Glacier change

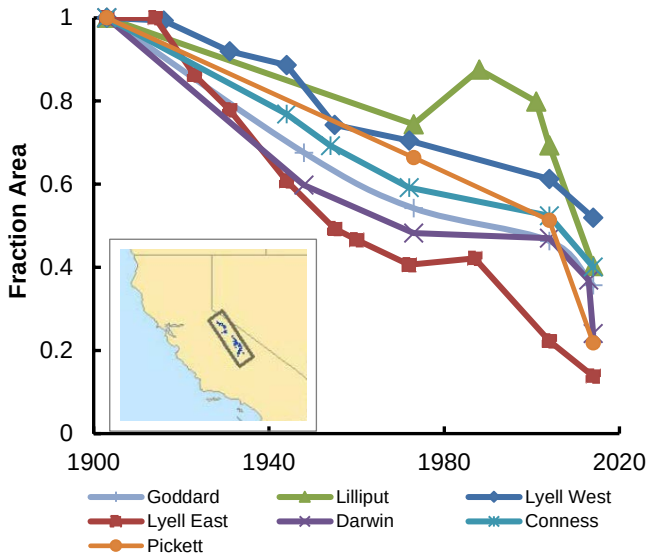
Glaciers in the Sierra Nevada have decreased dramatically in area since the beginning of the twentieth century.

Glaciers provide the most visible evidence of climate change. In California, most glaciers are found in the Sierra Nevada above 10,000 feet in elevation, from Yosemite National Park in the north to Sequoia National Park in the south. Between the early 1900s and 2014, some of the largest Sierra Nevada glaciers lost an average of 70 percent of their surface area.

Glaciers respond to the combination of winter snow and spring and summer temperatures. Glaciers gain mass from winter snowfall and lose mass (retreat) when warmer spring and summer temperatures melt ice and snow. Over the twentieth century, with few exceptions, alpine glaciers throughout the world have been retreating in response to a warming climate.

What does the indicator show?

The surface area of seven Sierra Nevada glaciers has decreased dramatically since the beginning of the twentieth century. The graph on the right shows the fraction of the area of these glaciers relative to the year 1903. These glaciers are among the largest at higher elevations for which data are available. In 2014, the size of these glaciers ranged from 14 to 52 percent of their 1903 area — a reduction of 48 to 86 percent. Historical photographs and field measurements were used to estimate the surface area of each glacier.



Source: Basagic and Fountain 2011 (updated 2017)

** Change relative to 1903*

The glacier retreat in the Sierra Nevada occurred during extended periods of above-average spring and summer temperatures. Winter snowfall appears to have been a less important factor.

The magnitude and rate of change in surface area are variable among the seven Sierra Nevada glaciers. These differences suggest that factors other than regional climate influenced these changes. For example, structural features such as cliffs can protect against loss by shading solar radiation, and avalanching from cliffs can enhance snow accumulation on a glacier.

The observations in the Sierra Nevada are consistent with the loss of glacier mass reported worldwide. The average mass of more than 130 glaciers throughout the world has been decreasing over the past 100 years.

Why is this indicator important?

California's glaciers are important to alpine hydrology. They begin to melt most rapidly in late summer, providing water for vegetation and wildlife when less precipitation is available and demand is high. Glacier shrinkage leads to earlier peak runoff and drier summer conditions. These changes affect the availability of water for plants and animals in the area, leading to ecological consequences. Glacier shrinkage globally is an important contributor to sea level rise.

The late summertime photographs below show the area and volume of Conness and Dana glaciers in Yosemite National Park. Additional photographs can be viewed at the *Glaciers of the American West* website, http://www.glaciers.us.

Historical and contemporary photographs of two Sierra Nevada glaciers

Dana Glacier

Photos: U.S. Geological Service, photo station ric046 (left); H. Basagic (right)

Conness Glacier

Photos: National Park Service, photo station Conness 5555 (left); H. Basagic (right)

For more information about this and other climate change indicators, visit:
https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california