



## Melting into history: Glacier Park's glaciers shrinking, streams drying up

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Photographed by *KURT WILSON* of the *Missoulian*

**WEST GLACIER** - This summer, for the first time in Glacier National Park's 100-year history, Gem Glacier was entirely snow-free, a glistening sheet of bare ice sweating dark and blue under a relentless sun.

Many miles away, a bubbling mountain stream turned to a trickle, fading finally, underground. It was one of many streambeds that dried up this year, and one of many more to come.

"There's still water down there under the cobble," Dan Fagre said of that stream, "but it's not so good if you're a fish."

Fagre, a research ecologist with the U.S. Geological Survey, has been monitoring Glacier's glaciers for years, studying the many implications of retreating ice and snow. This summer's disappearing streams, he said, are but the latest signs of a rapidly changing climate driving an equally rapidly changing park system.

For years, he said, scientists monitored streamflows throughout Glacier National Park, and lately he's put a renewed emphasis on that historic work. Fagre knew the glaciers were thawing out, knew streams would be running full with all the melt water, and so he set out to track the runoff.

But in the past couple years, he said, flows have slacked dramatically, far below even the historic averages.

"It looks like we're already past the melt-water peak," he said, "because we're seeing a declining flow. Of course, eventually that will go to zero."

Fagre initially pegged "zero" at about 2030, the year his models suggested the last of the glaciers would be gone from their namesake park.

"But we're about eight and a half years ahead of schedule," he said. "Our initial projection has proved too conservative. They're going faster than we thought."

The last official count - in 1998 - pegged the number of glaciers here at 27, down from 150 a century ago. Today, Fagre's putting the final touches on a brand-new inventory, which surely will show far fewer than the 27 counted just a decade ago. Grinnell Glacier has lost 14 acres - 9 percent of its total coverage - just in the past 24 months, Fagre said, and that doesn't even count acreage lost this summer.

Much of the ice that's left in the park has no snow cover, which means it melts faster because dark ice absorbs more sunlight and heat than white snow.

It's what scientists call a "noisy system," an interconnected tangle with lots of variables. Warmer, for instance, often means wetter, and wetter can actually mean glacier growth, unless the wetter comes as rain, in which case it can mean more flooding in spring, as well as more drought in summer.

Higher temperatures and longer growing seasons also mean more evapotranspiration, and more new

vegetation drinking up underground reservoirs. Trees now grow where only grasses could make a living 25 years ago, Fagre said, and trees suck up a lot more water than grasses.

Add to all this the fact that the park's few remaining glaciers are broken into 500 or so fragments, Fagre said, increasing their surface area and thus their melt - just as a smashed ice cube disappears more quickly than one left whole.

"We're starting to see this picture pretty clearly," Fagre said. "Glaciers have always been the summertime reservoirs, and now the natural reservoir system is diminishing. That's a concern, because you have this critically dry time of year, but you have no safety net to keep feeding water downstream."

The result, he said, is "very significant changes in the way Glacier National Park operates."

Look no farther than Snyder Creek, which runs alongside Lake McDonald Lodge but, this summer at least, did not reach the lake.

The water bugs that live there "will not do well," Fagre said, "and neither will the species that eat them."

One of those species is the bull trout, which Wade Fredenberg calls "the polar bear of fish."

What he means is that bull trout, like polar bears, prefer very cold water. And bull trout, like polar bears, are immediately threatened by a warming climate.

Fredenberg is native species coordinator for the U.S. Fish and Wildlife Service, and he's spent a career knowing Glacier's fish.

"We have several lakes that seem to be totally dependent on glaciers and snowmelt for fall flows," Fredenberg said. "They're not doing well."

That's not good for bull trout, which unlike other native trout spawn in the fall, and so need strong late-season flows.

"It's tough to be a fish in a river with no water," Fredenberg said.

He also worries about spring flows, which are pulsing down earlier - a full month earlier - and with far more intensity than in the past.

"A good March flood will bury the (bull trout) eggs and suffocate them," he said.

Blake Hossack, a zoologist with the USGS, says the amphibians he studies in Glacier Park are going through metamorphosis a surprising three weeks earlier than usual, "and our wetlands are drying up in a hurry. The schedule is certainly moving up, and the dry season is getting longer."

The amphibians time their breeding to coincide with snowmelt, Hossack said, and the snakes and shrews time their life cycles to feed on the baby metamorphs. If the metamorphs come early, then the young snakes and shrews don't eat, and then neither do the birds of prey.

"How big the impacts might be, that's a good question," Hossack said. "Things are changing pretty dramatically in these systems."



Fagre agrees. "It seems odd that high mountain ice and snow would be tied to a fish species of concern," he said, "but that's the way mountain ecosystems work. We call it the cascade effect."

Or, in this case, the lack-of-a-cascade effect.

Glacier Park streams Fagre has been visiting for decades disappeared this year. Waterfalls didn't fall. The Weeping Wall stopped weeping.

"The view of the park is changing," Fagre said. "The entire system is far more volatile than in the past."

His office is a stone's throw from the Middle Fork Flathead River, a wild whitewater stream usually full of kayaks and rafts. "Today, it looks like you could walk across it and not get your socks wet."

That's obviously a problem if you're a boater, or a fish, but also if you live far downstream, Fagre said, because "the water balance of mountain systems affects society at great distances. Changes here mean eventual changes downstream, and if anything, the changes are accelerating."

The Yellowstone River, running many miles from the Continental Divide, is at record low flows this fall, and that will have impacts for those who live and work along its banks.

"Who knows what all the implications might be," Fredenberg said. "It's a big experiment we've embarked on here. Check back in 100 years and we'll tell you how it went."

But Fagre doesn't need a century of hindsight. Check back in 100 years, or even 20, he said, "and there will be no more glaciers here, which means no more summer reservoir of water. The effects of that will be felt broadly throughout our society."

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