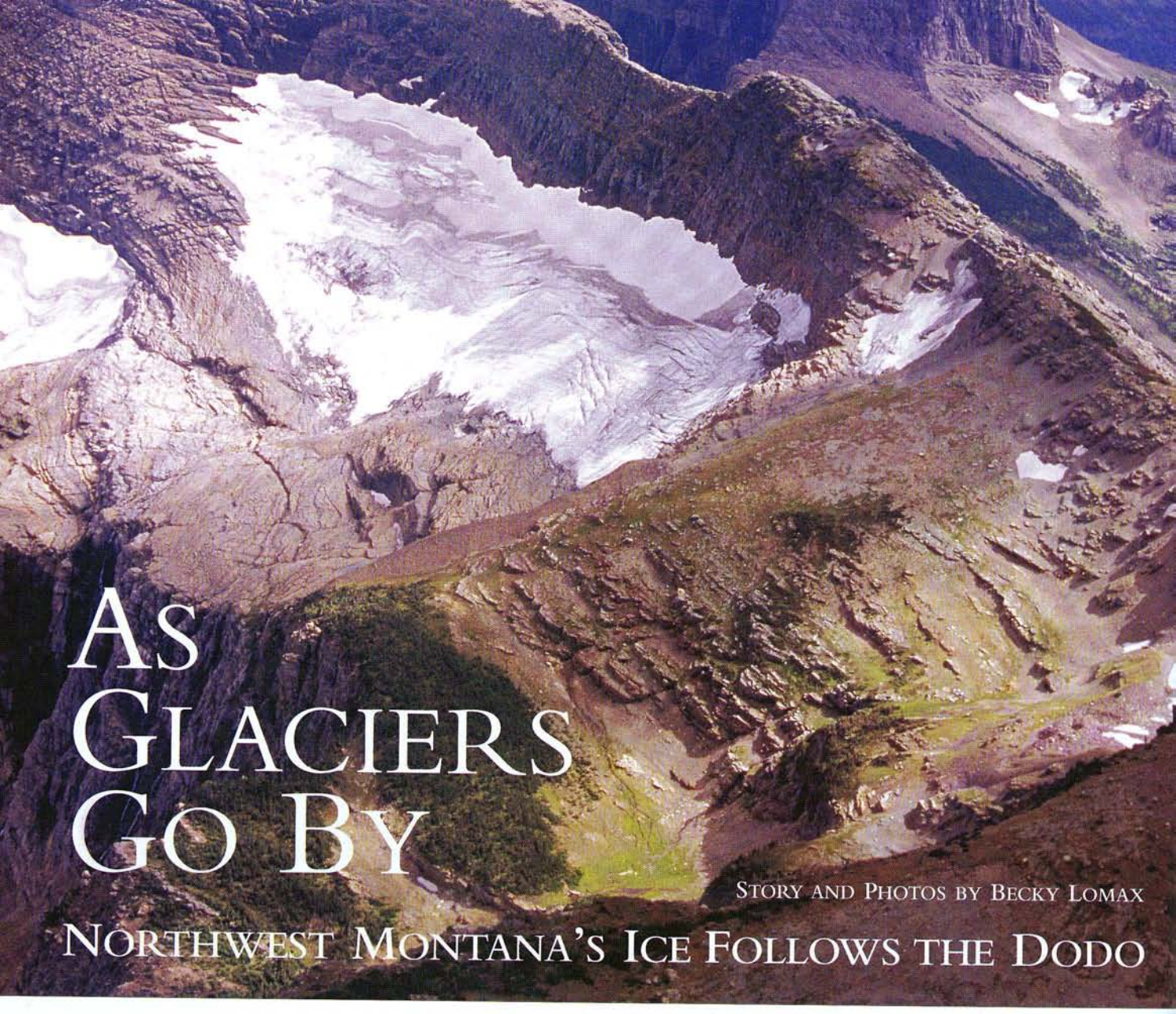


As Glaciers Go By

Northwest Montana's Ice Follows the Dodo

Story and Photos by Becky Lomax

"Where's the best place to go to watch the glaciers go by?" Most of us chuckle when someone who slept through seventh-grade Earth Science asks this question. But in reality, the question carries certain poignancy. For Glacier National Park's ice fields are moving rapidly. Melting, that is.

The United States Geological Survey (USGS) estimates that Northwestern Montana could be sans glaciers in 25 years. "Glaciers are the frosting on the cake," says Dr. Dan Fagre, an ecologist with the USGS in West Glacier and an avid mountain climber. "As indicators of climate change, the story of glaciers disappearing is the story of mountains changing." Relics from 7,000 years ago, these once-glamorous diamonds strung along the Continental Divide now look barely different from snowfields. But roughly 37 named glaciers do remain, although tiny in comparison to Alaska's and Canada's rivers of ice.

In 1850, more than 150 glaciers were documented within Glacier National Park's borders. With ensuing melting, many have passed into oblivion, blooming into alpine wildflower meadows broken by braided streams.

Very few glaciers remain within 100 miles of the Park – only nine dot the Mission, Swan, Flathead, Cabinet, and Lewis and Clark ranges. Even north into Canada, no glaciers to speak of range within 60 miles north of Waterton. Glacier National Park stands alone as an enclave of rare gems. But today, only 25 percent of the ice fields from a century ago remain. And not for long.

Ice Ages

Northwest Montana has seen several ice ages, but also several warming trends. The Pleistocene Ice Age gnawed Glacier's major jagged peaks and U-shaped valleys into being two million years ago. After advancing and retreating many times, these immense, several-thousand-feet-thick ice fields vacated local mountain ranges 12,000 years ago, leaving large moraines in their wake – like Howe and Snyder Ridges along Lake McDonald.

The smaller glaciers we see today formed in a much warmer ice age – launching into a growth spurt 400 years ago and plumping up rapidly toward the 1800s. As these glaciers swelled, some of them chewed out hanging valleys suspended high above the Pleistocene-gouged valley floors.

◀ South Swiftcurrent Glacier is now split into two pieces.

Iceberg sits in melt pond. ▶

Around 1850, temperatures cooked up, as evidenced by tree-ring studies, beginning the thaw that may see its final gasp in less than three decades. With many of our local glaciers, their mid-19th-century size is marked by moraines, large heaps of rock rubble resembling dump truck piles. These moraine footprints allow scientists like Fagre to note their size 150 years ago and match it against what they see today.

According to Sperry Glacier's moraine, its ice stretched across 960 acres; today it covers less than one-fourth that size. Because of the way it is melting, Fagre studies Sperry religiously as an index glacier. "As Sperry goes," he laments, "so go most of the glaciers."

While early melt rates tended to be slow, by the 1920s warmer summers and less snow triggered rapid melting for nearly 20 years, cleaving some larger glaciers in two. The Salamander split off from Grinnell while Jackson and Blackfoot glaciers were severed in half. As average summer temperatures increased by 1.8 degrees, glaciers thinned, shrunk, broke into several pieces or disappeared entirely, like a silent Wicked Witch of the West miming, "I'm melting!"

Beginning in 1960, a short period of respite lasted for nearly another 20 years, with increased snows and lower temperatures ushering in a brief growth spurt for larger glaciers. But since 1980, trends turned toward thawing again with a short, rapid-melt blast in the mid-1990s, pushing a few glaciers – like Red Eagle – along the same path as the dodo.

Glaciers or Snowfields?

Sometimes glaciers and snowfields look identical. It's hard to tell the difference, especially in winter, late spring and early summer, when fresh snow blankets both. Even though the two are vastly different beasts, a glacier can mutate into a snowfield.

Glaciers form when more snow accumulates each year than melts. Freeze-thaw cycles transform snow crystals into icy kernels. As snow amasses on the glacier's upper end, it pushes down, compressing the ice, which compacts over years.

Contrary to static snowfields, glaciers are rivers of ice – moving very slowly. With the hand of gravity, the ice presses down, forming a thin, elastic barrier between it and the rock surface. That supple base carries the mass of ice toward the glacier's toe, where it may calve off in chunks. Sperry Glacier used to travel 12 to 20 feet per year; Grinnell moved 30 to 50 feet per year. However, Fagre believes their movements have slowed considerably and is currently tracking their progress. For ice to move, it needs mass – usually 25 acres at 100 feet deep. With less than that, the ice usually becomes static – a permanent snowfield.

Gem Glacier is a notable exception. While smaller than normal at less than six acres, it still behaves like a glacier. Fagre notes that its placement right atop the Continental Divide permits wind-driven snow to dump on it, perhaps allowing it to continue moving and not lose mass.

You can identify glaciers by features that snowfields lack: crevasses, debris bands and moraines. When ice inches over rocky humps, the rigid surface cracks into crevasses up to hundreds of feet deep. Debris bands – or lines of rocks – pile atop the ice, carried along in lines that reveal the glacier's movement. When the ice melts, rocks and debris are left in large moraines, in either lateral or terminal piles.

Measuring Glaciers

So how does Fagre go about measuring ice that is ever moving, melting and changing, like an amoeba on the run? Photographs taken in different years reveal shape and size changes, as do GPS readings that map glacial perimeters. Ice radars report the glacier's thickness, bouncing signals off the rock below. A stream gauge station at Grinnell measures the amount of water running from the glacier and its lake. And, a precision GPS tracks movement with the use of stakes placed and tracked year to year.

During his 13 years measuring glaciers, Fagre has seen the most dramatic change in Agassiz Glacier in the Park's northeast corner. "It used to eat up trees," he says. Now, it's fragmented into 10 pieces totaling less than 25 percent of its 1850 size.

For Fagre, Grinnell Glacier held the biggest surprise – discovering just how deep the ice stretched. Radar readings measured the ice over 300 feet thick. "I was very surprised at the size of its icebergs," he says. "When they calve off, they look like huge, belly-up ships."

Old Sun Glacier clings to the side of Mount Merritt. ▼

As Glaciers Go By

Northwest Montana's Ice Follows the Dodo

Melting

"Glaciers are like a checkbook," says Fagre, "and ice is your currency." Like a checkbook, you can add and take away ice, with the balance remaining relatively the same, or you can run into a deficit if you take away too much. A glacier's upper end – called the accumulation zone – sees snow pile up, adding to the ice's mass. Downslope, summer's heat brings on melt. It's simple checkbook math: When more ice turns to water than is created, a glacier shrinks.

As glaciers retreat, they break into patches. In 1850, Mount Jackson ruled a realm of 27 glaciers clustered over 5,300 acres; now 15 of those glaciers have melted into oblivion. After splitting off from Blackfoot Glacier, Jackson Glacier broke into 23 separate pieces.

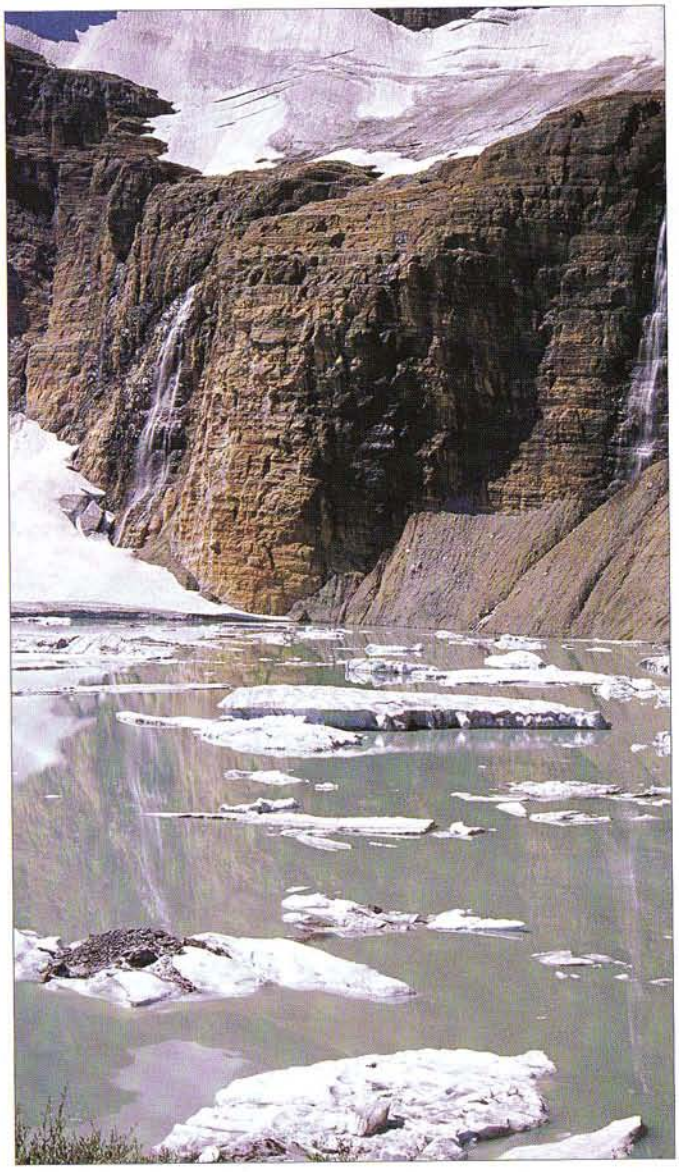
When glaciers melt, some form lakes at their snouts. Since 1937, Grinnell Glacier's recession has produced a lake. As the glacier shrinks, the lake grows. Within two decades of its onset, the lake mushroomed to 20 acres: Now the 124-acre lake slowly creeps toward a size equal to the shriveling glacier's. Within 25 years, it may take on the appearance of its neighboring Iceberg Lake.

What Will Happen to Glacier National Park?

"Mountains are the water towers of the world, providing 50 percent of the world's water supply," says Fagre. "Melting glaciers are also the story about our future water supply." As glaciers recede, other forms of life move in. Wildflowers grow where ice once was. As meadows press upward in elevation, so do trees. Using a computer model, Fagre shows the historic melting glacier pack and advancing treeline in Jackson-Blackfoot Basin and its possible future look in the next 95 years. (You can see this animated model at www.nrmsc.usgs.gov/research/glacier_model.htm.)

More trees aren't necessarily disastrous, but they will change the ecosystem. Animals and birds, especially those living on the fringes of their habitat, may seek a food base elsewhere, should their favorite alpine bug or flower suddenly find its home in a deep coniferous forest less to its liking. Water, which is seemingly so abundant in Northwest Montana, may not shed from the mountains in the same volume, effecting irrigation to salmon runs. And with more forests, bark beetle infestations and fires eventually come.

Northwest Montana does not stand alone with its losses. Glaciers in the Himalayas, Antarctica, the Andes, the Alps, the Pyrenees and the Canadian Rockies are all slowly disappearing. Even at 9,000 feet higher than mountains here, Tanzania's Kilimanjaro may mourn its ice vanishing 10 years before ours. But despite melting that will cause Glacier National Park to lose its jewels within our lifetime, the landscape will always reflect the labors of its namesake diamonds.



Icebergs float in Grinnell Glacier's increasingly larger melt pond. ▲

Fast Facts

- Largest Local Glacier: Blackfoot Glacier, 437.87 acres
- Smallest Local Glacier: Gem Glacier, 5.9 acres
- Glaciers in the U.S. cover 29,000 square miles (mostly in Alaska)
- 10% of Earth's area is covered by glaciers
- World's store of fresh water is 75% in glaciers
- World's Fastest Glacier: Kutiah Glacier, Pakistan (Moving 123 yards a day and 7.4 miles in three months in 1953)
- Fagre's studies on glaciers can be found at www.nrmsc.usgs.gov.