# Agassiz Glacier
## Glacier National Park, MT

**1913**

*W. C. Alden photo*
*courtesy of GNP archives*

**2005**

*Greg Pederson photo*
*USGS*

# Agassiz Glacier
## Glacier National Park, MT

**1943**

*M. V. Walker photo*
*courtesy of GNP archives*

**2005**

*Greg Pederson photo*
*USGS*

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Climate Change in Mountain Ecosystems

# Blackfoot – Jackson Glacier

## Glacier National Park, MT

1914


*E. C. Stebinger photo courtesy of GNP archives*

2009


*Lisa McKeon photo USGS*

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# Blackfoot and Jackson Glaciers
## Glacier National Park, MT

**1911**

*EC Stebinger photo*
*GNP Archives*

**2009**

*Lisa McKeon photo*
*USGS*

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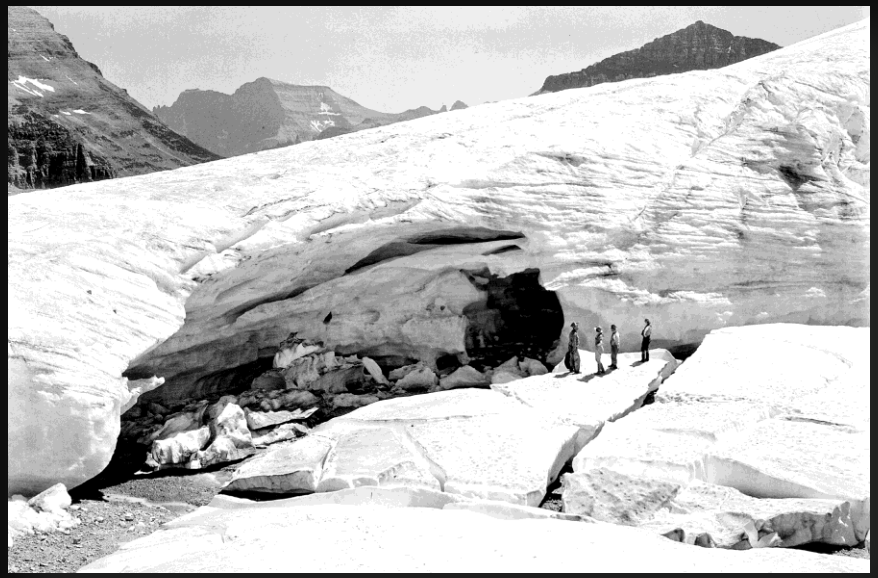
# Boulder Glacier
## Glacier National Park, MT



**1932**

*T. J. Hileman photo*
*courtesy of GNP archives*

**1988**

*Jerry DeSanto photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

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# Boulder Glacier
## Glacier National Park, MT


**1932**

*T. J. Hileman photo*
*courtesy of GNP archives*

**2005**

*Greg Pederson photo*
*USGS*

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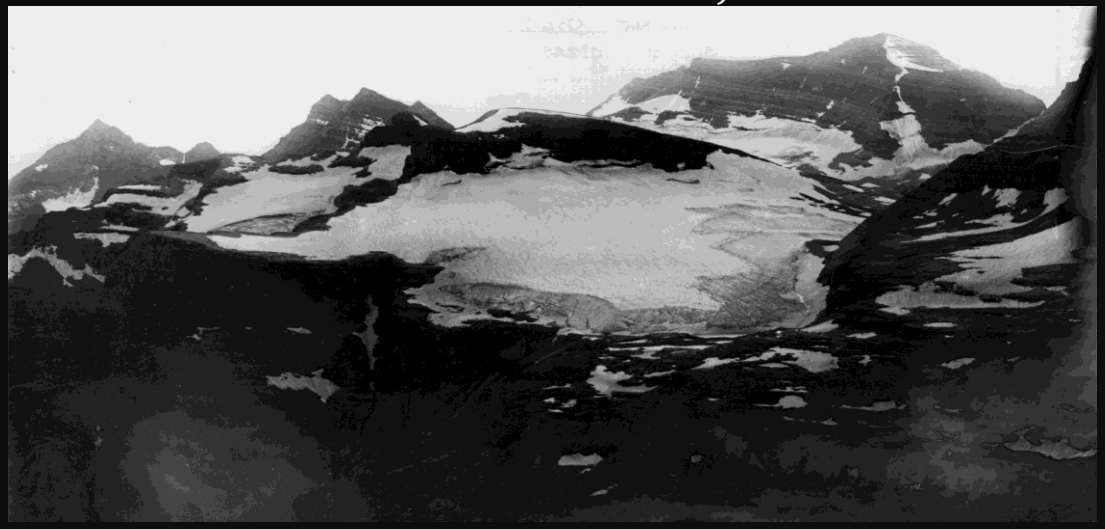
# Boulder Glacier

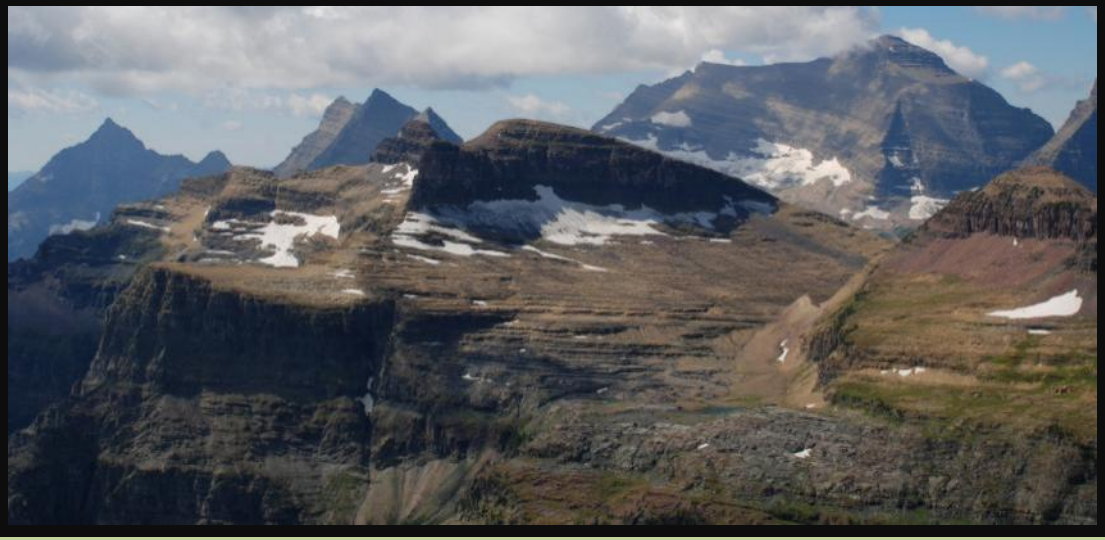
## Glacier National Park, MT

circa **1910**



*Morton Elrod photo*
*courtesy of GNP archives*

**2007**



*Fagre / Pederson photo*
*USGS*

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# Chaney Glacier
## Glacier National Park, MT

**1911**

*M.R. Campbell photo*
*USGS Photographic Library*

**2005**

*Blase Reardon photo*
*USGS*

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# Chaney Glacier
## Glacier National Park, MT

**1911**

*M.R. Campbell photo*
*USGS Photographic Library*

**2005**

*Blase Reardon photo*
*USGS*

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Climate Change in Mountain Ecosystems

# Clements Glacier
## Glacier National Park, MT

1914

*Elrod photo*
*GNP Archives*

2010

*Ralph Thornton photo*
*USGS*

*Clements Glacier displayed crevasses in 1914, but in 2010 it is merely a perennial ice mass. Each summer, thousands of visitors pass by the steep moraines sculpted by this glacier as they hike from Logan Pass to Hidden Lake Overlook. The trail is visible along the left side of the 2010 photo.*

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# Grant Glacier
## Glacier National Park, MT

**1902**

*Morton Elrod photo*
*courtesy of GNP Archives*

**1998**

*Karen Holzer photo*
*USGS*

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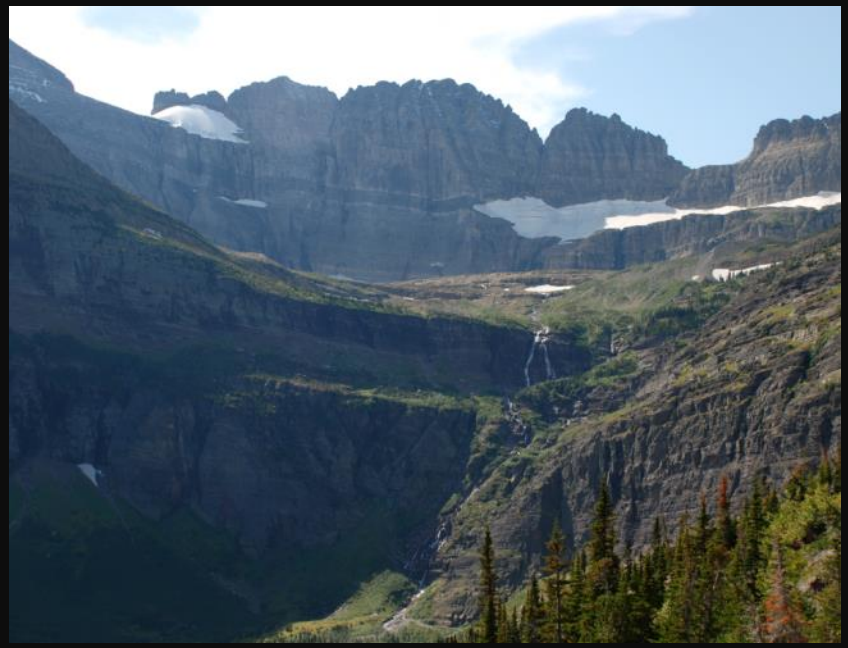
# Grinnell Glacier
## Glacier National Park, MT

**1900**

*F. E. Matthes photo courtesy of GNP Archives*



**2008**

*Lisa McKeon photo, USGS*

*In 1900 Grinnell Glacier's mass filled the cirque basin. This early photo shows the glacier's height along the headwall and how it was once joined the upper ice portion, now called The Salamander.*

# Grinnell Glacier
## Glacier National Park, MT

1910

*Fred Kiser photo courtesy of GNP Archives*

2008

*Lisa McKeon photo, USGS*

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# Grinnell Glacier
## Glacier National Park, MT

**1911**

*Stanton photo courtesy of GNP Archives*

**2008**

*Lisa McKeon photo, USGS*

*Nearly a century after Stanton's photograph was taken, Grinnell Glacier has receded Into it's cirque basin and is no longer visible from the trail above Grinnell Lake.*

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# Grinnell Glacier
## Glacier National Park, MT

**1887**

*Lieutenant Beacon*
*courtesy of GNP Archives*

**2008**

*Lisa McKeon photo, USGS*

*Among the earliest photos of Grinnell Glacier, this 1887 image shows the Immense extent and depth of the glacier at the turn of the 2oth century. The glacier has responded to temperature and precipitation in the past 100 years, resulting in it's obvious reduction in size.*

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# Grinnell Glacier
## Glacier National Park, MT

***circa 1920***

*T. J. Hileman photo*
*courtesy of GNP Archives*

**2008**

*Lisa McKeon photo, USGS*

*In addition to the change in the size of Grinnell Glacier, there is obvious change in the foreground streamside vegetation between these two images.*

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# Grinnell Glacier
## Glacier National Park, MT

**1914**

*Marble photo*
*courtesy GNP Archives*

**1938**

*T. J. Hileman photo*
*courtesy GNP Archives*

**2008**

*Lisa McKeon photo*
*USGS*

***Grinnell Glacier from the shore of Lake Josephine***

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# Grinnell Glacier

## Glacier National Park, MT

**1938**

*T. J. Hileman photo*
*Courtesy of GNP Archives*

**2009**

*Lindsey Bengtson photo*
*USGS*

***Oblique view of Grinnell Glacier taken from the summit of Mount Gould, Glacier National Park.***
*The relative sensitivity of glaciers to climate change is illustrated by the dramatic recession of Grinnell Glacier while surrounding vegetation patterns remain stable.*

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# Grinnell Glacier
## Glacier National Park, MT

**1938** *T. J. Hileman photo Courtesy of GNP Archives*

**1981** *Carl Key photo USGS*

**1998** *D. Fagre photo USGS*

**2009** *Lindsey Bengtson photo USGS*

***Oblique view of Grinnell Glacier taken from the summit of Mount Gould, Glacier National Park.***
*The relative sensitivity of glaciers to climate change is illustrated by the dramatic recession of Grinnell Glacier while surrounding vegetation patterns remain stable.*

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# Grinnell Glacier
## Glacier National Park, MT

circa **1940**

*Unknown photographer*
*Courtesy of GNP Archives*

**2006**

*Karen Holzer photo*
*USGS*

***Grinnell Glacier taken from the Grinnell Glacier Overlook off the Highline Trail, Glacier National Park.*** *The view of Grinnell Glacier taken circa 1940 shows the early formation of Upper Grinnell Lake, a proglacial lake visible at the terminus of the glacier. The 2006 photo shows a dramatic increase in the size of the lake as a result of melting ice.*

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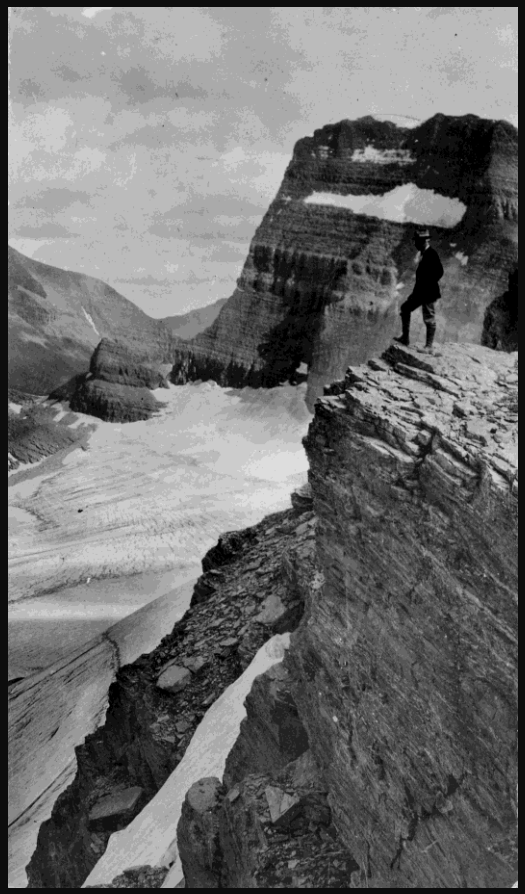
# Grinnell Glacier
## Glacier National Park, MT



**1920**

*Unknown photographer*
*Courtesy of NPS Historic Photograph Collection*
*Harpers Ferry Center*

**2008**

*Chris Miller photo*
*USGS*

*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.*

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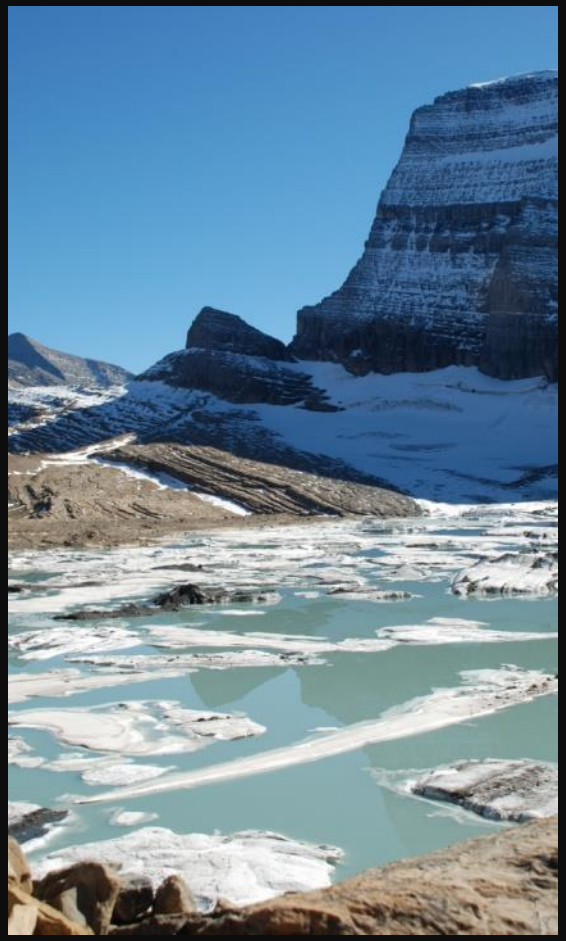
# Grinnell Glacier

## Glacier National Park, MT

**1922**

*Morton Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*



**2008**

*Lisa McKeon photo*
*USGS*

***View from north moraine of Grinnell Glacier***

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# Grinnell Glacier
## Glacier National Park, MT

**1924**

*Morton Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

**2008**

*Lisa McKeon photo*
*USGS*

***North moraine of Grinnell Glacier***
*In 1924 the glacier's ice margin was still in proximity to it's lateral moraine*

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# Grinnell Glacier
## Glacier National Park, MT

**1920**

*W. C. Alden photo*
*USGS Photographic Library*

**2008**

*Chris Miller photo, USGS*

*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 it's extent at the terminal moraine in the historic photograph.*

# Grinnell Glacier
## Glacier National Park, MT

**1924**

*Morton Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

**2008**

*Lisa McKeon photo*
*USGS*

***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.***

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# Grinnell Glacier
## Glacier National Park, MT

**1926**

*Morton Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

**2008**

*Lisa McKeon photo*
*USGS*

***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.***

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# Grinnell Glacier
## Glacier National Park, MT

***7-16-1936***

*W. C. Alden photo*
*USGS Photographic Library*

***8-26-2010***

*Dan Fagre photo, USGS*

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# Grinnell, Gem & Salamander Glaciers

## Glacier National Park, MT

**1910**

*M. Elrod photo*
*K. Ross Toole Archives*
*University of Montana*

**2012**

*Dan Fagre photo*
*USGS*

*In 1910, Morton Elrod documented how Grinnell Glacier's mass filled the basin and how the glacier was then joined with the ice apron we now call the Salamander (right). Close inspection of Gem Glacier (top-center) reveals a loss of thickness / volume over the past 112 years as well.*

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# Harrison Glacier
## Glacier National Park, MT

**1913** *W. C. Alden photo, USGS*

**2009** *Ralph Thornton, USGS photo*

*While difficult to quantify, this photo pair of Harrison Glacier exemplifies the loss of glacier volume. Comparison of the ice profile in the foreground of the photos shows a marked thinning of the glacier over the years,. Colorful layers of sedimentary bedrock are being exposed as the glacier recedes from the cliff bands.*

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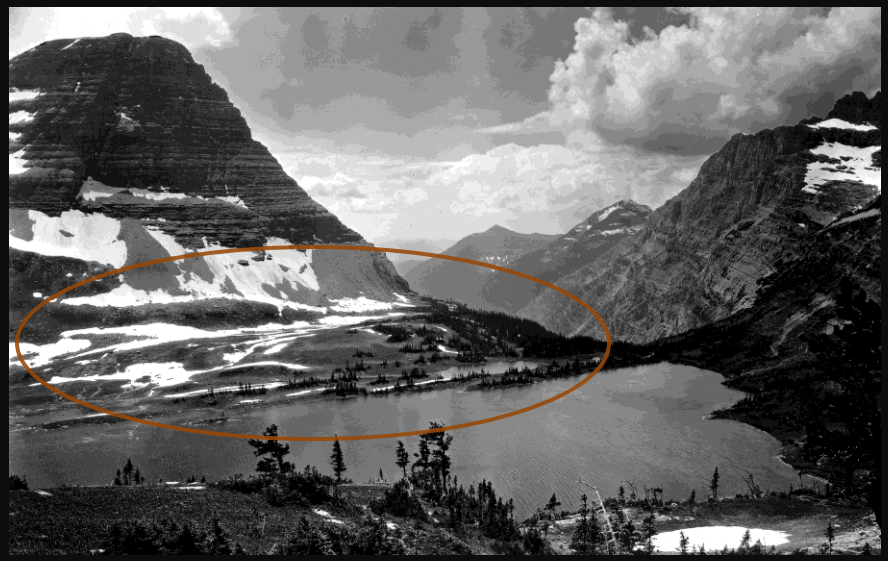
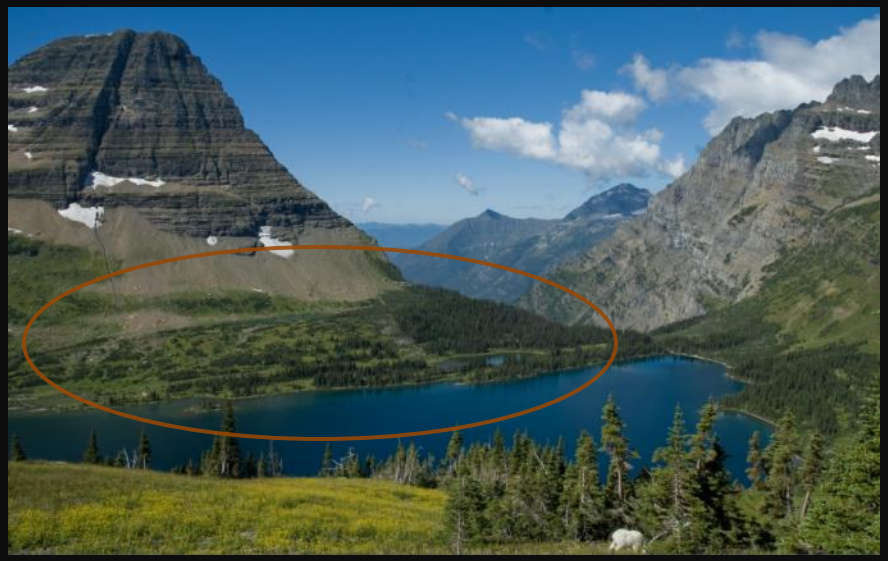
# Hidden Lake
## Glacier National Park, MT



circa **1930**

*TJ Hileman photo*
*GNP Archives*



**2009**

*Lisa McKeon photo*
*USGS*

*Alpine regions along the shores of Hidden Lake (1943 m) show tremendous expansion of vegetation in these photos, especially at the base of Bearhat Mountain (left).*

# Hidden Lake
## Glacier National Park, MT

circa **1930**

*TJ Hileman photo*
*GNP Archives*

**2009**

*Lindsey Bengtson photo*
*USGS*

Vegetation in-growth on the peninsula and surrounding lakeshore are evident in this pair of photos.

# Iceberg Glacier
## Glacier National Park, MT

circa 1940

*T. J. Hilemen photo*
*Courtesy of GNP archives*

2008

*Lisa McKeon photo USGS*

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# Jackson Glacier
## Glacier National Park, MT

**1911**

*M. Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

**2009**

*Lisa McKeon photo, USGS*

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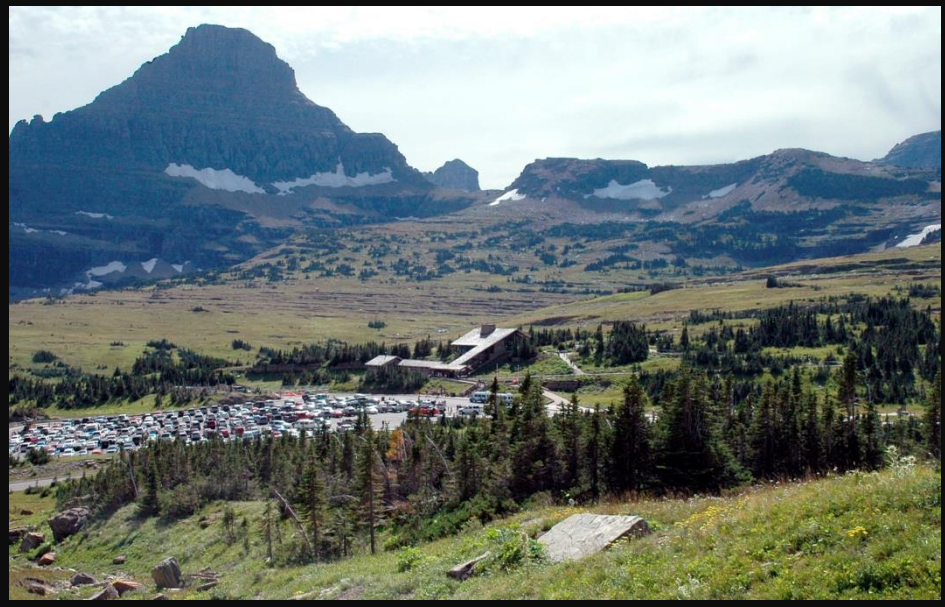
# Logan Pass
## Glacier National Park, MT

**1957**

*Unknown photographer*
*Courtesy of GNP archives*



**2009**

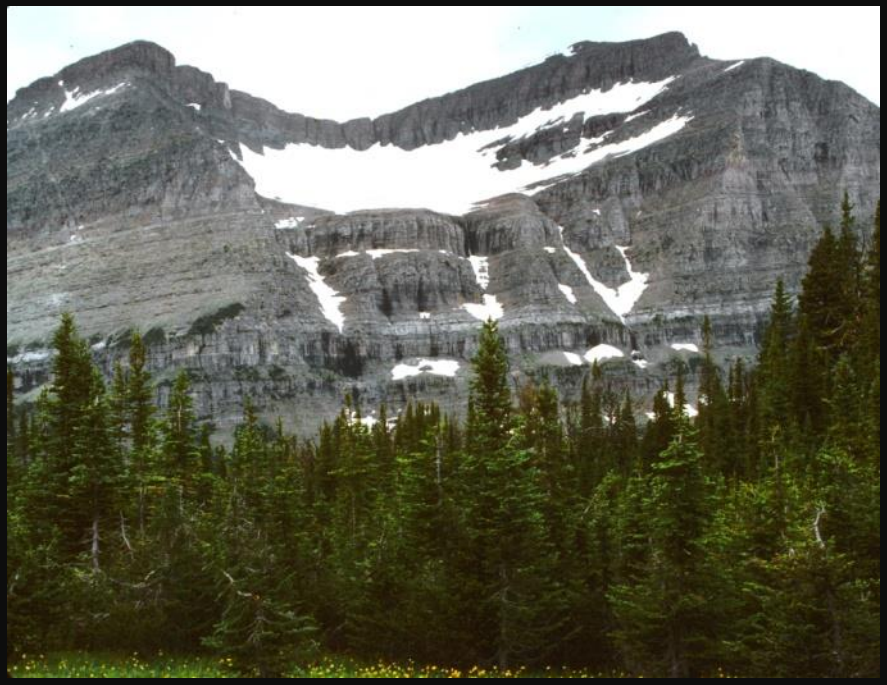
*Lisa McKeon photo*
*USGS*

***Establishment of new growth and expansion of existing sparse vegetation is obvious along the upper ridge line (center of photo).*** *Persistent snowpack in these alpine regions once deterred profusion of growth, but changing climate conditions have permitted these species to expand their range.*

# Piegan Glacier
## Glacier National Park, MT

circa **1930**

*George Ruhle photo*
*courtesy of GNP Archives*



**1998**

*Lisa McKeon photo*
*USGS*

***Piegan Glacier appears visibly unchanged in this pair, but the meadow in foreground has undergone significant vegetation change.***

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# Piegan Glacier
## Glacier National Park, MT

**1938**

*T. J. Hileman photo courtesy of GNP Archives*

**1998**

*Lisa McKeon photo USGS*

***View from Mount Siyeh***

*Piegan Glacier is one of the few glaciers in Glacier National Park that has not significantly changed since photographed in the 1930s.*

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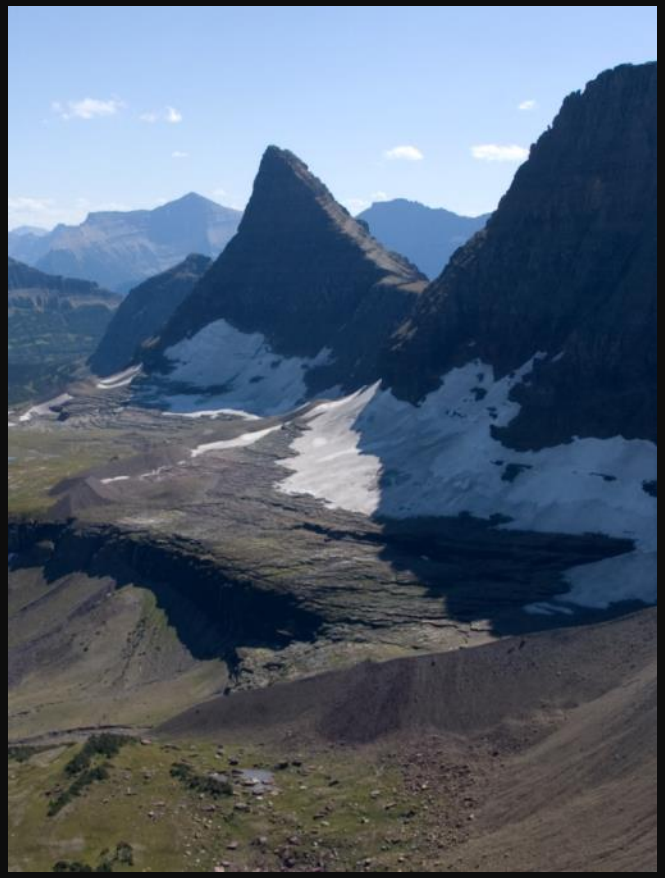
# Red Eagle and Logan Glaciers

## Glacier National Park, MT

**1914**

*EC Stebinger photo*
*GNP Archives*



**2009**

*Lisa McKeon photo*
*USGS*

*Although the 2009 photo location does not exactly match the historic photo station, a comparison of relative glacial coverage can still be made. Logan Glacier is in the foreground, while Red Eagle Glacier sits beneath the pyramidal peak that bears the same name.*

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# Sexton Glacier
## Glacier National Park, MT

**1901**

*Matthes photo*
*courtesy of GNP Archives*

**1998**

*Lisa McKeon photo*
*USGS*

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# Shepard Glacier
## Glacier National Park, MT

**1913**

*W. C. Alden photo*
*USGS Photographic Library*

**2005**

*Blase Reardon photo*
*USGS*

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# Sperry Glacier
## Glacier National Park, MT

**1913** *W. C. Alden photo, courtesy GNP Archives*

**2008** *Lisa McKeon photo, USGS*

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

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# Sperry Glacier
## Glacier National Park, MT

Circa **1930s**

*Marble photo*
*K. Ross Toole Archives*
*University of Montana*

**2009**

*Chris Miller photo, USGS*

*The expanse of Sperry Glacier that once greeted hikers facing NE on Comeau Pass is in stark contrast to the bedrock and vegetation that has since emerged as the ice retreated. The Marble image, most likely taken in the 1920s or early 1930s, was featured on a postcard with this caption: " Sperry Glacier from the river."*

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# Sperry Glacier
## Glacier National Park, MT

circa **1930**

*Morton Elrod photo*
*K. Ross Toole Archives*
*Mansfield Library, UM*

**2008**

*Lisa McKeon photo, USGS*

*Repeating Elrod's photograph from the same photo point was impossible since he 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.*

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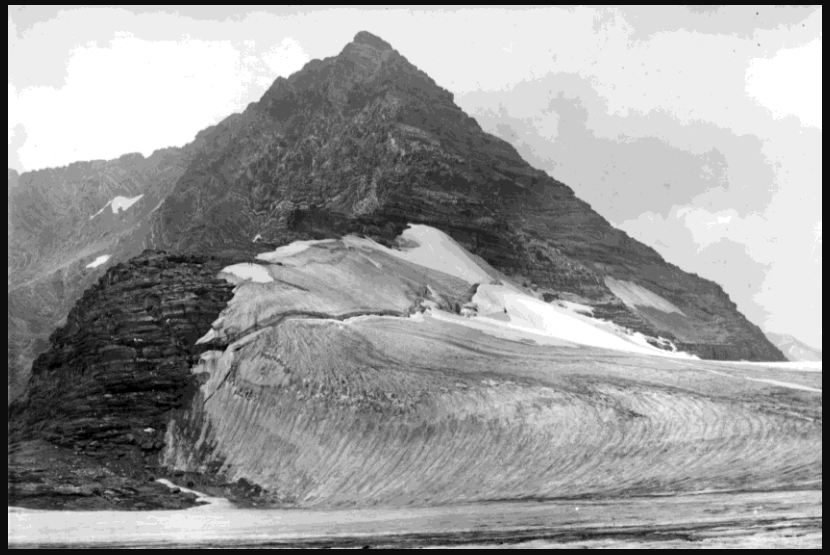
# Sperry Glacier
## Glacier National Park, MT



**1907**

*Morton Elrod photo*
*courtesy of GNP Archives*

**2001**

*Lisa McKeon photo*
*USGS*

***The northwest portion of Sperry Glacier once spanned Comeau Pass to the base of Edwards Mountain.***

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# Sperry Glacier – northeast view

## Glacier National Park, MT

**1913**

*Alden photo, courtesy of GNP Archives*
*Aug. 13, 1913*

**2007**

*Lisa McKeon photo, USGS*
*Sept. 15, 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.***

# Swiftcurrent Glacier
## Glacier National Park, MT

circa **1900**

*Matthes photo*
*courtesy of GNP Archives*

**1998**

*Karen Holzer photo*
*USGS*

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# Swiftcurrent Glacier
## Glacier National Park, MT

*circa* **1930**

*Unknown photographer*
*courtesy of GNP Archives*

**2002**

*Karen Holzer photo*
*USGS*

***View from Swiftcurrent Lookout***

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# Thunderbird Glacier
## Glacier National Park, MT

1907

*Morton Elrod photo courtesy of GNP Archives*

2007

*Dan Fagre / Greg Pederson photo USGS*

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