

Gallery Guide

Losing a Legacy: A photographic story of disappearing glaciers

Jan 29 – April 10, 2009

Hockaday Museum of Art

Kalispell, MT

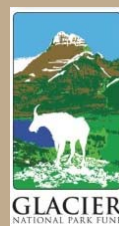
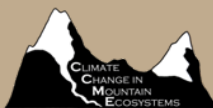


1913, W.C. Alden photo, GNP Archives



2005, B. Reardon photo, USGS

Dan Fagre & Lisa McKeon, USGS



This gallery guide is provided to help you, the visitor, further interpret and appreciate this collection of photographs. We hope this guide will enhance your visit. Additional information is available at the web link located at the end of the guide.

The following collection of repeat photographs of glaciers has been assembled and rephotographed by USGS scientists. The exhibit blends climate change research with landscape photography from Glacier National Park. Funding and cooperation was provided by the Hockaday Museum of Art, Glacier National Park Foundation, and Burlington Northern Santa Fe Railway.

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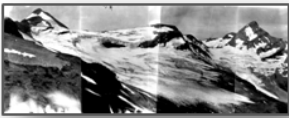
Photographs and panels were printed by Lee Kozlowski of Digital Planet and dry mounted by Jim Marjerrison of Glacier Frame Shop.



Agassiz Glacier

1913 - 2005

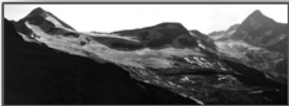
Agassiz Glacier was one of the largest glaciers in the park prior to 1917. In fact, during the colder, snowier period before 1850 this glacier had advanced down the valley and into the existing forest, bulldozing down trees and creating a “trimline”. During the drought between 1917 and 1941, this glacier retreated more quickly than others - more than 100 yards per year. This is partly due to the downward sloping bedrock underlying Agassiz Glacier and the relative thinness of the glacier ice, both of which contributed to faster melting and retreat. Agassiz Glacier now covers about 296 acres.



Blackfoot – Jackson Glacier

1914 - 2001

Blackfoot Glacier is the largest glacier in the park and the glacier where some impressive glacial features such as ice cliffs with blue color and large crevasses (i.e. cracks in the glacier ice up to 30 feet wide and 200 feet long) are still visible. Blackfoot and Jackson Glaciers were once joined as a single large glacier, but have split in two as the ice has retreated upwards toward the summits. Now, each glacier is in its own basin. A computer model of the effects of climate change on these two glaciers shows that they will be gone by 2030. Recent data suggests the glaciers are melting even faster than the model predicts and, at present rates, they will melt by around 2020. In the summer of 2007, a large part of Blackfoot Glacier collapsed and cascaded down the mountain as an ice avalanche.



Boulder Glacier, ice cave

1932 - 1988

This is one of the earliest photographs repeated from Glacier Park that show the disappearance of glacier ice and helped to start the current Repeat Photography Project. The 1932 photograph shows a guide, wearing chaps, and three clients next to the ice cave. This was one of the popular routes during the hey day of horseback trips through the park and underscores the charisma that glaciers had for early park visitors. The 1988 photo not only shows a completely ice-free view 56 years later, but shows how vegetation has moved in to the area vacated by the glacier. Boulder Glacier is now about 14 acres and too small to be considered a viable glacier.

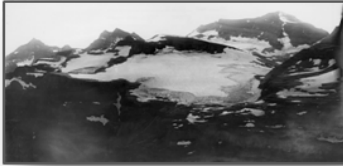




Boulder Glacier

1932 - 2005

This view of Boulder Glacier has a jumble of rocks in the foreground that appeared to be 6-10 feet tall. It took quite a bit of time to find the exact location for repeating the photograph, in part because the rocks are only 1-2 feet tall! This anecdote illustrates some of the challenges in relocating photo points even with a good photo in hand. The 1932 photograph shows the ice cave (center right) that was featured in another exhibit photograph with several people at the ice cave mouth (1932/1988 pair). In the 2005 photograph, what remains of Boulder Glacier is tucked under the shadow of the cliff at the skyline of Boulder Peak.



Boulder Glacier

circa 1910 - 2007

This view of Boulder Glacier was taken from a ridge above Hole-in-the-Wall that connects to a spur ridge from Chapman Peak. The 1910 photograph indicates that this area is just coming out of the grip of the "Little Ice Age," a 400-year period of below average temperatures and above average snowfall that increased the size of the glaciers. The glacier actually extended to the right and over Boulder Pass in 1910. A very different view is evident in 2007. If you hike over Boulder Pass today you pass beneath and between several sets of moraines that indicate where the glacier used to be.



Chaney Glacier

1911 - 2005

The 1911 photograph shows glacier ice extending all the way down slope to the valley whereas Chaney is now confined to a small patch below the ridge in the 2005 photograph. Chaney is now about 87 acres in size. Note the small group of dark vegetation patches on the slope to the left of the glacier. These "krummholz" patches of subalpine fir have not changed much in 90 years and are likely hundreds of years old.





Chaney Glacier

1911 - 2005

This photograph pair clearly shows how the glacier has shrunk in area and also in thickness. In 1911, the glacier ice covered the band of cliffs and nearly reached the summit on the right.



Grinnell Glacier

1911 - 2008

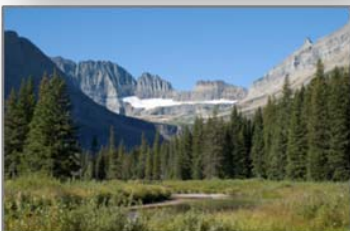
The 1911 photo shows Grinnell Glacier poised at the top of the waterfalls in the foreground and joined with what is now called Salamander Glacier in the background. Grinnell described this wall of ice as being 1,000 feet high in 1887. As of 2008, that wall of ice is gone and Grinnell Glacier is not even visible in the contemporary photograph. Instead, it is behind the buff-colored ridge just above the waterfalls. Salamander Glacier lies along the Garden Wall below the ridgeline. This glacier is thinning in the middle so rapidly that it will probably be in two pieces within a few years. To the upper left is the small, rounded glacier, Gem Glacier, that until recently had not shown signs of retreat. It, too, is now becoming smaller.



Grinnell Glacier

1887 - 2008

The 1887 photo is by Lt. Beacon who accompanied George Bird Grinnell on his first exploration of the glacier. Beacon is credited with the suggestion to name the glacier after Grinnell. The 1887 scene is snowy and cold despite the fact that the exploration took part during summer. Trees are slowly encroaching on this view and will likely obscure it in another decade.





Grinnell Glacier **1914 – 1938 - 2008**

This series shows when Grinnell and Salamander separated as glacial ice continued to melt during a prolonged dry and hot period from 1917-1941. Many of the park's glaciers experienced sharp reductions in size and tree-ring studies indicate that this was one of the larger local droughts in over 400 years.



Grinnell Glacier **circa 1911 - 2008**

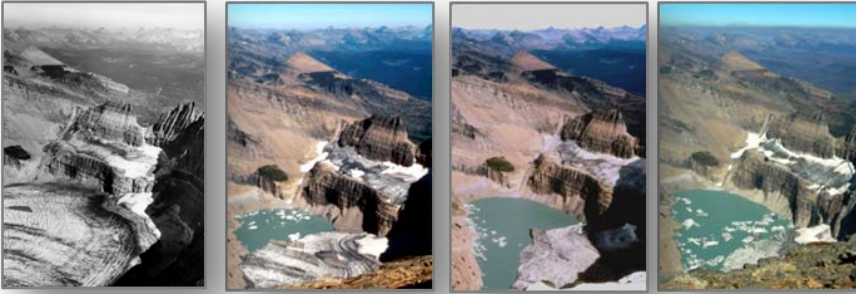
Around the time Glacier National Park was established, the historic photo shows a group of women admiring Grinnell Glacier from the shore of Lake Josephine. Contemporary views from this spot differ greatly as Grinnell Glacier has receded, leaving only the Salamander visible from this perspective. This photograph indicates that glaciers were attractive to tourists a century ago and the photographers hired to promote this area often included glaciers in their scenes.



Grinnell Glacier **circa 1940 - 2006**

This overlook is accessed by a spur trail off the Highline trail in the vicinity of Granite Park and shows the degree to which Grinnell Glacier has receded. It also offers a view of Salamander Glacier on its shelf (right foreground) and the miniature meltwater lake that has formed as a result of accelerated melting.





Grinnell Glacier
1938 – 1981 – 1998 - 2006

This series offers a different perspective on Grinnell Glacier by highlighting the creation and growth of the meltwater lake in front of the glacier. It is also clear that the glacier has thinned with the ice surface elevation lowering hundreds of feet by 2006. The relative sensitivity of glaciers to climate change is illustrated by the dramatic recession of Grinnell Glacier while surrounding vegetation patterns remain stable.



Grinnell Glacier
1920 - 2008

The 1920 photo shows National Park Service Director, Steven Mather, on Piatt Path near present day Grinnell Glacier Overlook. Darren Pfeifle strikes a similar pose in the 2008 repeat photograph.



Grinnell Glacier
1922 - 2008

This striking pair of photographs gives a sense for the mass of ice that used to exist. Small human figures are visible on the right side of the 1922 photograph walking up the glacier. The brighter patch in the rear of the photograph is snow from the previous winter. The crevasses and striations of exposed glacier ice take up the foreground.



Grinnell Party on Grinnell Glacier
unknown date

This photo, taken from a similar perspective as the 1922/2008 pair above, shows a hiking party on the north end of Grinnell Glacier where today open water exists. On the far right is the party's guide, Hans Reiss (brother of artist W. Reiss) and next to him, George Bird Grinnell, for whom the glacier is named.



Grinnell Glacier

1924 - 2008

The rock in the foreground of the 1924 photograph is balanced on an ice pedestal that eventually melted and probably sent the rock sliding downslope. We searched for the rock but it is likely in the lake now. The glacier ice (coming in from the right) is covered with rock debris from rocks falling off the cliff, embedding in the ice, and being carried along with the creeping ice. The moraine (i.e. rock debris piled up by the glacier) is on the left. In the 2008 photograph, vegetation is now growing on the moraine, the glacier is gone, and only icebergs from the receding glacier are floating in the Upper Grinnell Lake.



Grinnell Glacier

1926 - 2008

This large boulder was used by Morton Elrod and other scientists as a baseline to measure the retreat of Grinnell Glacier's terminus. It is now referred to as "Elrod's Rock," and the glacier's terminus is no longer visible from this point.



Grinnell Glacier

1920 - 2008

This pair of photographs from Grinnell Glacier's southeast edge shows the dramatic change in the glacier's volume and area. Note the glacier's depth along the headwall and its extent at the terminal moraine in the historic photograph.





Piegan Glacier circa 1930 - 1998

In the photograph pairs of Piegan Glacier there are two changes. The broad crowns of the whitebark pine (center of 1930 photograph) are missing in the modern photograph because they were killed by blister rust, an exotic pathogen. However, the subalpine fir trees have grown vigorously and encroached on the subalpine meadow, a valuable habitat for wildlife. This example illustrates that repeat photography is a potent tool for documenting other types of changes to mountain ecosystems over time. Piegan Glacier has recently become smaller and is now about 61 acres.



Shepard Glacier 1913 - 2005

This photograph pair illustrates one of the more dramatic cases of disappearing glaciers. In the 1913 photograph, thick ice is evident along the bottom lobe of the glacier and extensive crevasses are present on the upper section, indicating the glacier is flowing and has significant mass. By 2005, however, the contemporary photograph shows no ice on the bottom shelf, a small meltwater pond (center) and virtually no ice (two debris covered patches left of center). Shepard Glacier is now below 25 acres and isn't a viable glacier anymore.



Sperry Glacier 1913 - 2008

In 1913, Sperry Glacier's mass spanned across the entire basin and the glacier's terminus was recorded to be over 150 ft. tall. Contemporary images show how the glacier has receded and separated into fragments.





Sperry Glacier circa 1930 - 2008

Repeating Elrod's photograph from the same photo point was impossible since the historic photograph was shot from the elevated perspective of the glacier's surface. The terminus of the glacier has retreated beyond the field of view, but these images give a sense of the glacier's extent and mass early in the 20th century.



Sperry Glacier 1907 - 2001

The northwest portion of Sperry Glacier once spanned Comeau Pass to the base of Edwards Mountain. Sperry Glacier has recently been shrinking at 3-4 times the rate that it did in the 1950s and 1960s. Sperry is now approximately 207 acres.



Sperry Glacier 1913 - 2007

This view of the northeast portion of Sperry Glacier shows evidence of the glacier's recession as well as the advancement of conifer species and other vegetation on the glacial moraines. Although melting glaciers are the most visible and direct indication of climate change in the mountains, the entire mountain ecosystem also is responding. Using both repeat photography and tree-ring studies, we have documented that trees are growing faster, becoming taller and filling in the spaces with adjacent trees. Young tree seedlings have established and are surviving in areas where deep snowpacks and harsh weather conditions had previously excluded them. These changes are evident in the paired photographs and are representative of high-elevation forest changes occurring elsewhere in the park.

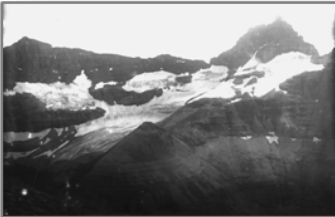




Swiftcurrent Glacier

circa 1900 - 1998

Swiftcurrent Glacier has recently separated into two smaller glaciers. This usually accelerates the rate at which both disappear. Swiftcurrent Glacier is one of the glaciers being monitored with daily photos to track how snow accumulates and melts over the course of a year. This helps us understand the role of topographic shading or wind redistribution of snow in the overall changes to the glacier.



Thunderbird Glacier

1907 - 2007

This photo pair represents a century of glacier change. Thunderbird Glacier is now made up of numerous patches of ice and, when closely examined, this 2007 photo reveals a number of cliff bands that were covered by ice in 1907. Also, the corner of a tiny lake is just visible in the 2007 photograph. Acquiring the contemporary photograph involved some serious scrambling on cliffs and made us admire Morton Elrod, the original photographer, who carried much heavier and bulkier gear over the same terrain! Thunderbird Glacier is 63 acres but will probably disappear within a few years now that it is reduced to a collection of ice patches.



Glaciers

Glacier National Park, MT



Legend
Glaciers/Perm. Snowfields



0 3 6 12 18 24 Miles

map by Dan Kotter, GNP

Acknowledgements

The USGS would like to recognize the many people who have contributed to the Repeat Photography Project: Carl Key, Jerry DeSanto, Karen Holzer, Blase Reardon, Greg Pederson, Lindsey Bengtson, Chris Miller, Deirdre Shaw, Ann Fagre, Ali White, Kim Corette, Mark Fritch, Donna McRea , Suzanna Carrithers, Dan Kotter, Richard Menicke, Jean Tabbert, Joe Giersch, George McFarland, Rick Yates, Brian, Maggie and Eloise McKeon, and any others we may have inadvertently overlooked

Special thanks to the exhibition sponsors
Hockaday Museum of Art
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Burlington Northern Santa Fe Railway



Hileman collection, GNP Archives

Visit our website to download the images displayed in this exhibit
and to learn more about the Repeat Photography Project

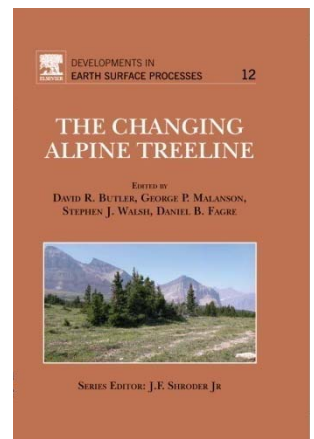
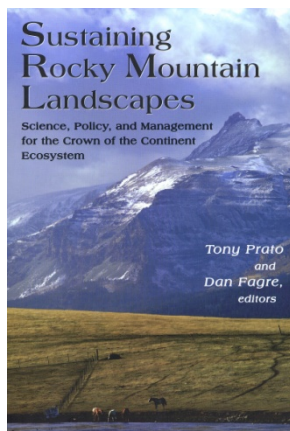
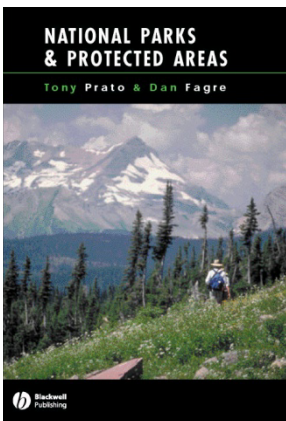
<http://nrmsc.usgs.gov/repeatphoto/>

Dan Fagre



Dr. Dan Fagre is Research Ecologist for the Northern Rocky Mountain Science Center of the U.S. Geological Survey and Director of the Climate Change in Mountain Ecosystems Project. He is stationed at Glacier National Park, Montana and is a faculty affiliate at the University of Montana, Montana State University, University of Missouri-Columbia, University of Arizona and several other universities. He's worked for the past 18 years with many staff, partners and collaborators in the Northern Rockies to understand how global-scale environmental changes will affect our mountain ecosystems. His diverse research programs have addressed glaciers, avalanches, amphibians, alpine plants, paleoclimates, snow chemistry, and ecosystem dynamics. He has particularly enjoyed incorporating his life-long passion for photography into his research and feels that better use of photography is critical to effectively communicating scientific findings. This exhibit on repeat photography is a convergence of many of his interests.

Dan received his Ph.D. from the University of California, Davis, and has held positions in universities and several federal agencies. He helped establish the Western Mountain Initiative, a program to tie mountain science across different areas, and is active in several international science networks that address mountain issues. He served on the Montana Governor's Advisory Board for Climate Change, and recently was lead author for a commissioned report to the President and Congress through the U.S. Climate Change Science Program. He received the Director's Award for Natural Resource Research from the National Park Service and a National Special Service award from the USGS Director. He is an author on more than 120 publications and has co-published three books recently.



Lisa McKeon



Lisa McKeon, a Flathead Valley native, has been employed as a Physical Scientist for the USGS Climate Change in Mountain Ecosystems (CCME) program since 1997. She has worked on the Repeat Photography Project since its inception and has been astounded by the interest these images have garnered over the past twelve years. During those years Lisa has perused hundreds of archival photographs, hiked many backcountry miles in search of the correct photo point, and cataloged every repeat photograph taken by the USGS researchers as well as the original archival photographs from the early 20th century. Responding to the demand for repeat photographs of the receding glaciers, Lisa created the current website that allows the public to download images for their own use. The diverse uses to which these photos have lent themselves have surprised her as much as the rate at which she has seen glacial retreat over her own life time. Whether taking precision measurements of glacier margins, or challenging herself with the new experience of creating an art exhibit, Lisa enjoys her participation in climate change research in the mountains she's always considered home.

In addition to her work with the Repeat Photography Project, Lisa has been involved in many facets of the CCME program. She has maintained remote weather stations, conducted snow surveys, monitored UV radiation, surveyed amphibian populations, created graphic resources and outreach materials, designed the CCME website, and managed a large archival database of photographs. Lisa and her husband, Brian, make their home in West Glacier where they enjoy the beauty and wildness of Glacier National Park with their two young daughters.