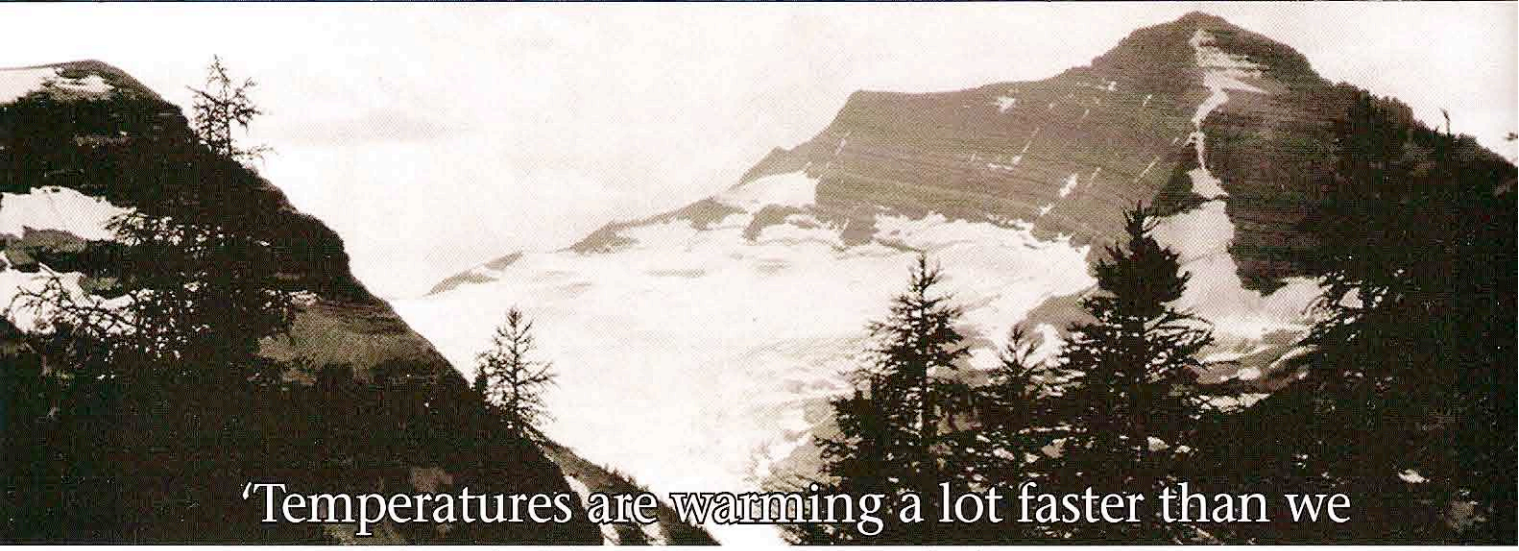
Moving & Melting

Scientists are charting
the disappearing act
of Montana's glaciers



'Temperatures are warming a lot faster than we anticipated. A high percentage of glaciers are getting to that in between stage where they are or aren't glaciers.'

Dr. Dan Fagre

An estimated 150 alpine glaciers gnawed at Glacier Park's mountains a century and a half ago. Most of those glaciers have passed into oblivion, their scooped-out graves blooming into alpine wildflower meadows broken by braided streams. The hotter climate provoked a glacial thaw that may see its final gasp soon. That has scientists scrambling for answers before it's too late.

This year, Dan Fagre, a climate change research ecologist with the USGS Northern Rocky Mountain Science Center, axed one more icefield—Boulder Glacier—from the list of park gems. Each summer, his list grows smaller and smaller. Glaciers, after all, are moving ice. Once they no longer have enough mass to chew on the landscape, they behave like year-round snowfields—white, picturesque, but static and growing fainter every year.

Fagre had estimated that by 2030 the park's glaciers would all melt below the requisite mass to move, which is 25 acres and 100 feet deep. But more recent evidence may force him to bump up the extinction date. "Temperatures are warming a lot faster than we anticipated," explains Fagre. "A high percentage of glaciers are getting to that in-between stage where they are or aren't glaciers."

Most of the 25 remaining glaciers stretch less than one square kilometer each. Together, they total only 6.6 square miles. Despite their diminutive size, they form the largest bastion of icefields in Montana and one of the two largest in the U.S. Rocky Mountains.

Aerial photography this decade shows the recent glacial melt. Piegan Glacier, one of the most stable since the 1930s, shrunk nearly 9 percent in only seven years, a rate slightly faster than average. Grinnell Glacier lost 13 of its 153 acres in just two years, due to behemoth ice chunks calving into its lake. The Jackson-Blackfoot icefield plummeted to a square kilometer smaller than predicted. "The glaciers may be melting 10 years ahead of predictions," speculates Fagre.

Through repeat photography, Fagre matches glacier sizes from 100 years ago against today's to document the visual changes. Using historic photos, he locates the same place the shot was taken and duplicates it in the same light during the same season. The repeat photo of Boulder Glacier shows a dramatic decline, with large moraines, or rubble piles of rock, marking its larger size. "We have an urgency to understand these glaciers because we won't have a chance in the future," Fagre says.

That's why he studies Sperry Glacier. Its ice once stretched across 960 acres, most of which succumbed to massive melting in the early 20th century. Today, at one-third that size, its rate of thawing has slowed, but not enough to stave off its inevitable demise. For four summers, Fagre, along with Blase Reardon, a geoscience graduate student, and Joel Harper, an assistant professor, both from the University of Montana, have been perusing nearly every inch of Sperry to learn about climate change.

Although Sperry Glacier sits at a higher elevation than many other park glaciers, it is ripe for study—unbroken by cliff bands like Blackfoot Glacier, nor severed in pieces like Jackson, and has no lake at the snout like Grinnell. More important, it is one of the largest remaining glaciers in the park and because of its accessibility—a short jaunt above Sperry Chalet—it has reams of data accumulated. It was first photographed in 1894 and mapped seven years later.

But Reardon points out that size doesn't tell the whole climate story; mass balance—the gain or loss of surface ice—paints a better picture. "It's kind of like an account balance," he says. "Paychecks come in as snow, and bills go out in the form of melting ice." Over time, the mass balance speaks to a changing climate one way or another. He's sure of the answer: that Sperry is losing more ice over time than it's gaining, but he's gathering the data for concrete descriptions of how much and how fast.

The trio has been mapping the surface to compare the ice mass to maps made from aerial photographs from 1950 and 1960. Digging snow pits and probing the winter snow pack, the researchers measure new snow added each year. Precision global positioning technology is used

to track the glacier's speed. To gauge the ice lost each summer, radar signals are bounced off the rock below to map the base, and stakes placed flush with the ice surface at summer's onset show the amount of ice melted by fall.

Reardon describes the complexity of measuring overall glacial melt: Each year, climate fluctuations spin winter snow pack and summer heat into a maze of combinations that may speed or slow melting. His preliminary findings reveal the average loss of one meter per year of mass.

Tromping around on monstrous icefields in Alaska, Greenland, and the Himalayas, Harper studies the connection between melting glaciers and rising sea levels. "The story of glaciers melting is not as simple as big ice cubes melting in the sun," he says. "That's because glaciers move." Between movement and shifting mass, measuring glaciers is tricky. Ice may melt as it crawls from high to low elevation, or thicken and add mass if velocity slows.

Even though Harper sees small melting icefields affecting sea level in the next 50 years, the tiny volume of the park's glaciers won't cause much impact. But their rapid change supplies the means to understand how bigger ice may respond to climate change. "Sperry Glacier is a perfect laboratory," Harper says.

For Fagre, Sperry provides data to extrapolate results to the park's other dying icefields. While Glacier's namesake diamonds wane, the research continues. "We'll just keep measuring until they're gone," Fagre says. **M**

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