

The great thaw

As temperatures rise, many American glaciers could vanish in a few decades

WEST GLACIER, Mont.



The river of ice that hugs Mount Grinnell's high ridges is neither big nor particularly beautiful, but it may be the most accessible glacier in all of North America. In as little as three hours, an average hiker can traverse the mountain's well-groomed trail to plant a foot on a frozen relic of the Little Ice Age.



(<http://www.washingtonpost.com>)

— fast.

This crescent-shaped glacier in Montana's northern Rockies has been contracting for decades because of warming temperatures. It has been shrinking at a breathtaking clip, losing as much as a 10th of its area a single year. As early as 2030, scientists say, it may no longer

s disappearing

The glacier's steep decline mirrors that of hundreds of other U.S. glaciers from California's Sierra Nevada to the North Cascades to the Colorado Range. All are in retreat, yet nowhere are the effects so profound as here in Glacier National Park, which experts say could be glaciated by the mid-century.

"They'll be gone in a few decades," said Dan Fagre, a scientist with the U.S. Geological Survey who monitors the park's 25 remaining glaciers and estimates each year's losses. "Every year exposes rock that hasn't seen daylight in centuries."

The decline of glaciers here and around the world is frequent enough for scientists as evidence of a climate undergoing rapid change. Satellite studies have confirmed that more than 90 percent of the world's glaciers are retreating, and many of the smaller ones — like the alpine ice fields in Glacier National Park — are rapidly disappearing.

The impacts extend well beyond the loss of majestic scenery. Mountain glaciers account for about 20 percent of the sea-level rise recorded in the past century, adding to the meltwater coming from polar ice caps and ice sheets. In the United States, the loss of mountain glaciers and snowpack is depriving Western states of a critical water source during the summer months when snowmelt feeds streams and rivers and helps farmers and ranchers survive the dry months.

The problems will almost certainly grow worse for decades, unless the world's nations do more to address climate change, scientists say. That's because at high mountain altitudes where most glaciers are found, temperatures are rising faster than in the valleys below, with all signs pointing to still-higher increases in the decades ahead.

Diplomats from more than 190 countries are set to gather in Paris to try to negotiate a historic treaty to curb emissions of greenhouse gases blamed for global warming. The ultimate goal — one that U.S. officials say is unlikely to

be achieved during this round of talks — is to cut carbon pollution so that temperatures climb no more than two degrees Celsius (3.6 Fahrenheit) over historical averages.

But at Glacier National Park, temperatures already have jumped by nearly two degrees Celsius since 1990. What happens to the glaciers in the coming years, climate scientists say, could offer a preview of the broader changes that lie ahead for a warming planet.

“At this trajectory, within a few centuries most glaciers are going to be toast,” said Jeremy Shakun, an assistant professor of earth and environmental sciences at Boston College. “We’re orchestrating something akin to the end of an ice age, but much faster.”

‘It’s functionally gone’



For nearly 25 years, Fagre has been keeping watch on Glacier National Park’s ice fields with the concern of a physician tending to a room full of very sick patients. He scales the mountains regularly to take photographs and measurements, recording a steady decline that is counted in tons and meters.

Already there have been losses. Boulder Glacier, once a large ice field above the park’s Boulder Pass, was the backdrop for many a tourist photo, including a famous 1910 portrait of cowboys silhouetted against an immense field of white. It was still impressive in 1992, when Fagre first hiked to the glacier to take measurements. Today, nothing remains but a few slushy leftovers.

“I’ve gone there regularly enough to see it go from an awesome thing to a tiny strip clinging to the shadows,” said Fagre, a research ecologist and the park’s resident climate-change expert. “It’s functionally gone. What’s left is remnant ice, not a glacier.”

Scores of the park’s glaciers have experienced the same fate. In the mid-19th

century, 150 glaciers existed within the boundaries of what became Glacier National Park. Only 25 remain, and already park officials are preparing for a time when the park so famous for its glaciers will no longer have them.

The park's scientists acknowledge that glaciers can wax and wane for reasons unrelated to man-made climate change. Montana's small alpine glaciers are less than 7,000 years old—young, by geological standards — and they have been gradually declining for at least a century, long before humans began emitting huge volumes of carbon dioxide into the atmosphere. George Bird Grinnell, the naturalist who in 1885 discovered the glacier that now bears his name, observed 90 years go that it appeared to be losing mass.

But there are unmistakable signs that the warming and thawing have accelerated. A 2003 scientific paper co-authored by Fagre mapped out possible futures for the park's glaciers, with predictions that varied depending on the level of carbon pollution in the atmosphere. The most dire scenario predicts that all glaciers in the park's main Blackfoot-Jackson Glacier Basin could be gone by 2030. The forecast, which drew scoffs at the time, now appears to have been slightly optimistic.

“We keep going beyond what we predicted a few years ago,” Fagre said.

The Grinnell Glacier, in another corner of the park, appears to be riding a similar trajectory. The small glacier has been photographed by tens of thousands of visitors and was famously visited in 1997 by Vice President Al Gore, who stood on the ice to call attention to climate change. The glacier has shriveled dramatically since then, losing scores of meters in length and shedding much of the imposing bulk remembered by journalists who accompanied Gore on the trip.

“We used to have to climb 15 to 20 feet on the land side to get on top of the glacier, and we worried about ice falling down on our people,” Fagre recalled. “Now it's not even up to your kneecap.”

'Water is the lifeblood'



he loss of Grinnell and its neighbors will almost certainly mean fewer visitors to a park that annually draws 2 million tourists eager to gawk at a real glacier. But that's perhaps the least of the challenges the park's managers could soon face.

With the retreat of the ice, new threats emerge daily to an alpine ecosystem that has evolved along the edges of glaciers. The park is home to rare insects and plants that exist only in a small zone near the ice, where the glacier provides year-round air conditioning. These little-noticed creatures are the first rungs in a complex food web that includes wolverines, as well as endangered bull trout, that survive only in very cold, oxygen-rich streams.

The glaciers also act as nature's free reservoir system, providing the meltwater that keeps streams flowing and irrigation pumps working when rainfall is rare. Already, some of the park's perennial streams are drying up during the summer months, and declining soil moisture leaves the park's forest more vulnerable to disease and forest fires. Members of the Blackfoot Nation, a tribe on the park's eastern fringe, say traditional watering holes used for cattle and irrigation are drying up.

"Whether you look at it culturally or scientifically, water is the lifeblood of the universe," said Joe McKay, a member of the Blackfoot tribe's business council. "In our world, glaciers then are not just drying up or disappearing. Glaciers are dying."

The park's neighbors aren't the only ones bracing for major change. Rapid melting is underway in all seven U.S. states that have significant glaciers. Like those in Montana, some are on a fast glide toward extinction.

In Wyoming, the Cloud Peak Glacier, the only named glacier in the Bighorn Mountain Range, is forecast to disappear by 2034. In Washington state's North Cascades, scientists documented record rates of melting in 2015 for all the region's alpine glaciers, which collectively lost between 5 and 7 percent

of their mass in a single year. In Alaska, the only Arctic state, glaciers shed 75 gigatons — or 75 billion metric tons — each year between 1994 and 2013, an amount equal to half the ice loss for all of Antarctica.

Similarly impressive losses have been reported in other parts of the world. Greenland's massive Jakobshavn Glacier set a record in August when it lost nearly five square miles of ice to a massive iceberg in a single day. Historic rates of melting have been observed for glaciers in the Himalayas, the European Alps, eastern Africa, New Zealand's Southern Alps and the Peruvian Andes. The handful of glaciers that are not losing significant mass — those in the Arctic, for example — appear to be the outliers, experts say.

The fact that so many glaciers are retreating in near lock step is powerful evidence not only for the existence of climate change but also for the underlying cause, said Boston College's Shakun. The last time the planet experienced so much melting was at the end of the last Ice Age, about 12,000 years ago, when volcanoes and a changing ocean discharged huge quantities of carbon dioxide into the atmosphere. The difference today is that the CO₂ comes not from volcanoes but from smokestacks and exhaust pipes — and there is vastly more of it, Shakun said.

“We’ve already raised CO₂ by more than it increased at the end of the Ice Age,” he said. “And we’re on track to go up much higher.”