Thawing permafrost cools Arctic currents: This might affect fish stocks

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GEOGRAFI A new study by a University of Copenhagen researcher finds that thawing permafrost in Alaska causes colder water in smaller rivers and streams. This surprising consequence of climate change could

affect the survival of fish species in the Arctic's offshore waters.

Arctic stream

The study's researchers discovered that thawing permafrost causes groundwater to run deeper, where it becomes cooler than when it flows near the soil surface.

Rising global temperatures are causing frozen Arctic soil—permafrost—to thaw. In a new study, researchers have discovered something surprising: small rivers, creeks and streams that flow into larger lakes and coastal waters seem be to getting colder as permafrost melts. The phenomenon was previously documented in Russian rivers in the Arctic. But until now, no one had studied why the water was getting colder, even as air temperatures are warming and the permafrost is thawing.

Together with researchers from the US Geological Survey Alaska Science Center, Associate Professor Ylva Sjöberg of UCPH's Department of Geosciences and Natural Resource Management has shed new light on this cold water. The study's researchers discovered that thawing permafrost causes groundwater to run deeper, where it becomes cooler than when it flows near the soil surface.

"Permafrost is found just beneath the ground's surface. When permafrost is intact, groundwater flows from springs and the mountains and atop the permafrost layer, where it is significantly heated throughout summer. However, as permafrost disappears, runoff seeps deeper into the ground, where it cools before making its way into nearby streams, rivers and lakes," explains Ylva Sjöberg, the study's lead author.

Yet another climate change complication

In their study, the researchers studied the Noatak National Preserve in northwest Alaska. As with other Arctic areas, the Noatak is experiencing higher temperature due to climate change.

However, very little data is available for how climate change affects the temperature of smaller water flows. The researchers positioned 62 measuring sensors in different streams in areas both with and without permafrost. Here, they observed that water temperatures were warmer in permafrost-covered areas.

Using a computer model, the researchers were able to calculate that the summer water temperatures would average 11 degrees in areas of permafrost, while in areas without permafrost, it would be 4 degrees.

"We have no reason to believe that our observations in Alaska would be any different in other Arctic regions with analogous landscapes. This complicates the effects of climate change, as it seems that areas with permafrost are not subject to the same simple ratio of temperature increases in air and water as are used elsewhere," explains Ylva Sjöberg.

Could affect fish stocks

Salmon, grayling and sculpin are a few of the fish species that spawn and grow in these streams. Fish biologists from the U.S. Geological Survey (USGS) Alaska Science Center made initial observations of how cooler water temperatures might affect fish.

"Stream temperature ultimately determines a fish's ability to reproduce and survive. We suspect that colder water may limit how large a fish grows and likely limits whether they will thrive," explains Michael P. Carey, USGS fish biologist.

According to the biologists, who are now busy with analyzing the study

data, thawing permafrost can also introduce other factors that may disturb the aquatic environments of these fish.

"Streams draining from areas of thawing permafrost will likely show not only temperature fluctuations but also an increase in carbon and nutrient runoff," concludes Carey.

More information: Ylva Sjöberg et al, Permafrost Promotes Shallow Groundwater Flow and Warmer Headwater Streams, *Water Resources Research* (2020). DOI: 10.1029/2020WR027463

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