



From left to right, the four glaciated volcanoes in Oregon's Three Sisters Wilderness: Broken Top and the South, Middle and North Sisters.  **Pete Alport**



A Glacial Task



No one is monitoring America's glaciers—a concern for skiers and scientists alike. The new Oregon Glaciers Institute is working to change that.



by TESS WEAVER STOKES

IT'S NOT EVEN 8 A.M. on a smoke-free August day in central Oregon when scientists Aaron Hartz and Dr. Anders Carlson deliver the first round of bad news. We're walking over glacial sediments and boulders left by the Oregon Cascades ice cap during the last glacial maximum, about 20,000 years ago, on our way to North Sister's Thayer Glacier. The approach affords views of glaciers on neighboring volcanoes: Prouty Glacier on South Sister and Bend Glacier on Broken Top. Carlson and Hartz are shocked at what they see.

They haven't visited these glaciers since June, and Prouty Glacier, cut by a steep chute in its headwall, looks thin, with exposed bedrock poking through the ice. That means ice must flow around the bedrock, not over it like before, explains Carlson. "The glacier will have a harder time feeding the lower terminus from its upper accumulation zone," he says, noting that, as a result, the terminus, or the end of the glacier, "becomes starved for new ice and will retreat more upslope."

Beyond, Bend Glacier looks worse. The upper glacier flows down the flanks of Broken Top's northern summit ridge, offering challenging and popular ski and snowboard descents, but a bedrock ridge has fully melted through the glacier's middle, cutting off the lower portion. "The glacier can no longer be fed," Carlson says. "It may still move and deform and technically be a glacier, but now it's just waiting to melt away." >>



We leave Pole Creek Trail and head west up the Soap Creek drainage toward the outwash plain of North Sister's Thayer Glacier. As soon as we climb its Little Ice Age moraine and take in the view of the cerulean-hued lake dotted with icebergs, Carlson shakes his head.

AS SCIENTISTS AND SKIERS, Carlson and Hartz are on a mission to document the health of Oregon's glaciers. Carlson holds a doctorate in glacial geology and was a professor at the University of Wisconsin-Madison and Oregon State University before starting Carlson Climate Consulting. Hartz, meanwhile, is a biologist, an AMGA-certified ski and climbing guide and owner of Hartz Science Explorations. Together they founded the nonprofit Oregon Glaciers Institute (OGI) in May 2020 and are seeking to determine how many glaciers existed in Oregon a century ago, document how many glaciers remain and forecast their sustainability.

Seventy years ago, the U.S. Geological Survey (USGS) recognized 36 glaciers in the state, but, based on field observations from 2020, OGI proposes there were likely 57. OGI currently projects that just over half remain. Once they finish measuring Oregon's glaciers, they'll begin measuring how much snow each receives in winter and how much ice melts in summer.

"It's doing a budget of the glacier, the ins—snow—and outs—melt," Carlson says. With this data, OGI can determine how the glacier area changes, which can help with modeling future glacier health for a given degree of warming from future human carbon emissions. Right now, however, the task at hand is finding out whether Thayer Glacier even remains.

In order for ice to be a glacier, it needs to

measure 100 feet thick. "Under the pressure, the bottom ice starts to deform and flow like toothpaste," Carlson says. This causes the glacier to move from high elevation to lower, sliding over its bed. Carlson and Hartz look for crevasses or a bergschrund on the surface and glacial flour (fine silt in the glacier's runoff) as evidence that ice is moving.

◆
As soon as we climb its Little Ice Age moraine and take in the view of the cerulean-hued lake dotted with icebergs, Carlson shakes his head.
◆



[Top, Left] Aaron Hartz, the author and Gordy Megroz trek toward the east side of the North Sister, where Thayer Glacier used to sit. □ **Anders Carlson**

[Top, Right] Hartz and Carlson's dogs chill out on what remains of Clark Glacier on the south side of the South Sister. □ **Anders Carlson**

[Above] A 2016 topographic map that shows Thayer Glacier based on 1950s aerial photos is compared with a satellite image taken on October 1, 2020 of Thayer Glacier's current state. □ **Figures by Aaron Hartz**

We make our way down the moraine and around the lake where Hartz, who has skied every major Cascade volcano, from Mt. Baker to Mt. Lassen, starts digging through a pile of debris. Even just 10 centimeters of debris, he tells me, is enough to absorb the sun's warmth and reduce melting enough to keep some glacial ice around. Hartz finds some ice, but it's no longer moving. Next, he takes water samples from the lake to measure oxygen isotopes and determine if the meltwater was primarily coming from first-year snow or from older glacier ice.

Hartz, who guides roughly 50 days a year and forecasts for the Central Oregon Avalanche Center, knows that, in addition to feeding critical rivers, fish habitat, forests and municipal water supplies, glaciers are vital for maintaining the snowpack necessary for skiing and snowboarding in these mountains. "Glacier skiing is an integral part of the Cascade volcano ski-mountaineering experience and allows us to ski well into the summer," he says. "Glacier-covered peaks are icons of the Northwest and part of our identity."

Carlson is off to check out an odd geomorphic feature coming out of the Little Ice Age moraine. He finds a rare, older moraine segment that denotes an earlier, pre-Little Ice Age advance of Thayer Glacier. "We'll have to date the moraine, but this means Thayer Glacier has been part of the Oregon landscape for much longer than the last couple hundred years," he reports back excitedly. For geologists like Carlson, finding physical evidence that takes a "known unknown" and makes it a "known known" is thrilling. For conservationists, and skiers, it's a meaningful message: Millennium-old glaciers can't survive our current climate.



IN THE CONTINENTAL U.S., any new glacier data is a novelty. Around 90 percent of the observations used by the U.S. Forest Service (USFS) and USGS to determine Oregon's glaciers are from the 1950s, meaning Oregon's USGS topo maps have not been updated since then. "That means the state of Oregon is utilizing 70-year-old data on the state of its [Cascade] glaciers when it comes to water resources planning," Carlson says.

In the 1980s, the USGS updated some of the 1950s map outlines throughout western states with glaciers, but made no changes to the Cascades' maps. Since then, aside from USGS monitoring of the South Cascade Glacier in Washington and Montana's Sperry Glacier, no state or federal agency has closely observed glaciers in the continental United States.

Later in August, OGI spent a week visiting every glacier in the Three Sisters/Broken Top region before wildfires consumed Oregon. During that time, they found another victim of climate change: the century-old Clark Glacier on South Sister, the most prominent glacier on one of central Oregon's most popular volcanoes for backcountry users.

"It's the most visible and accessible of the glaciers that have disappeared," says Carlson, who made his first turns on the glacier in 2004. Carlson held a funeral for the deceased glacier on the steps of the Oregon State Capitol in Salem, going so far as to put Clark Glacier water inside a coffin.

"The death of the Clark Glacier is a sign of things to come if we do not address rising atmospheric CO₂ and the broader impacts of global climate change," says Hartz, who has skied the Clark Glacier dozens of times.

OGI is pushing for more glacier monitoring in the lower 48, particularly on Oregon's volcanoes. Beyond their research, Carlson and Hartz are also educating the public about the existence of glaciers and the role they play in the economy and ecosystem. OGI gives public talks, develops literature, writes op-eds and helps ensure accurate information is displayed at public kiosks and education centers. The organization's end goal is for state and federal policy makers and agencies to support glacier monitoring and impose carbon taxes and policies to reduce CO₂ in the atmosphere.

BY THE END OF OUR day, Carlson and Hartz determine what they gathered upon first look: Thayer Glacier is dead. The water running from Thayer's terminus has no glacial flour. The glacier shows no crevasses. "[Thayer Glacier] may have existed as far back as the first recorded contacts between Europeans and North Americans during the late Viking Age," says Carlson. "It is now gone due to human carbon emissions."

It's one thing to read about climate change causalities; it's another to witness scientists issuing a formal declaration of death in the alpine. It's especially devastating to hear the news about this glacier on this peak. I grew up in Bend, where the North Sister looms on the horizon, and have skied her sister volcanoes and made turns on their glaciers. I learned to ski on nearby Bachelor Butte, a stratovolcano atop a shield volcano that once had a nine-month ski season. For me, like for Carlson and Hartz, what we learned today is as personal as it is scientific.

It's a quiet downclimb off the mountain and a somber hike through a charred forest recovering from a large wildfire. As I say goodbye

to Hartz and Carlson, I'm incredibly grateful for their efforts. Someday—maybe sooner than we think—Oregon's glaciers will be gone. Not being able to ski on them will be the least of our concerns. ■

Editors' Note: Oregon Glaciers Institute is a 501 (c)(3) nonprofit that relies on donations to fund its fieldwork and supplies. Learn more at orglaciersinst.org.



[Top] The view from Broken Top of the Bend Glacier below and the Three Sisters in the distance reveals the peaks' glaciers, both living and dead. Thayer Glacier once decorated the east side of the North Sister, which sits farthest from sight. □ **Anders Carlson**

[Above] Carlson holds a funeral for Clark Glacier on the steps of the Oregon State Capitol with his two children, Aspen and Ruby. □ **Lisa Carlson**