



## Columbia Icefield shrinking fast

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Glaciers: the word hardly brings to mind words like surge, accelerate and faster.

But just two hours north of the Bow Valley sits the Columbia Icefield and its most accessible glacier, the Athabasca. Perhaps it is the wrong word because, according to many glaciologists, the icefield is shrinking in ways not seen for millennia.

Tree stumps buried under snow and ice are now being exposed for the first time in as much as 8,000 years. Meltwater from the icefield on the whole is shrinking substantially and has maxed out. The Athabasca and perhaps the entire field is shrinking at its fastest rate in the last 100 years.

Just like glaciers around the world right now (some 90-95 per cent are shrinking, say some glaciologists), the Athabasca is undergoing some serious changes and man-made climate change may be one of the principle reasons why.

"The Athabasca Glacier is the single best accessible example of what we are seeing happening in the world today because of climate change," said Bob Sandford, director of the Western Watersheds Climate Research Collaborative and the Canadian Chair of the United Nations 2005, decade-long, Water for Life initiative. "We have been using the glaciers as a kind of climate change canary. What we're finding now is that the canary has already sung."

Other glaciologists believe the canary might even be close to death.

The Columbia Icefield, a remnant of past Ice Ages, is located in a southern section of Jasper National Park along the Icefields Parkway. It extends six kilometres and is almost a kilometre across. In some places, it is 300 metres thick, yet trickling water can still be heard underfoot. Massive avalanches occur on the mountains surrounding it. Children and men have died falling into its hidden cracks and



The Columbia Icefield and Athabasca Icefield could completely melt within 100 years, a change which would significantly alter the ecosystems that flow from it.

by Bob Sandford

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crevasses along its most accessible point, the Athabasca Glacier.

That the icefield is shrinking is not news. Signs today at the Columbia Icefield state that since 1843, the toe of the Athabasca Glacier has retreated 1.5 kilometres (10m per year on average). Like some unfortunate men's hairlines, glaciers recede naturally.

What is news is just how much ice and snow, on both the Athabasca glacier and the Columbia Icefield, is now gone.

According to Sandford, comparative studies of the thickness of the Athabasca Glacier indicate that it is now some 60 per cent smaller in volume than it was a century and a half ago. Several years ago, the consensus in the glaciologist community was the glacier was only 50 per cent smaller. Other glaciologists point out the Athabasca has been reduced to a size not seen in 4,000 to 8,000 years.

"We can't just consider the glacial length, although that is certainly decreasing, but the depth of the glacier is also becoming increasingly diminished," said Sandford. "It's really a massive change."

Furthermore, Sandford said that for a long time, glaciologists and researchers had been expecting to see a surge or a pulse in the amount of melt coming off of the entire Columbia Icefield.

However, Sandford said that researchers found in 2009 that, unexpectedly, the surge has already occurred. The maximum melt from the icefield, which drains primarily into the Arctic, the North Saskatchewan River and a variety of other rivers that flow into the Prairies, has already happened and it's deposits of meltwater are depleting fast.

"This is extremely significant," said Sandford. "We've passed a 'tipping point' in terms of water supply."

According to Michael Demuth, Head of Glaciology within the Geological Survey of Canada section of Natural Resources Canada, the scales have tipped over for a variety of reasons.

According to Demuth, winter is not producing as much snow and is warmer than in the early 20th century. This has large consequences for the Columbia Icefield and the Athabasca Glacier, because snowfall nourishes glaciers.

"This all affects the glacier's mass balance and eventually the glacier responds with changes in its length and area," said Demuth. "The observed rates of change in the Columbia Icefield area are quite dramatic, even exceptional."

While Demuth says he's not yet sure if man-made climate change can be attributed as the sole reason why the Columbia Icefield is shrinking, he said it's certainly a part of the story.

Furthermore, Demuth said that, in general for glaciers around the world, "Our evidence really points to increasing rates of change beyond what we would expect on account of natural variability. The consensus in the community is that this is due to human activities."

Dr. John Pomeroy, Canada Research Chair in Water Resource and Climate Change at the University of Saskatchewan Centre for Hydrology and also the President of the International Commission for Snow and Ice Hydrology, says human activities could have and are beginning to have negative consequences for the chain of life that lives along the melt water coming off the Columbia Icefield.

"In a warming climate there is more ice melt than the winter snowfall can replenish and so streamflow increases compared to a stable climate glacier. The danger of climate warming (which we have had since the little ice age of the 1800s, but which is really accelerating now) is that we got used to the extra water from the shrinking glaciers," he stated in an email. But those flows are now smaller.

The larger than normal flow volumes from the Columbia Icefield acted as a natural streamflow regulator for the North Saskatchewan and its flow into the man-made Lake Abraham. The flows essentially made the system "drought-proof," said Pomeroy. Because the icefield is much smaller now and because of warmer temperatures, the meltwater has fallen off substantially. The regulator is broken.

"Unfortunately, that is where we are now. The canary is close to being dead," stated Pomeroy. "Without the melt from the icefield, mountain rivers sustain much lower flows in drought years. This would be reflected downstream at times when water supply from the river is particularly important."

The consequences run from increased temperatures in rivers that flow out of the icefield to unregulated, abnormal groundwater pH levels. In short, life in the shade of glacial melt-off could change substantially.

"Glaciers are extremely important to stream ecology," said Pomeroy.

Glacial water can dilute ground water, keeping its acidity levels low enough so that life can survive in it. If the glacier is no longer adding water to mountain streams in the late summer, then there will be changes in store for aquatic life. Because that change is happening at an accelerating rate, trout and other species in the water are not going to be able to adapt, said Pomeroy, and their numbers will dwindle.

"Whatever the cause of these changes in glacier cover, they will have significant effects on the flow volumes, the seasonal flow patterns, plus water temperatures and water quality, that will impact human activities downstream (irrigation, water supply and in some cases, power generation) and also on stream ecology," stated Dr. Brian Luckman, a geography professor at the University of Western Ontario who specializes in alpine environments, dendrochronology (study of annual tree rings), glacier fluctuations, and global change.

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He believes all of the changes he mentioned will then affect human activities downstream – irrigation, water supply and, in some cases, power generation.

“These changes are occurring today, whatever one thinks of the global warming issue, and they are changes which have, and will continue to have, significant impacts on these drainage basins,” he said.

Perhaps the greatest change, though, will be the loss of a prized and beautiful Canadian natural icon. Bare rock and, eventually, forests, will replace gleaming white snow and thousands of years of snow and ice that has sat within walking distance from a road that anyone in Canada can drive, will be gone.

Canada is often said in popular literature to lack a strong national character, but some Canadian cultural commentators such as Pierre Berton and artists like the Group of Seven have often argued that whatever fleeting national identity Canadians have is surely tied to a vast, dominating, varied natural landscape. If that landscape is reduced in its variety, if the Columbia Icefield shrinks beyond recognition or disappears, a possibility, then something that makes Canadians Canadian, even if only in some small way, could be lost.

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