Glaciers in Oregon

Glaciers and permanent snowfields—found in many western states, including Washington, California, Colorado, Wyoming, Montana, and Nevada—are common in the high alpine environments of Oregon. There are about 463 glaciers or perennial snowfields in Oregon (35 of them named), covering an area of about 42.5 square kilometers. They can be found in the Wallowa Mountains of northeastern Oregon and along the crest of the Cascade Range from Mt. Hood south to Mt. Thielson. The fundamental requirement for a glacier is that more snow accumulates in winter than melts away in summer, so glaciers can exist in relatively warm environments where annual average air temperatures are above freezing as long as enough winter snow accumulates to survive the summer.

By definition, a glacier is composed of perennial snow or ice and it moves. One indication of movement is the existence of crevasses, the gaping cracks that develop in the ice. Differential movement of the ice causes tension; if the tension exceeds the strength of the ice, then it cracks and forms crevasses. Another indication of movement is scratches on the bedrock that once covered the glacier. These scratches, known as striations, are caused by ice dragging rocks over the bedrock, much like sandpaper over wood.

Glaciers in the western United States were unknown to science until 1871, when a geological survey expedition, led by Clarence King, identified glaciers on California's Mt. Shasta. At nearly the same time, a field team from the King Survey, led by Arnold Hague, identified the Sandy Glacier on Mt. Hood. Not long after, many glaciers in Oregon and the western states in general were identified. Until that time, early scientist/explorers did not realize that glaciers lay in the high peaks beneath the seasonal snow that covered the mountains. Exploration in early summer would not reveal them because thick seasonal snow-cover all but hides the glaciers and surrounding terrain.

This was particularly true in the mid- to late-1800s when earth's climate was in the last stages of what is known as the Little Ice Age and seasonal snows lasted late into the summer. Only by late summer, from August to September, would glacier ice be revealed. Early explorer/scientists such as John Newberry, who explored the eastern side of the Oregon Cascades in the 1850s, recognized the glacially carved landscape of the Cascades and correctly deduced that glaciers were once quite extensive. Had they traveled later in the season and into higher elevations, they would have encountered the small remnants of those once titanic glaciers.

An ice cap covered Mt. Hood during the Pleistocene (also known as the Ice Age, from about 1.8 million years ago to about 10,000 years ago). Another ice cap covered the Oregon Cascades from Mt. Jefferson south to Three Sisters, with glaciers descending on the east and west flanks of the range. These glaciers retreated during the warmer Holocene—over the last 10,000 years—resulting in much smaller glaciers. Climate fluctuations during the Holocene caused glaciers to wax and wane.

The last major cooling period was the Little Ice Age, which lasted from 1300 AD to about 1900 AD in the western states, resulting in glaciers that were much larger than they are today. The earliest photographs of glaciers, which date to the early 1900s, clearly show the former glacial extent. Today, hikers and climbers traveling the high alpine regions walk over the rocky, sandy deposits left by the glaciers. These deposits, called moraines, form along the glacier margin and outline the extent of the former glacier.

Over the past century, we have witnessed glacier advance and retreat in response to climatic variations. Oregon's glaciers retreated rapidly from 1900 through the 1950s. During the 1960s and 1970s, the climate cooled a bit and the glaciers held their own, some of them even advancing a little. Retreat resumed by the early 1980s, started to accelerate by the mid-1990s, and continues to the time of this writing.

The only glacier in Oregon known to be responding to volcanic heat is the White River Glacier on Mt. Hood. Steam vents appeared in the early 1900s near the top of this glacier, causing it to melt. Its dramatic retreat, compared to other glaciers on the mountain, must reflect this unusual situation. Overall, glaciers on Mt. Hood, the best studied in the state, have lost about 34 percent of their glacier cover since about 1910. Collier Glacier on North Sister has lost about 60 percent.

Much of the research on glaciers in Oregon was conducted by the Mazamas, a hiking club in Portland. In the mid-1920s, the club's research committee recognized that the glaciers on Mt. Hood were shrinking and established a program of measurements to track their changes. The measurements included glacier length, thickness change, and melt

rates. The Mazamas also contracted aerial photographic surveys of the glaciers of Mt. Hood and from Mt. Jefferson south to Three Sisters and Broken Top. The Mazamas continued their studies for sixty years, a scientific effort by a hiking club that is unique in the annals of American glacier studies.

Other notable efforts include a forty-year photographic record of Collier Glacier on North Sister by Dr. Ruth Hopson Keen and a thirty-plus-year history of the area of Lathrop Glacier by Ralph Nafziger. Other glacier studies have been conducted by the U.S. Geological Survey, Oregon State University, Portland State University, University of Oregon, and other universities.

Two glaciers deserve special attention because of the wealth of information about them: Eliot Glacier on Mt. Hood and Collier Glacier on North Sister.

Eliot Glacier is Oregon's largest glacier, covering about 1.6 square kilometers in 2004. It flows from near the summit of Mt. Hood and down the north side. Meltwater from this glacier forms Eliot Creek, which provides water to the apple and pear orchards below. In the late 1800s, a road was built to reach the glacier and to serve alpine recreation. Today, the glacier can be reached after a forty-five-minute drive from the town of Hood River and a short fifteen-minute hike.

The glacier was named after Dr. Thomas L. Eliot, a mountaineer and pastor of the Unitarian Church in Portland in the late 1800s. Because of its size and ease of access, the glacier was selected for study by the Mazamas' research committee. The glacier is a bit unusual because the headwall of Mt. Hood is fairly weak and occasionally avalanches throw rocks onto the glacier surface. These rocks become buried with subsequent snowfalls and become part of the glacier. After flowing though the body of the glacier, they melt out near the foot of the glacier and blanket the ice. In some places, this rock blanket is over two meters thick. Consequently, the casual observer will mistake the lower rock-covered portion of the glacier as part of the ice-free landscape. The glacier is ninety meters thick in places and moves 2.3 to 6.9 meters per year. Because of climate warming since the early 1900s, by 2010 the glacier lost 19 percent of its area and retreated about 600 meters.

One of the hazards posed by glacier retreat on volcanoes such as Mt. Hood is massive failure of the valley walls. The glacier erodes the volcanic edifice and deposits the material along the glacier margin (moraines). When the glacier retreats, it leaves behind an over-steepened wall of loosely packed sediment that is no longer buttressed by the glacier. These walls are subject to failure, particularly during rainstorms that turn the streams into debris-choked flows. In November 2006, a heavy rainstorm caused numerous moraines to fail, creating debris flows that covered forests and roads. Part of the Eliot Glacier moraine failed, causing a debris flow that reached nearly five miles. A debris flow from the White River, which is fed by the White River Glacier, inundated a major state highway on the east side of Mt. Hood.

Collier Glacier, the largest glacier on the Three Sisters, is named after George H. Collier, a University of Oregon professor who climbed the Sisters in 1880. The glacier measured about 0.65 square kilometers in 1994, having lost 64 percent of its area and retreating 1,500 meters since 1910. The glacier can be reached by a ninety-minute hike from the trailhead near the McKenzie Pass Highway out of Eugene.

The earliest scientific study of Collier Glacier was by Dr. Edwin Hodge of the University of Oregon, who made the first known map of the glacier. In 1928, Ray Sims of the Obsidians, an outdoor club in Eugene, began annual August hikes to the glacier, a tradition that continued for thirty years. Starting in 1941, Ruth Hopsen Keen, a Eugene high school teacher, was asked by Dr. Francois Matthes of the U.S. Geological Survey to study the glacier. It was a good choice, not only because she completed her Ph.D. in geology in 1946, but she also compiled a twenty-six-year photographic record (1936-1962) of its changes, the longest sustained research effort of the glacier.

Based on that record, more recent photographs, and additional research, we now know that the glacier rapidly retreated in the early part of the twentieth century. It then slowed down in the 1940s, retreated again in the 1950s and 1960s, stopped retreating in the 1970s, and slightly advanced in the 1980s before resuming its rapid retreat in the late 1980s and 1990s. This behavior is similar to other glaciers in the region.

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Further Reading:

Benn, D. I., and Evans, D. J. A. *Glaciers and Glaciation*. Oxford, U.K.: A Hodder Arnold Publication, 1998.

Hambrey, M., and Alean, J. *Glaciers*. Cambridge, U.K.: Cambridge University Press, 2004.

Paterson, W. S. B. *The Physics of Glaciers*. Oxford, U.K.: Pergamon Press, 1994.