along with the free program ArcReader - will be included when someone requests a copy of our results.

Photo Permissions

Many of the historical photos in our collection are used with permission of holding institutions such as the Alaska State Library. This permission is contingent on the photos' use as part of this project. To regulate the use of these photos, we will maintain the original ArcGIS database ourselves, and will make available information on how to obtain high-resolution copies for those interested in taking their own repeat photos or in analyzing ours.

Above: view of the Mendenhall Valley, Juneau, from the ArcMap project. Hyperlinks have been enabled (the small blue dots in the center of photo icons), and the hyperlink for photo g09026, an 1893 view from the top of Mt McGinnis, has been clicked, bringing up the Picture Viewer windown at lower left and showing the original and repeat photos.

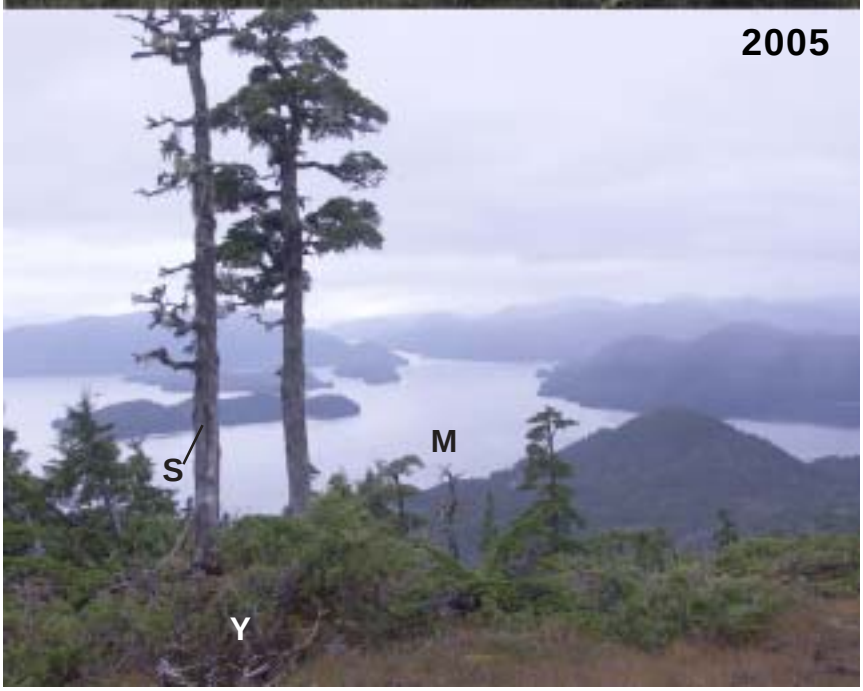
Select Results



Pages 10-27 show a selection of some of our most intriguing results. Photos are organized by ecoporovince, as shown on the map above. Photo numbers and page numbers are listed. Photos shown in red are ground-based; those in blue are aerial.

RP ID# g06001

location: Sitka
re-take date: 20050911
observers: KH
photo source: FSL
date: 1960?
photographer: ___
ID#
subject: subalpine bog
re-take photographer: Kathy Hocker
time: 1700
elev: 1537 ft
bearing: 310
GPS N: 57.05.834 **W:** 135.22.045
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 35mm
spd/f-stop: 1/160 f4
e com: 0



USDA Forest Service, Forestry Sciences Laboratory

This photo was one that intrigued us from the first time we saw it. We found it in the Forestry Sciences Laboratory's photo archives, in a set of folders that contained beautiful, crisp black and white images. There was no photographer or date listed, but by the process of elimination we settled on the 1960s.

Despite lack of documentation, however, the photo has a lot to interest us. We could see it was from Harbor Mountain, and probably was taken from near the road - so it would be easy to find. The complex island background and the distinctive foreground trees made it easily relocated (in fact, when we showed the photo to FS intern Matt Hunter in Sitka, he recognized the view and the trees instantly and gave us perfect directions to the site).

Although the re-take weather was disappointing (all but eliminating any information about the clearcuts at right middle distance), the foreground shows some interesting developments.

After 40 years, the two tall mountain hemlocks remain, but the leftmost one is dead. Lingering bark, especially at this high, exposed site, indicate it died within the last 10-15 years - and the trunk scar at "S" shows some filling in since the first picture was taken. Foliage on the right-hand tree has thinned considerably, indicating that it may be moribund as well.

In fact, there are indications of larger-scale tree dieback here (although the hemlocks at left have grown taller). The mountain hemlock at "M" is now dead, and the ones on either side of it show foliage thinning. In addition, there has been dieback of yellow cedar brush at "Y". There were no new cedar or hemlock seedlings in this area.

It would be interesting to find and re-take more photos on bogs such as this one, where vistas remain open for centuries, and distinctively-shaped trees aid in finding photopoints. Such photos might help elucidate patterns of recruitment or die-off in these slow-growing, long-lived trees.

RP ID# g08017

location: Mud Bay Road
retake date: 20050824
observers: KH, RC
photo source: Sheldon Museum
date: 19430000
photographer: Ordway
ID# Sheldon Museum, folder J-3
subject: Pyramid Island
retake photographer: Kathy Hocker, Richard Carstensen
time: 1754
elev: ~25 feet
bearing: 315
GPS N: 59.21124 **W:** 135.44908
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 35mm
spd/f-stop: 1/100 f5.6
e com: 0

Shelton Museum, Haines

The primary "disturbance" to this uplift meadow (located on the shoulder of Mud Bay Road) was recent depression below the high tide line by increased weight of ice during the Little Ice Age. The site is rebounding at about an inch per year. The gently rolling ridges resembling dunes are actually raised beach lines that form a "staircase" of progressively higher and older uplift surfaces.

In the 1943 photo, the foreground was covered with medium-height meadow vegetation: much ryegrass, with what appears to be fireweed on the far left ridge top. The small-leafed shrubs at "A" may be roses, which are also abundant in the 2005 re-take. There are no spruce trees visible in the original photo, although there are a couple of young alders in the immediate foreground (these may later have been cleared for highway work).

Today there are scattered spruce saplings to 25 feet tall advancing into the meadow. We were surprised to see that even the saplings barely taller than a person are bearing cones. In uplift meadows we've examined elsewhere, age at first reproduction is usually about 30 years (and ~30 feet tall) for this species.

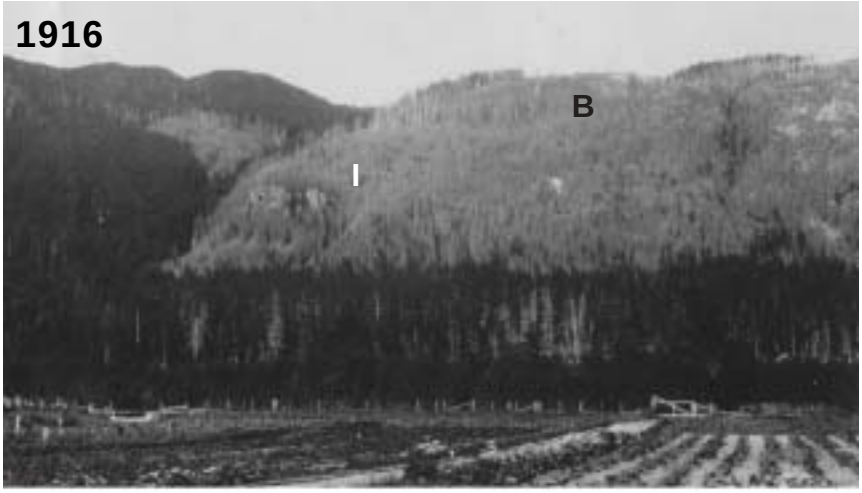
The frontal strips of these uplift meadows are dominated by ryegrass, beach pea and the moss *Rhytidiadelphus triquetrus*. Also common are hemlock parsley, yarrow, fireweed and strawberry. Invasive species include dandelion and toadflax (*Linaria vulgaris*, also known as butter-and-eggs). We've noted this latter plant along Haines roadsides since at least the late 1980s, but this is the first time we've seen it extending out from human disturbances into natural communities. Royer and Dickinson (1999) call it "an aggressive weed in rangeland where it quickly replaces grasses and herbs."

We also took a photo along this same line of sight from farther out on the beach, to study succession on Pyramid Island (pair at right). Pyramid Island is part of an arcuate, mostly subsurface glacial moraine that swings across the mouth of Chilkat River. It is definitely not a Little Ice Age moraine, but probably much older. Greg Streveler speculates that it may be Younger Dryas in age–a period of glacial re-advance 10- to 11,000 years BP that followed the waning of the Great Ice.

Note the spruce colonization, primarily on the southeast side of the island. This little speck of land must get blasted by wind from many directions. Certainly the steady parade of southeasterly gales blowing up Lynn Canal must be a force to contend with on Pyramid Island. But clustering of spruces on the southeast side suggests that the really violent winds here are the down-river winter northerlies.

RP ID# g08019

location: Haines
re-take date: 20050824
observers: KH
photo source: Sheldon Museum
date: 1916
photographer: unknown
ID# SM agriculture folder
subject: fire scars on hill above town
re-take photographer: Kathy Hocker
time: 1355
elev: 60 feet
bearing: 360
GPS N: 59.23760 **W:** 135.46924
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 35mm
spd/f-stop: 1/80 f5.6
e com: 0



Shelton Museum, Haines

In 1915, a large forest fire began at the Haines sawmill, burned up the slope of Ripinski, threatened the town, crept around to the east, and continued down the peninsula. Many early photographs of Haines (such as the 1929 Navy aerial below) clearly show this burn. This view, taken in 1916, is from a strawberry field in the vicinity of today's Eagle's Nest Motel

The repeat photo is not taken from the exact location of the original. That site is now occupied by the Eagle's Nest Motel and trees have grown up to obscure the burned mountainside. Therefore, we took the repeat from a gravel yard across the highway and up Sawmill Road a few hundred yards.

Even though the mountain slope is not perfectly aligned in the repeat, these two make a good comparison.

It's clear from the 1916 photo that the burn pattern was not uniform. At the lower edge, fire-killed trees interfinger with live trees, while the center slope has been burned more intensely. At the top of the ridge, many trees are left standing - some even appear to have survived the fire.

The results of this uneven burn pattern: the most intensely burned area has the greatest concentration of deciduous trees (birch, alder; light green), while the upper and lower slopes have more conifers. One exception is the intensely-burned patch at "I" where conifers dominate. Do slope differences as well as burn intensity affect post-fire succession?

There are at least two exceptionally tall trees standing above the canopy on the ridgeline in the 2005 photo ("A" above). Their locations correspond to sections of forest that appear not to have completely burned. Are these survivors of the fire or are they just growing on prominent landscape points?

The 1915 fire jumped the leftmost gully and burned for a short distance north of it. This triangular burned area is still discernable in the 2005 photo, bounded by taller trees upslope ("S"). The 2005 canopy in this burned area is quite uneven.

This suggests an interesting difference between fire and windthrow/clearcut succession. The latter disturbances lead within 100 years to a smooth-canopy evergreen forest. However, from the photos and observations of this trip, it would seem that fire-succession forests of a comparable age can be more structurally complex, with dominance shared by conifers and deciduous trees.

Interestingly, the 1915 fire did not burn into the section of smooth-canopy evergreens at "B" - the remnants of a large windthrow, perhaps? Even 90 years later that section is still dense and green.

See our entry for the Skagway fire/logging photo (g23028) on page 17 for another analysis of fire ecology in the northern Lynn Canal region.

RP ID# g09014

location: Juneau
re-take date: 20040813
observers: RC
photo source: Richard Carstensen
date: 1949
photographers: Donald Lawrence
subject: Mt Roberts subalpine/alpine
re-take photographer: Richard Carstensen
time:
elev: 1900 feet
bearing:
GPS N: W:
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 35mm
spd/f-stop:
e com:

Richard Carstensen, personal collection

This is one of a set of seven re-takes we did on Mt Roberts near Juneau, in the summer of 2004. All originals were taken in the summer of 1949 by Professor Donald B. Lawrence, a pioneer of plant succession studies who focused on 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, during the Little Ice Age, persistant summer-long snowpacks 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 of ancient mountain hemlocks to persist throughout the Little Ice Age.

All of our repeats of the 1949 photos document clear changes in subalpine vegetation, particularly in areas where seasonal snow has been disappearing earlier and earlier. In these areas, snow once persisted late into the summer, melting only long enough for the establishment of herbaceous vegetation. The result was lush subalpine meadow communities. As Earth's climate warms, however, the snow melts earlier in the summer, allowing establishment of woody vegetation (particularly alder brush) in these meadow areas. The photo presented here is one of the more dramatic of these shots.

Our 2004 repeat was taken from the same photopoint as the 1949 original, although the photographer had to stand on a picnic table to see over the nearby alder trees. In addition, the scale-person in the 2004 photo (Robert Armstrong) had to stand considerably downslope from the site of the 1949 scale-person (Elizabeth Lawrence) to be visible from the photopoint.

Very little remains of the original herbaceous meadow, which included hellebore, geranium, lupine, and chocolate lily. Its remnants are visible in the foreground of our retake, where seeding hellebore stalks emerge from a grass/herb patch.

Note: the phenology of the hellebore, and the fullness of the alder leaves, might lead one to assume that the 2004 photo was taken later in the summer than was the 1949 shot. The two were actually both taken in late August. In the 1949 photo, the bare-stemmed alders and the meadow vegetation have just melted out from under the snow, while in 2004 the snow was long gone by August. NOAA records show both summers to have been anomalously warm. However, more persistent snow in summer 1949 may indicate greater accumulation in winter 1948-49.

RP ID# g09021

location: Juneau
re-take date: 20050808
observers: KH
photo source: NSIDC
date: 1894
photographer: Ogilvie
ID# mendenhall000001
subject: recessional moraines of Mendenhall Glacier
re-take photographer: Kathy Hocker
time: 1655
elev: 60 feet
bearing: 30
GPS N: 58.24.092^{o} **W:** 134.34.778^{o}
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 35mm
spd/f-stop: 1/50 f2.8
e com: 0

We found a number of excellent candidates for repeat photography on the National Snow and Ice Data Center website, including this panorama of the Mendenhall Glacier, taken by surveyor William Ogilvie in 1894. The original is actually three glass-plate negatives that, when stitched together, create this sweeping view.

Photopoint location was done for us by Juneau historian Jim Geraghty, who had heard of our project and contacted us to share his photos and experiences. He found the original photos on the National Snow and Ice Data Center website, determined that they were a panoramic set, then put in the footwork to find the site by triangulating from the mountain ridges to get the bearing, then tracking down the three distinctive boulders marked with red arrows in the photos below.

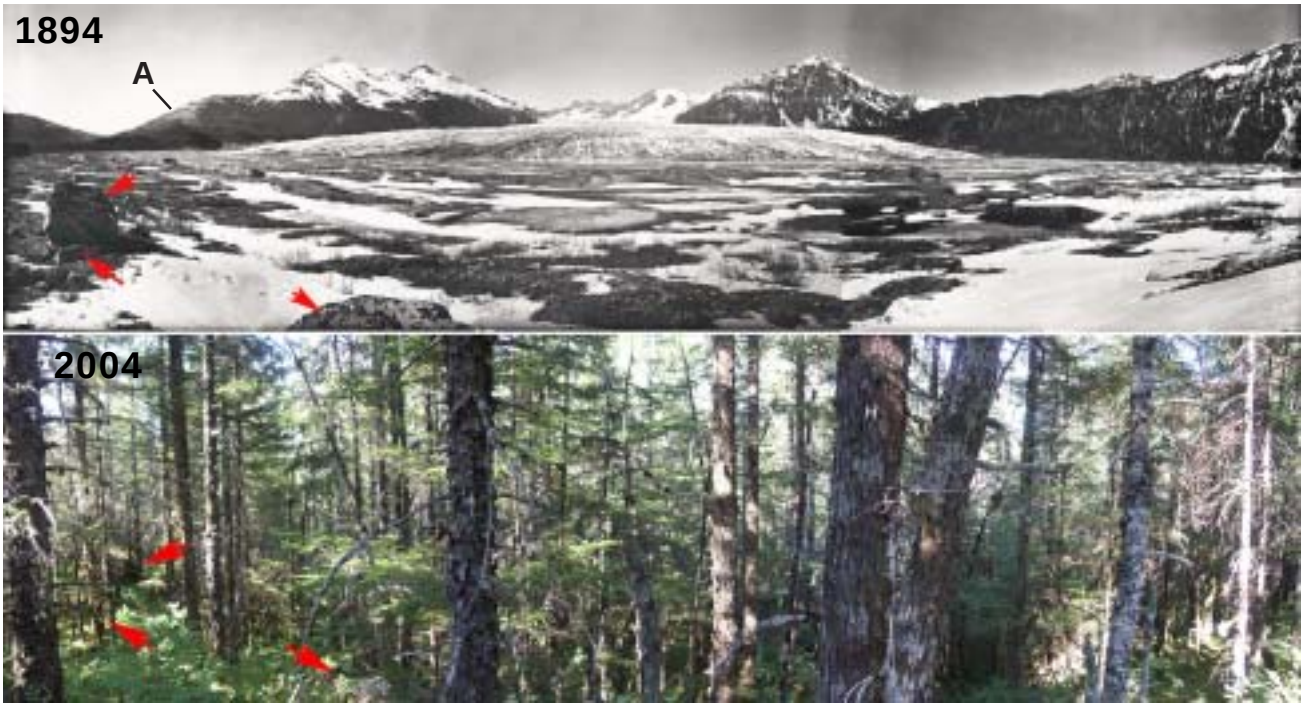
These photos show a "classic" succession on well-drained morainal material. In the original photos, cottonwood and willow brush are just emerging. 110 years later, the site supports a dense forest of nearly 100% spruce. A few scattered senescent cottonwoods are all that remain of the original cottonwood saplings, although willows persist in the swales and kettle ponds between moraines. Blueberry, western hemlock, and step-moss dominate the understory, and a few hemlocks have entered the canopy.

One notable vegetation feature that does not show in our re-take is the open forest on the flank of Mt. McGinnis ("A"). Today, that area is covered with dense timber. There may have been some mine-related logging in that vicinity as early as the 1890s, though it would have to have been extensive to show at this scale. Another intriguing possibility is that this bare area is blowdown from a massive windstorm that struck northern Southeast Alaska in 1883. For more

NSIDC

about the blowdown, see the next page.

Of additional interest here is our repeat photo g09026 (taken by Terry Schwarz), shown above. The original was taken in 1893, also by William Ogilvie, from the top of Mt McGinnis. Note the apparent lack of change in alpine vegetation. This photo reveals a wealth of information about change in the Mendenhall Valley. In particular, note the dense evergreen forest that has covered the glacier's many recessional moraines, and the swath of open land along the glacier's former outwash channel, now Duck Creek ("D"). In 1893, the Mendenhall River had only recently emerged as the primary glacial drainage, and it had not yet begun to cut down into the valley floor sediements.



Nataional Snow and Ice Data Center

RP ID# g09028

location: Juneau
re-take date: 20021009
observers: RC, JC
photo source: FSL
date: 19661100
photographer: Bob Smith
ID# ****
subject: blowdown forest at Eagle River
re-take photographer: Richard Carstensen, John Caouette
time: ****
elev: ~40 ft
bearing: 160
GPS N: 58.518° **W:** 134.802°
camera: Olympus Ultrazoom
lens: 35 mm
spd/f-stop:
e com: 0

USDA Forest Service

Although this photograph was taken before our project began, we have included it as part of the repeat collection, as it provides information about stand development following blowdown.

Sometime around 1883, a huge windstorm swept through northern Southeast Alaska, blowing down forest patches tens of acres in size. Events such as this are common in this region, but only more recent ones have been documented. In the case of the 1883 blowdown, there are no historical records or photographs specifically documenting it, so what we know about it is gleaned from studies of stand structure, species composition, and tree ages. In general, this blowdown event produced stands of relatively even-aged hemlocks which were released to grow into the canopy when overstory trees fell. When the 1966 photo above was taken, the remains of the toppled overstory trees are still visible on the forest floor; most of those have rotted away by 2002.

In 1966, USFS forester Bob Smith photographed an 1883 blowdown forest near Eagle River. A precisely labelled 1962 vertical aerial stereopair made it easy to relocate the 1/5-acre circular plot. Smith recorded average height of 3 tallest hemlocks as 107 feet. On our 2002 visit, average was 122 feet, so vertical growth has been meager.

A more important change is in understory composition. In 1966 there was virtually no understory. By 2002, the 120-year-old stand had substantial blueberry cover.

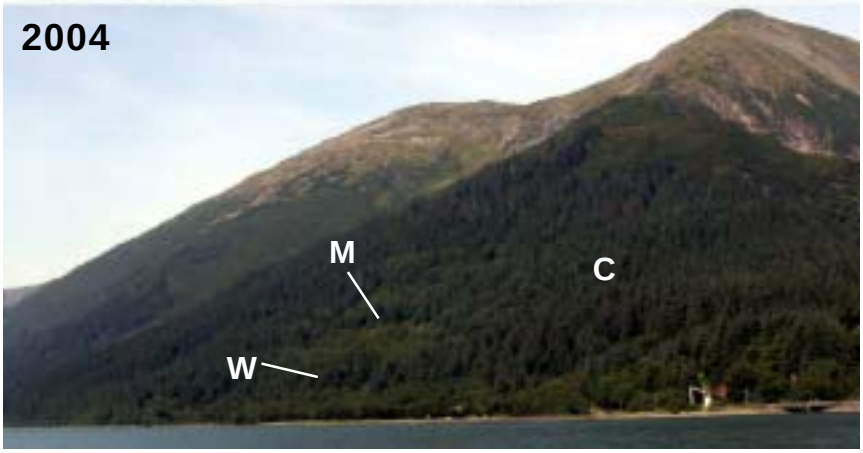
This change is an important one for wildlife, particularly Sitka black-tailed deer, which depend on understory plants such as blueberry, bunchberry, and fern-leaf goldthread to carry them through winters when open-grown forage plants are covered with heavy snow. These photographs show that these critical forage plants did not enter the post-blowdown forest until perhaps 90 years after the event.

Both pairs of photos are stereo pairs, viewable with the naked eye by holding the images at about half arm's length and focusing the eyes beyond the plane of the image until both sides of the image merge. They can also be studied in 3D with a special viewer called a stereoscope.

RP ID# g09034

location: Juneau
re-take date: 20040831
observers: KH, CC
photo source: ASHL
date: 1915
photographer: Winter and Pond
ID# PCA 87-388
subject: Alaska Gastineau Mine mill and adjacent buildings
re-take photographer: Kathy Hocker
time: 1400
elev: 0
bearing: 343
GPS N: 58.18.326^{o} **W:** 134.20.187^{o}
camera: Konica Minolta Dimage A2 28-200mm
lens: 40
spd/f-stop: 1/400 f7.1
e com: -.7

Alaska State Library, Historical Collections



From 1880 to 1944, the Juneau area saw the development of scores of gold mines. Early efforts concentrated on placer deposits, but by 1910, much of the focus had shifted to hard rock mining. During the height of the gold era, mining was by far Juneau's principal industry, and many Juneau-area mines were well documented by local photographers such as Lloyd Winter and Percy Pond, who took the historic photos on this page and the next.

In 1944, the last of Juneau's major mines closed; most others had already failed. Because of their remote or peripheral locations, many mine working sites and camps were abandoned; buildings fell apart or fell prey to vandals, while waste rock and tailings piles, road and railroad beds became overgrown. Because of the quality of the early mining photographs and good documentation of many mine locations, many of these old mine sites are easily re-located.

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. They also tend to have a complex history of use and disuse, resulting in uncertainties as to actual "zero points" of the successional timeline.

This complexity can make the photo pairs difficult to interpret, but also rich in information about plant succession as it relates to different types of human disturbance.

The Alaska Gastineau millsite at Sheep Creek south of downtown Juneau is a good case in point. The site was first developed in the early 1900s, and the mill (large building at center) was active until 1921, though some of the smaller buildings continued to be maintained for decades after that. The site included not only the mill, but also housing for mine employees, docks and warehouse facilities, and other peripheral buildings. The slope of Gastineau mountain was clearcut, and large piles of waste rock (mixed rubble removed as part of tunneling operations) and tailings (fine, crushed material from which gold has been extracted) built up below the mill and on the delta of Sheep Creek.

The repeat photo shows clear correlations between vegetation types and disturbance types. On the millsite "M", a mixed deciduous forest of cottonwood and alder has developed, with some understory spruce now moving toward the canopy. The nearby clearcut slope "C" has grown back in spruce with some hemlock. This difference may be most closely tied to substrate; most mine buildings in the Juneau area had foundations of low-quality cement that disintegrates on exposure to weather into a flaky mineral seedbed. Nitrogen-fixing alder, which establishes easily on such seedbeds, may have captured the decomposing building sites while losing out to spruce and (pre-established?) hemlock on nearby organic soils in the clearcut.

Note the waste rock/tailings pile below the mill building, marked "W" in the repeat photo. Evergreen establishment on this pile is comparable to that on the clearcut slope. This contrasts strongly with the story at Perseverance mine camp, shown on the next page.

RP ID# g09039

location: Juneau
re-take date: 20050817
observers: KH
photo source: ASHL
date: 1914
photographer: Winter and Pond
ID# PCA 87-1407
subject: Alaska Gastineau Mine mill and adjacent buildings
re-take photographer: Kathy Hocker
time: 1545
elev: 1100 feet
bearing: 343
GPS N: 58.15.305° **W:** 134.19.527°
camera: Konica Minolta Dimage A2 28-200mm
lens: 28
spd/f-stop: 1/100 f3.5
e com: 0

This camp, 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. The floor of the valley, where Gold Creek flows in a braided channel, shows some deciduous regrowth after extensive placer workings of the late 1800s. Buildings, including bunkhouses, administration buildings, and a mill, are scattered on the rock outcrops and the valley floor. The pale, sloped piles at middle left ("W") are waste rock, removed from mine tunnels. This camp was abandoned in the early 1920s, though some of the buildings were probably maintained for a couple of decades thereafter..

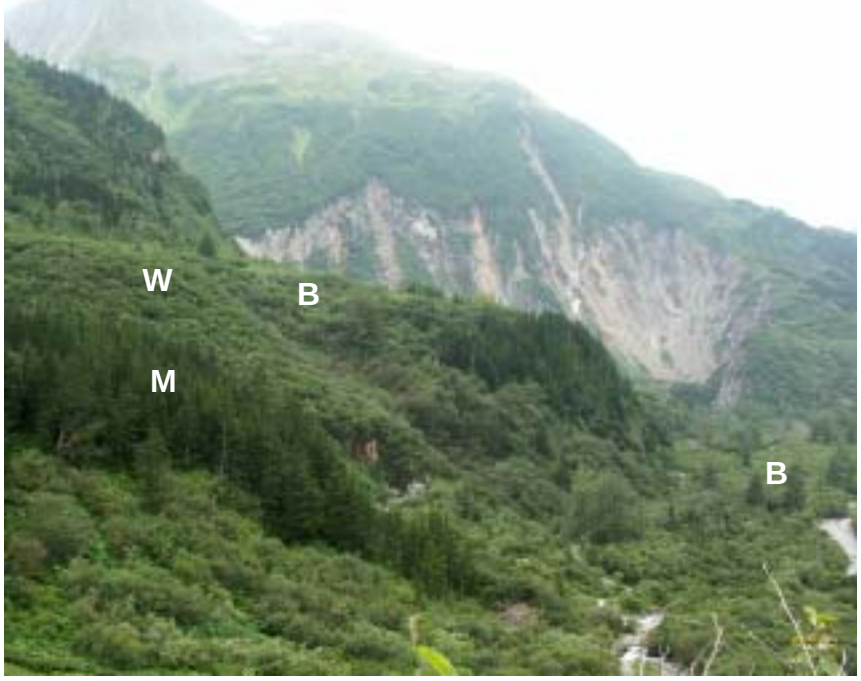
Our 2005 retake of this photo shows dense mountain hemlock (M) growth on the logged slopes. However, similar, unlogged evergreen-covered buttresses at this elevation show significantly larger percentages of Sitka spruce in the overstory. It seems likely that the pre-development forest on this buttress consisted of mixed spruce and mountain hemlock; after logging, mountain hemlock predominated forest regeneration . On the building sites (B), alder/willow scrub (with devil's-club, salmonberry, and goatsbeard patches and the occasional black cottonwood) predominates. However, the waste rock pile (W) shows a much more uniform canopy, which consists of almost 100% roughly even-aged sitka alder—a stand that seems surprisingly young, considering the rock pile has been abandoned for at least 80 years. The difference may be attributable to a combination of snow effects and slope/soil instability as the waste rock pile settled.

Vegetational composition on this rock pile also differs strongly from that on the Gastineau tailings/waste rock pile (previous page), also abandoned in the 1920s. Some of those differences can perhaps be attributed to elevation, including snow accumulation and temperature extremes. Another factor, however, may be substrate composition. Waste rock at this site is generally coarse, while the piles at Gastineau probably contain a higher percentage of fine tailings material.

1914

Alaska State Library, Historical Collections

2005



RP ID# g23023

location: Dyea
re-take date: 20050826
observers: KH,KG
photo source: KGRNHP
date: 1898
photographer: E.A. Hegg
ID# KNP folder 92-R-03
subject: Dyea townsite
re-take photographer: Kathy Hocker
time: 1300
elev: 25 ft
bearing: 2
GPS N: 59.30.245^{o} **W:** 135.21.215^{o}
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 30mm
spd/f-stop: 1/25 f2.8
e com: 0

University of Washington, Special Collections Division

This photograph looks north along Main Street between 4th and 5th in the gold rush town of Dyea.Dyea was established ca. 1898, and grew quickly as prospectors rushed through to the Chilkoot Trail, but the boom stalled when stampeders shifted to the nearby White Pass route (via Skagway). By 1905, Dyea was largely abandoned. The buildings on the townsite were either hauled away or left to decompose on site, although a handful of homesteaders and their employees occupied buildings into the 1920s.

A few horses and cattle were grazing the townsite and meadows until the 1980s, and there were scattered gardens. In the 1960s and 1970s, there was some logging of cottonwood on homesteads to the north, but it appears that the townsite itself was not logged; there are no large stumps, and the trees would not have been commercially valuable.The primary disturbance today is trampling by tourists (this site is part of Klondike Gold Rush National Historic Park).

Very little physically remains of Dyea. One structure is visible in this retake: the facade of a small real estate office (“A”). Now known as the “False Front,” it has been re-erected. To the right in the photo, a depression is all that’s left of the cellar of the Ross Bigins Building (“H”).

Dyea was built on recently-uplifted marine sediments, which would have supported meadow vegetation at the time. Historical aerial photos show forest vegetation did not begin to overtake the site until the 1940s.

Today’s vegetation is a closed-canopy forest of vigorous 40- to 70-year-old spruce, with a few cottonwood, alder, and willow - and, rarely, paper birch and shore pine. Forest floor vegetation is sparse in trampled areas, Step-moss and electrified cat’s tail mosses are the predominant groundcover, with only a few scattered vascular plants, including wintergreen and twisted stalk.

These understory and overstory species are fairly typical of a transitional uplift-succession forest, with the interesting exception of paper birch and lodgepole pine - both presumably contributed by the fire-forest of the valley walls above.

On the site of the Ross Biggins Co. building (“H” above), overstory tree density is considerably lower than it is on the rest of Main Street. Perhaps the Biggins building remained standing longer Or perhaps the fact that the Biggins building had a cellar contributed to the pattern of succession here. Most Dyea buildings were constructed directly on the ground, with no basements or cellars.

We thank historian Karl Gurcke from KGRNHP for his assistance with this and other Skagway photographs.

RP ID# g23028

location: Skagway
re-take date: 20050825
observers: KH,RC
photo source: KGRNHP
date: 1916
photographer: ___
ID# S094 1961 N-117
subject: just after fire
re-take photographer: Kathy Hocker
time: 1830
elev: 30 to 2000 ft
bearing: 150o
GPS N: 59.46.642^{o} **W:** 135.32.356^{o}
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 40mm
spd/f-stop: 1/50 f2.8
e com: 0

Yukoin Archives

In Skagway and Dyea, we found a fascinating mosaic (temporal and spatial) of fire history. In the late 1800s and early 1900s, several fires burned the hillsides above the young towns.Of all the shots of fire's aftermath, this one, taken in 1915, best summarizes the multiple events.

Letters A, B and C correspond to fires and logging as described below. Unfortunately, we found little documentation of forest fires within the historical records of Skagway; most newspaper accounts were concerned with which saloon or rooming house burned down rather than which hillside was ablaze. Therefore we had to use historical photos to narrow our search, and most fire dates are approximate.

Around 1895, a large fire burned the hillside above town at A. As the town grew, the remaining trees on this hillside were selectively cut, and a logging operation began to make inroads into the hillside above Dewey Lake ("B"). Sometime around 1912, another large fire - perhaps logging-related - burned further up this same hillside "C"; the scar from this fire is clear in our photo g23028 above, where standing dead trees still retain their branches.

What is immediately clear from these two photos is the striking difference in vegetation regrowth between the logged forest at "B" and the fire forest at "C." Both disturbances occurred within 5 years of each other, and yet they produced very different forests. The fire forest has a much higher deciduous component (lighter green in this early-autumn photo) while the clearcut has regrown in dense conifers. The edges of both of these disturbances are still quite clear in 2005. The older forest above the burn has a much lower percentage of deciduous trees.

We didn't have time during our Skagway visit to hike up the Dewey Lakes trail that transects these 3 forest types for notes on structure and understory species. That would be fascinating, and useful information to include in an interpretive guide. We did, however, take notes during our walk up to the photopoint for this shot on the AB Mountain trail (west side) - although we don't wish to imply that this forest is necessarily similar to A, B or C in g23028. (Based on other historical photos, this forest burned prior to 1894). The forest was heavily dominated by surprisingly small lodgepole pines, 30 to 70-feet tall and mostly less than 9 inches in diameter. Occasional birches, hemlocks and spruces were mixed in. Vascular understory was exceedingly sparse, with just a thin layer of scarcely decomposed pine needles over bedrock in the concavities, and exposed granite.

Landscape Replications With Google Earth

Google Earth is a free program that can be downloaded at **http://earth.google.com/earth.html.** It requires high speed internet access. This program will be very useful for people trying to figure out exactly where historical photographs were taken.

The program opens with a view of the earth that gradually enlarges. You can direct it to any place of interest, then tilt and rotate the landscape to achieve the desired view. Most of the earth's surface is represented by fairly coarse satellite imagery, as in the above example from the east arm of Glacier Bay. For selected areas, however, there is high resolution imagery on which objects as small as cars can be detected. .

Especially for our trip to Haines and Skagway, where we werelacking digital elevation models (DEMs) and orthophotography to create ArcScene replications for landscape views, Google Earth was important in providing context information, and in verifying the locations of photos we did not have the time to re-take. After discovering its capabilities, we began using it more frequently, especially in creating illustrations for our field journals.

Even where GE's satellite imagery is fairly low resolution, it is extremely helpful to be able to drop down to ground level, tilt back the landscape, and compare the view to the backdrop of historical photographs. The elevation models incorporated into Google Earth are not detailed enough to represent features such as the jagged crests of mountaintops, etc. But in most cases only the broad outlines of mountains are necessary for replicating the original photo position.

In addition to imagery and DEM resolution issues, Google Earth has a few limitations compared to ArcScene. Tilting and rotating commands are slower and less "organic," and so far we've been unable to extract XYZ coordinates or photo bearings directly from the program. In other ways, however, GE is easier and more convenient than ArcScene, in which a new project must be set up for every scene. GE takes only seconds to zoom from Alaska to Mexico. GE imagery is also usually more up-to-date than our currently-used orthophotography (NASA 1996). At Dyea, GE satellite photos showed forest fire scars that were only three years old.

The Alaskan Aerial Survey Expedition (AASE) 1926-1929

Left: AASE mapping planes over Twin Glacier Lakes, Taku Inlet. These planes took oblique photos to supplement their mapping-related vertical photography mission. Below: survey member with a Fairchild mapping camera.

The primary purpose of the Navy's photo expedition to Southeast in 1926 and 1929 was to acquire vertical imagery for mapping at a scale of 1:20,000. They flew at 10,000 feet for these photos, which were shot with special tri-lens cameras (T-1) that took three photos simultaneously; a vertical and two obliques, thus achieving wide coverage of the landscape. The mapping photography was taken through hatches in the bottom of amphibious biplanes.

In addition to this systematic vertical coverage on preplanned flight-lines, the Navy took hundreds of pictures over the side of the open-air cockpits. Most appear to have been taken between 2000 and 5000 feet and have excellent detail. We have added nearly 200 of these photos to our database, and have re-taken several.

The first 1926 mission is well documented. But because these side-view photos were clearly secondary in importance to the vertical "triplicates," we haven't learned much about them. According to USGS Bull. #797 by Sargent and Moffit (1928), a Fairchild camera was used for the 1926 side-view oblique photos. They were taken primarily for the Forest Service (thus the common label "timber" on many of the big-tree scenes) but also for other agencies such as the bureau of lighthouses. Lieutenant Ben Wyatt, the expedition leader, took many of these oblique photos.

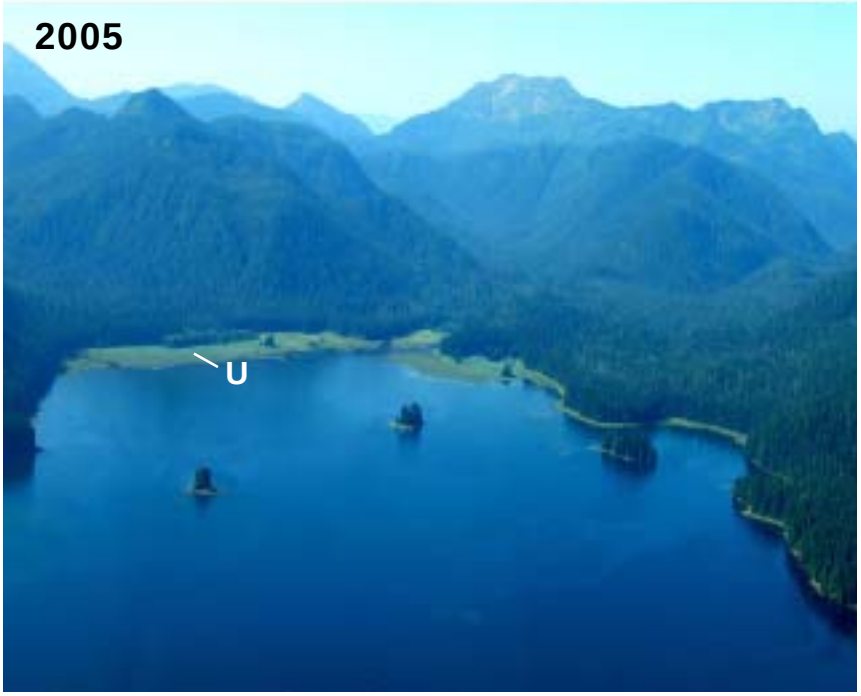
It seems as though the obliques were taken on separate missions from the vertical triplicates. Only a few appear to be from 10,000 feet. There were 3 members on the vertical (mapping) missions: pilot, navigator and photographer. They must all have been too preoccupied with staying on course and in timing their shots for proper overlap to be shooting additional scenics out the side of the plane.

The Fairchild K-3B aerial mapping camera was invented in the 1920s. It produced 9.5"X9.5" negatives and became standard equipment on military and some private air mapping missions.

Right: Hand-drawn index to coverage of the 1926 obliques. Unfortunately, we did not find an index for the 1929s and had to reconstruct views ourselves.

RP ID# ob7003

location: Pybus Bay
re-take date: 20050810
observers: RC, DA, JS
photo source: Geometronics, USFS
date: 19290623
photographer: US Navy
ID# FS T25
subject: uplift
re-take photographer: Richard Carstensen
time: 1505
elev: <2000 feet
bearing: 320
GPS N: 57.36^{o} **W:** 134.17^{o}
camera: Panasonic 4M DMC FZ10 35-420mm
lens: 50mm
spd/f-stop: 1/250 f4
e com: 0

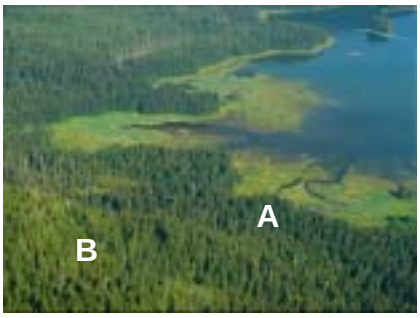


USDA Forest Service, Geometronics

Our re-take of this Navy shot is on roughly the same bearing as the original, but we were flying much lower–probably less than 2000 feet. In the 1929 shot you can see over the snowy central island peaks to sea level on the Chatham Strait side, so they were probably flying above 5000 feet. For this pair, we stretched the re-take vertically a bit to make comparison easier. This vertical exaggeration makes comparisons based on tree height difficult, although even with the vertical shift, it's clear that there has been some significant spruce growth on the two smaller islands - no doubt a response to uplift.

The old-growth forest blanketing most of the 1929 scene has changed little in 76 years. The main changes are to the coastline, in the uplifting bay-head salt marsh and fringing spruce and alder stands. Most of these uplift-related details are better seen in the close-up (non RP) oblique below, although the emergence of a thick alder stand at "U" (perhaps on uplifting, aggrading alluvium) shows clearly even from this distance.

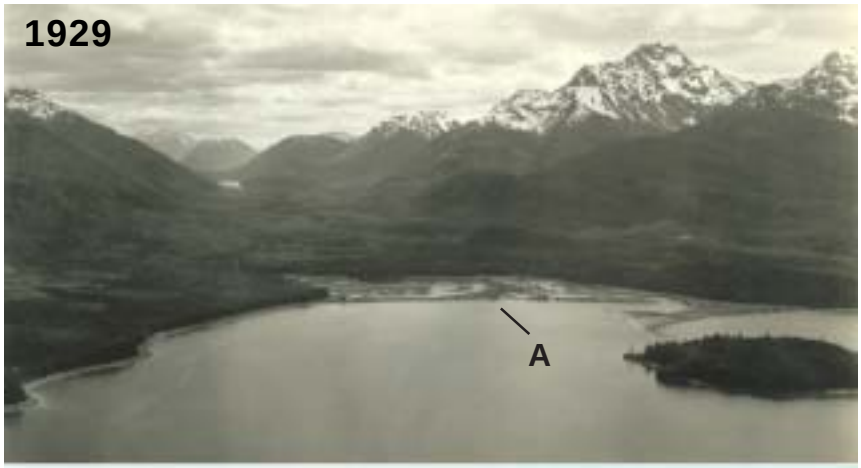
At left: Eastward view from low over the head of Pybus Bay. Note the difference in color and texture between the forests at A and B. The A-stands are young spruces on essentially level surfaces barely above extreme high water. The B-forests are hemlock-dominated, on the higher upland slopes. The A-stands are probably growing on former tideland, elevated from intertidal levels with the waning of the Little Ice Age.



Note: existing maps of glacial rebound such as those produced by Hicks and Schofnos and Larsen et. al. suggest almost no uplift this far south - an interesting contrast with evidence in this photo.

RP ID# ob7004

location: Admiralty Cove
re-take date: 20050810
observers: RC, DA, JS
photo source: Geometronics, USFS
date: 19290622
photographer: US Navy
ID# FS T13
subject: uplift
re-take photographer: Richard Carstensen
time: 1606
elev: ~2000 feet
bearing: 153o
GPS N: 58.21^{o} **W:** 134.59^{o}
camera: Panasonic 4M DMC FZ10 35-420mm
lens: 45mm
spd/f-stop: 1/200 f4
e com: 0



USDA Forest Service, Geometronics

Strong back-lighting made the view south to Admiralty Cove so problematic that Richard almost didn't bother shooting it. He didn't ask pilot John Schoen to deviate from his homeward flight path to bring it into alignment. But he got some wonderful close-up shots of the estuary before heading out into Stephen's Passage. The example below gives more detailed information about uplift succession in this cove than we could obtain with even the best lighting conditions from the fairly distant Navy photopoint.

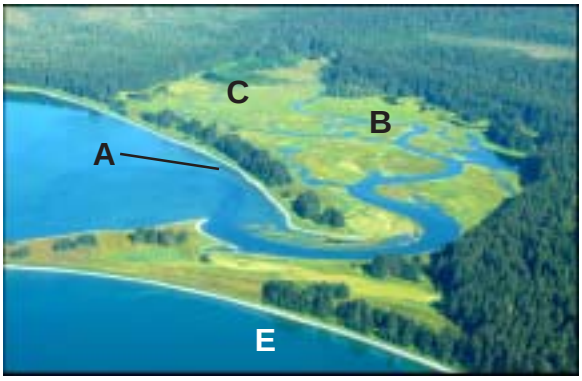
Uplift succession is more pronounced at Admiralty Cove than in any of the other re-take pairs on the island. There are two reasons: 1) This is the most extensive and gently shoaling estuary of the 7 RP pairs. 2) It's the farthest north. In general the rate of glacial rebound increases northward as you approach the presumed center of Little Ice Age depression in Glacier Bay. The rate here is thought to be roughly 0.5 in/yr, or twice that of Angoon.

Spruces at A (same labelling on the 1929 and the oblique below) are colonizing a wave-built spit. At B they are moving into the better-drained microsites at the back edge of the tidal marsh. At C, red alder has advanced onto fresh alluvial deposits at the mouth of Young Creek. We saw these stream-mouth alder stands repeatedly on our Admiralty flight. Because they are excellent wildlife habitat it would be interesting to map their distribution and study the depositional dynamics that lead to alder as opposed to other vegetation types.

The island in the right foreground is a "tombolo" (an island that isn't an island at low tide). Most of the forest on the south side is tall, even-aged, spruce-dominated, and looks about 150 years old. The most likely disturbance is wind. Perhaps this is actually part of Juneau's widespread 1883 blowdown forest, and just looks older because it's on a more productive site and has more spruce.

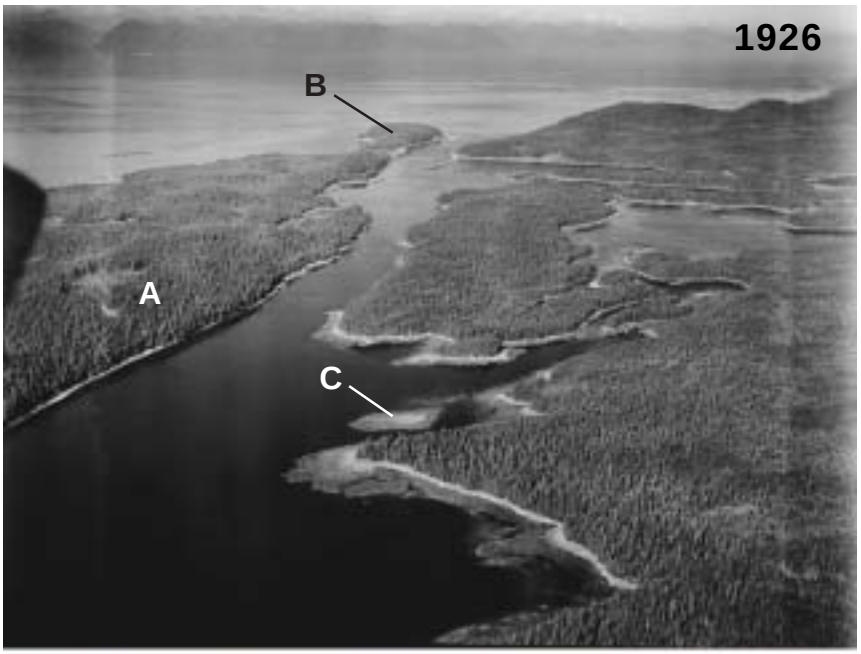
At D on the 1929 shot there was a recent disturbance, enlarged in the inset. Defoliated, open-grown spruces suggest possibly fire, combined with logging that removed the other trees. To the right in the inset is a paler, smooth-canopied stand, probably cutover.

Uplifting storm beaches are often aligned in a series of parallel ridges similar to dunes, higher and older with distance from high tide line. At E in the close-up oblique is a line of small spruces marking the most recent storm beach crest.



RP ID# ob7006

location: Favorite Bay, Angoon
re-take date: 20050810
observers: RC, DA, JS
photo source: Geometronics, USFS
date: 1926
photographer: US Navy
ID# 220963
subject: clearcuts, uplift, unique topography
re-take photographer: Richard Carstensen
time: 1425
elev: ~2000 feet
bearing: 305°
GPS N: 57.47^{o} **W:** 134.48^{o}
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 50mm
spd/f-stop: 1/125 f5.6
e com: 0



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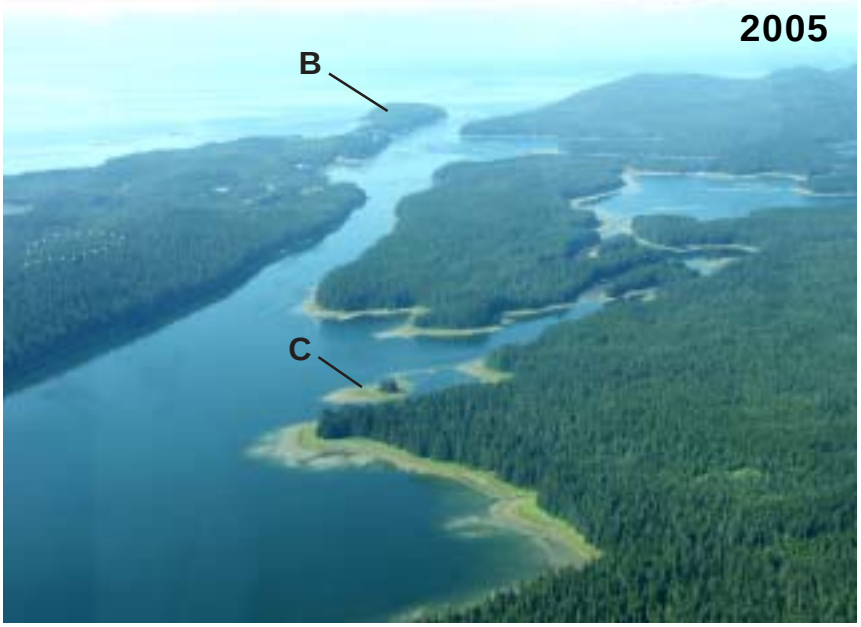


Of all of our aerial RP shots so far, this one of Favorite Bay comes the closest to perfect alignment.

The flat topography inland from Angoon is geologically unique for Southeast: low-grade marble on the peninsula; tertiary sedimentarie to the east. The forest habitats here are equally unique.

The most obvious fresh disturbance in the 1926 photo is the clearcut at "A." This was prior to the development of chainsaws–a time when selective logging was more common than clearcutting (there is a considerable amount of pre-chainsaw logging - some of which is visible in the 1926 aerials - in the Angoon area). An Alaska Geographic dated map of Admiralty logging says this stand was logged in 1923, which would have made it 3 years old at the time the photo was taken. The resulting smooth-canopied second-growth stand is outlined on the 2005 re-take.

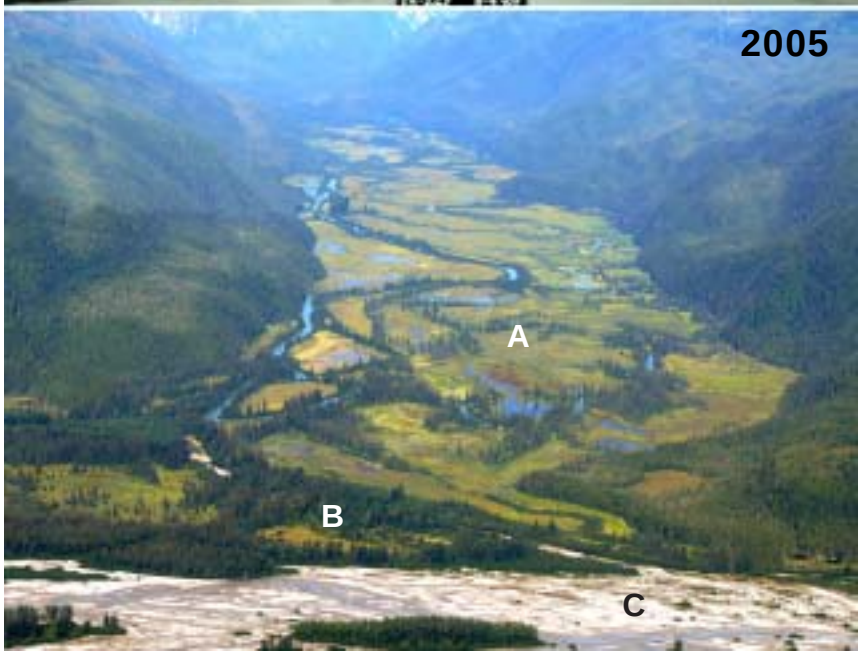
In 2001, we cored trees in the young stand at "B" just north of downtown Angoon that was apparently logged around 1940. Oddly, that area shows a smooth canopy even in the 1926 shot, indicating a young-growth stand. If it was already second growth in 1926 that could mean this is one of the rare Southeast examples of a "third-growth" forest. There was clearcut logging on nearby Killisnoo Island in 1850 and 1880. If the downtown stand was also first cut in, say, 1880, that would have made it about 46 years old in 1926. At re-entry time in 1940, it would have been a limby but fairly high volume forest, much like the one that exists there now.

Compare the island at "C" in 1926 and 2005. Trees here are colonizing uplift surfaces. The spruces on the point just in front of this island have also extended outward, and are taller and fuller-canopied.

As at Pybus Bay (ob07003, p. 21), our repeat photography suggests higher rates of rebound than are shown on current maps of uplift rates (Larsen et. a.l., 2005). In addition to the changes shown on this photo, there are other, more extensive uplift-type meadows at the mouth of Hood Bay, just south of Angoon.

RP ID# ob8001

location: Berners River mouth
re-take date: 20050811
observers: RC, JS, MS
photo source: Geometronics, USFS
date: 19290804
photographer: US Navy
ID# FS-Z62
subject: marshy river, forested levees
re-take photographer: Richard Carstensen
time: 1220
elev: ~2000 feet
bearing: 345°
GPS N: 58.84^{o} **W:** 134.97^{o}
camera: Panasonic 4M DMC FZ10 35-420mm
lens: 85mm
spd/f-stop: 1/500 f4.6
e com: 0



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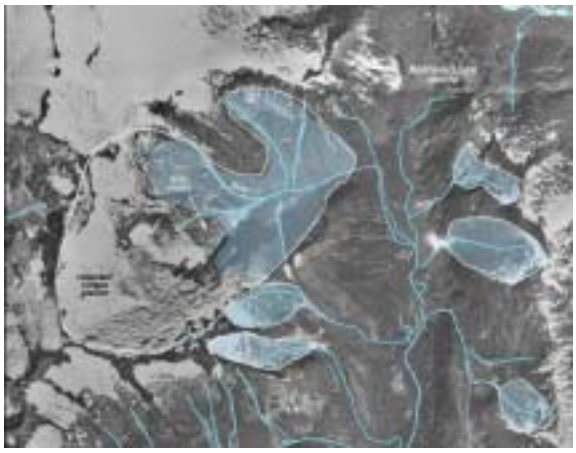
In contrast to their active glacial neighbors the Lace and Gilkey Rivers, the Berners and Antler (next photo pair) Rivers are relatively sedate streams meandering through marshy floodplains. However, the patterns of vegetation in their valleys retain the memory of their more raucous glacial histories. Both rivers were once actively aggrading, silt-laden torrents that braided and rebraided themselves across their own floodplains.

During the Little Ice Age, perhaps 6 to 8 of the small cirques cin the Berners headwaters north of Lionshead Mountain contained glaciers that delivered sediment into the Berner's River. Now only the 2 largest of these–both northeast-facing and with "dirty" snouts typical of wasting ice–still contribute sediment. In the orthophoto below, the little Ice Age extents of these cirque glaciers are indicated with a blue tint.



Comparison of the 1929 and 2005 shots above shows remarkable "stability" in the Berner's floodplain. Probably the headwater glaciers had retreated high up into their cirques by 1929. In both views, fine sediments result in sedge marshes from wall to wall, with forests only on the raised levees bracketing the old channels.Although not apparent at this distance, beavers are certainly a factor in the movement of water through these marshes.

At A and B there has been minor spruce colonization, but for the most part the low-gradient floodplain is too poorly drained to support rapid tree growth. Point C is on the Lace River. Comparing this reach in 29 and 05, there seems to have been scattered colonization on bar islands. Bar vegetation does not necessarily indicate reduced sediment delivery because this reach is slowly being removed from tidal elevations by glacial rebound; channels have probably adjusted by downcutting.

RP ID# ob8006

location: Antler River mouth
re-take date: 20050811
observers: RC, JS, MS
photo source: Geometronics, USFS
date: 19290804
photographer: US Navy
ID# FS-Z59
subject: end of aggradation
re-take photographer: Richard Carstensen
time: 1223
elev: ~2000 feet
bearing: 47°
GPS N: 58.83^{o} **W:** 134.84^{o}
camera: Panasonic 4M DMC FZ10 35-420mm
lens: 35mm
spd/f-stop: 1/160 f4
e com: 0

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The Antler River is intermediate in successional status between the marshy, entrenched Berners and the barren, aggrading Lace and Gilkey (and Katzehin, see following page).

It's clear from the Navy photo that in 1929 the Antler was receiving a much greater glacial contribution than it is today. Braided channels in the foreground and middle distance testify to its aggrading nature. This raw alluvium is the output of the Bucher "spillover glacier" that in 1929 occupied the place of today's Antler Lake. The lake now serves as a sediment trap, and although the Antler River is somewhat more turbid than the Berners (compare water color in the 2005 shots) its bedload is much reduced.

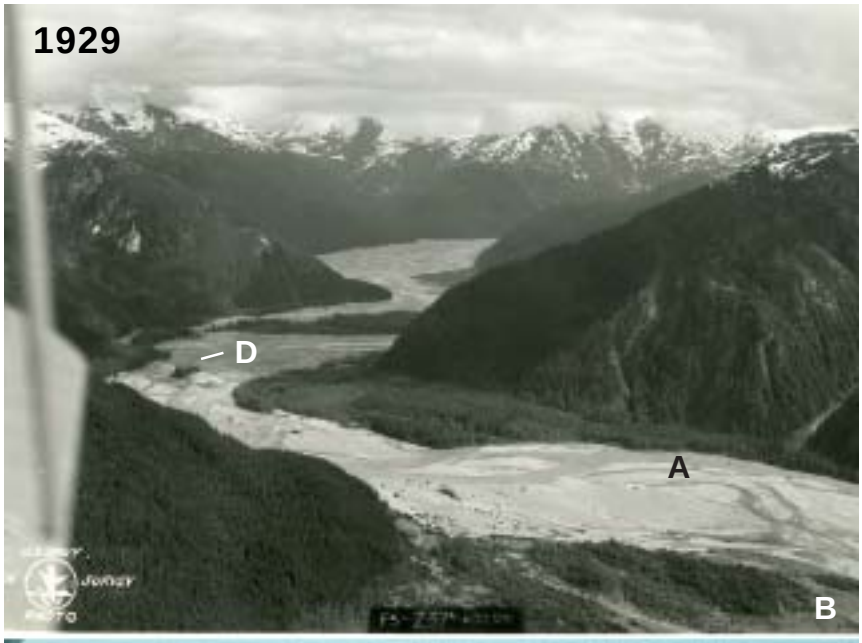
The Antler's raw main channel today has grown in with alder/willow thickets and–in the least-often flooded higher spots–a few stringers of cottonwood. The overflow channel (B) was active in 1929 but today contains clear water, runoff from upland slopes. Scrub/shrub communities have colonized the channel fringes here as well.

On the floodplain margins in both 1929 and 2005, sedgey palustrine wetlands resemble those that dominate the Berner's floodplain; their levee patterns suggest that the outwash from the Antler was once even greater.

These photos show the expansion of valuable wildlife habitats across what was once raw glacial outwash. Alder/willow thickets such as those that have colonized the old outwash channels provide nest sites, cover, and forage for neotropical migrant birds, and adjacent wet meadows and freshwater marshes (formed in areas where alluvial silt deposits create poorly-drained soils) support water birds, moose, and beaver. Rivers and side channels provide excellent spawning and rearing habitat for salmonids - and, consequently, excellent feeding habitat for bears. The presence of so much of this valuable habitat, shaped by the ebb and flow of glaciers, makes Berners Bay a site of phenomenal productivity.

RP ID# ob8018

location: Katzehin River mouth
re-take date: 20050811
observers: RC, JS, MS
photo source: Geometronics, USFS
date: 19290622
photographer: US Navy
ID# FS-Z-37a
subject: aggrading river, raw outwash
re-take photographer: Richard Carstensen
time: 1210
elev: ~3000 feet
bearing: 20°
GPS N: 59.18^{o} **W:** 135.30^{o}
camera: Minolta 8.0M Dimage A2 28-200mm
lens: 75mm
spd/f-stop: 1/250 f6.3
e com: 0



USDA Forest Service, Geometronics

The Katzehin River is fed by the enormous Meade Glacier that drains a region of the Juneau Icefield nearly equal to that of the Taku Glacier. At the peak of the Little Ice Age it may have extended nearly into the far bend shown in the 1929 Navy shot. The bedrock, although largely unmapped, appears to be mostly granitic. The combination of relatively sterile, acidic parent rock and aggrading, constantly migrating channels makes this one of the least vegetated floodplains in Southeast. Recent bird surveys on the mainland rivers by Jim Johnson of USFWS and Bob Christensen of SEAWEAD found relatively low nesting densities for most songbird species on the Katzehin. It was also felt not to be an important connecting corridor with interior populations; the sprawling Meade Glacier in the Katzehin headwaters is not inviting to passerines.

Our re-take is to the right of the original so it takes a moment to match up corresponding features. Note the relative positions of A and B on the two shots.

The most obvious changes to vegetation in this photo pair are at these points A and B near the river mouth. In this tidally-affected reach glacial rebound has elevated river bars above extreme high water while the river has degraded downward into its channel, allowing colonization by decidous forest. Examination of 1979 photos indicates that almost all of the forest invasion at A has occurred in the past 20 years.

Note the depositional bar in the immediate foreground of the 1929 shot (B). This bar lay just above the reach of tidewater in 1929. At the time, it was covered with uplift meadow vegetation being invaded by colonizing spruce trees. By 2005, the spruce have continued their march toward the sea, all but engulfing the former meadow.

Upriver beyond the extent of tides, continued aggradation has not permitted much colonization of river bars, nor has it allowed the development of the kind of rich sedge wetland/scrub mosaic that is characteristic of the more “settled” Antler and Berners Rivers (see previous two pages).

Notice also the spruces on the bar island at D, which have remained little changed over 76 years.

Future Directions

This project was, by its nature, driven less by investigation of specific vegetational phenomena than by exploration of the possibilities and values of repeat photography in Southeast Alaska - therefore we were free to choose the best and most intriguing photographs, covering a broad range of disturbance types. The result is a "sampler" of repeat photos rather than an in-depth look at any single phenomenon.

Nevertheless, as we explored our images, certain patterns, questions, and ideas emerged.

Exploring Neoglacial Climate Change

Our repeats of Donald Lawrence's photos on Mt. Roberts (g09018 shown above) show a dramatic increase in brush within subalpine areas once dominated by meadow vegetation. With increasing global realization of the reality and impacts of climate change, these sites will be valuable monitoring stations. It would be good to search for and include additional subalpine/alpine sites to expand this effort. One set of possibilities is a collection of boundary survey photos taken in the late 1800s and in possession of the Klondike Gold Rush National Historical Park. These photos are beautifully detailed, and their photopoints, while not documented on maps that we know of, should be easy to re-locate. In addition, several of the US Navy's 1926 and 1929 oblique aerials show subalpine areas.

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Exploring Uplift/Rebound and Alluvial Processes

Especially in northern Southeast Alaska, glacial rebound/tectonic uplift is a dramatic force of landscape change.Uplift creates unique, ephemeral habitats that are still not well-understood. In the Berners Bay and Katzehin rivers, our repeat photos show how uplift has combined with glacial retreat and alluvial processes to shape meadow, brush, and forest habitats. It would be interesting to extend the investigation to include documentation of change in areas where rebound rates are thought to be minimal or nil; perhaps the Stikine (above) or Speel Rivers for which we have very good aerial oblique coverage.

Investigating Fire History

Some of the most fascinating explorations we did during the course of this project involved the unraveling of forest fire history in northern Southeast, using historical photos. Southeast Alaska is not generally considered a fire-prone area, but our historical photos showed evidence of a number of very extensive fires dating back to the late 1800s. Although much more work is needed, our initial repeat photos suggest some intriguing vegetational responses to fire. We have only just scratched the surface of historical photo possibilities for this subject as well; there are many more sources to draw from.

Public Education

In the course of this project, we shared our information both formally and informally with a number of groups and individuals. In most cases, people were intrigued by the project and the process, and captivated by the results. Our repeat pairs invited careful observation and sparked lively discussion about how human and natural disturbances shape vegetation.

We are intrigued by the

possibilities of the internet in sharing the results of our project, and will continue to work on refining the web-based presentation. As an extension, it would be interesting to foster a "repeat photography network" to allow amateur photo-hunters to share and discuss their work.

Repeat photography is also well-suited to youth education, either as part of presentations for younger students or as hands-on projects for small groups of older students. It is also a powerful interpretive tool - either in static exhibits such as interpretive signs, or in presentations.

Extending Aerial Oblique Coverage

We have catalogued nearly 200 beautiful aerial oblique photos from the US Navy's flights in our potential photos database. A systematic effort to re-take these photos could provide a wealth of information about the lingering signatures of landslides, fires, early logging, rebound/uplift, and other phenomena (see examples on this page). Although air time is expensive, in some areas as many as 15 repeat photos could be taken in a two-hour flight. It could require many days to retake as many ground-based historical photos.

ob07038: clearcuts just south of Angoon on Admiralty Island. This was not one of the Admiralty photos we re-took, but it would be an excellent one to re-take in the future, as it is a relatively low-elevation view of early clearcuts.

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ob09038: A mysterious scar on a mountainside near Slocaum Inlet at the mouth of the Taku River. Vegetation texture is varied. Was it fIre? A series of mass wasting events? A repeat photo, plus some ground work, would provide clues.

ob07017: A recent landslide on Admiralty Island. These mass-wasting events are a common initiator of primary succession on steep, wooded slopes in Southeast Alaska. They are visible in several of the Navy aerial obliques.

USDA Forest Service, Geometronics

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