

Climate change is behind rising metal and acid pollution in Colorado's mountain rivers

KUNC | By [Rae Solomon](#)

Published July 25, 2024 at 8:44 AM MDT



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USGS researchers Rob Runkel, Andrew Manning and Sara Warix collect water samples from an unnamed tributary to the Upper Snake River on June 26th, 2024. The tributary is growing increasingly acidic and high in mineral concentrations.

High in the Rockies above Keystone, Colo., there's a mountain meadow covered in willow bushes where the Upper Snake River converges with Deer Creek.

This convergence would be a picturesque, but otherwise unremarkable meeting of the waters except for the fact that Deer Creek and Upper Snake River are two very different waterways. While Deer Creek runs clear, Upper Snake River is tinged distinctively red. That's because the rushing water continually deposits iron onto the riverbed.

"This is a kind of a unique stream in that it has unusually high metal concentrations and high acidity," said Andrew Manning, a research geologist with the United States Geological Survey, who has been studying changes on the Upper Snake.

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According to Manning, Upper Snake River has always run hot when it comes to metals and acidity. It's the natural consequence of headwaters that flow through highly mineralized bedrock. But [research](#) he conducted with colleagues at USGS and the University of Colorado Boulder has found concerning changes over the last 30 years. Metal content and acidity are increasing in at least 17 watersheds across the Colorado

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The confluence of Upper Snake River (left) and Deer Creek (right) at approximately 11,000 feet, near Montezuma, Colo., on June 26, 2024. Deer Creek runs clean, but metal concentrations and acidity of the Upper Snake River have been increasing over the past 3 decades.

"We looked specifically at zinc and copper. It amounts to about a doubling of concentrations over the past three decades," he said. "That's substantial."

Their research determined that it's all happening because of changes in the climate.

"You have large zones of the subsurface that never saw any water or oxygen," Manning said. "Because they're armored off by a frozen ground layer or under the water table."

Temperatures are rising in the Rocky Mountains. The frozen ground is thawing. The water table is dropping, exposing new rocks to the elements. As they weather and start reacting with water and oxygen for the first time, they release acids and new minerals, like zinc, iron, copper and aluminum into the watershed.

Devastated ecosystems

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Changes caused by rising temperatures and the changing landscape can be deadly for plants and wildlife.

"We've seen it on the ground in more than a few watersheds," said Ashley Rust, a water quality specialist with Colorado Parks and Wildlife. "Of the water quality problems I deal with, this is the largest scale and the most daunting."



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USGS research hydrologist Rob Runkel wades into the Upper Snake River to collect a water sample on June 26, 2024. The samples will be analyzed for metal content and other contaminants.

According to Rust, the acid rock drainage is devastating to river ecosystems. The acidic water makes the rivers inhospitable to fish and insects.

"It can dissolve tissue. It can dissolve shells," she said. "The exoskeleton of an insect's body is made of calcium carbonate material. The low pH will dissolve it, and the insects

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Fish are particularly vulnerable to high metal loads in the water, which overwhelm their systems.

“Their gills can be surrounded by metals that then can prevent them from getting rid of some of the waste in their body,” Rust said. “It really messes with their own ability to balance internal chemistry.”

Rust says that while her agency has seen some fish kills due to the increasing acidity and metals in the rivers, “more often, what we’re seeing is an absence of fish where they used to be. I anticipate where we will see this having an effect, we will see more fishless waters,” she said. That would forever change the natural ecosystem.



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Researchers Andrew Manning and Sarah Warix haul scientific equipment to a spot above the confluence of Deer Creek and the Upper Snake River. They are keeping track of the rising levels of acidity and metals in the Upper Snake River.

A global phenomenon

And it's not just in Colorado. Researchers in Alaska have been seeing [similar issues](#) -

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"Literally, the water looks orange," said Amanda Barker, a research chemist with the Army Corps of Engineers' Cold Regions Research and Engineering Laboratory. "You're seeing impaired waterways that are just bright orange and that's oxidized iron."

Researchers don't know yet how widespread this phenomenon of increasingly acidic and metallic waterways might be. Of course, exactly what ends up in the rivers when permafrost thaws depends on what's in the ground to begin with. But in general, the melting is a concern for watersheds.

"Anywhere you have permafrost that is thawing, you're likely going to see the waterways being impacted," Barker said. "Because you're exposing fresh mineral surfaces to weathering reactions."

Concerns for the drinking supply

Continuing their research on the Upper Snake, Andrew Manning and his colleague Sara Warix crouched at the river's edge. Warix dropped a probe that measures acidity into the swirling water.



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A specific conductance meter measures stream flow in the Upper Snake River near Montezuma, Colo., on June 16, 2024. The reading will help researchers calculate the concentration of metals building up in the waterway.

“So our pH is 3.88,” she said. “When I was here last September, it was 3.5. So, it's gone up a touch.” She noted that the drop in acidity was due to seasonal fluctuations.

They also collected water samples in small plastic bottles to take back to the lab and analyze for metal content.

The ongoing monitoring will give the researchers more insight into which qualities of a watershed make it most vulnerable to the effects of acid rock drainage. Manning said that's especially important because beyond ecosystem damage, there could be problems for the drinking supply.

The Upper Snake River, for instance, drains into Dillon Reservoir, which makes up part of the supply for Denver Water.

“Denver Water closely monitors the water quality throughout our watersheds. Information and data from studies improve our understanding of our source water quality so we can continue to prepare for the future,” the utility told KUNC in an emailed statement. “Denver Water's experts and scientists have reviewed the study, and we also conduct our own water quality sampling further downstream from where this study occurs — closer to the inlet of Dillon Reservoir. Ultimately, the levels we see are diluted by additional flows downstream of these high elevation locations, and further diluted in reservoirs (such as Dillon) because of their size.”

The statement went on to say that as a provider of clean, safe drinking water, they are preparing to adapt to the many impacts of climate change.



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Andrew Manning and Sara Warix, with the USGS, collect water samples from an unnamed tributary to the Upper Snake River in Summit County, Colo., on June 26, 2024.

But as contaminant levels continue to rise, Manning said some utilities, particularly those serving higher elevation communities, might eventually be at risk.

"A lot of our mountain communities get their water resources from these streams," Manning said. If metal concentrations continue rising, there may come a day when they can't be effectively diluted downstream.

"[Mountain communities] may have to start treating that water or taking it out in a different place."

Municipal water managers, he warned, would be wise to take note.

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Rae Solomon

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