2022 Volume 7, Issue 34

NWT Environmental Research Bulletin (NERB)

NWT Cumulative Impact Monitoring Program (NWT CIMP)

A source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT.

NWT Environmental Research Bulletin (NERB)

A series of brief plain language summaries of various environmental research findings in the Northwest Territories. If you're conducting environmental research in the NWT, consider sharing your information with northern residents in a bulletin. These research summaries are also of use to northern resource decision-makers.

Impacts of peatland permafrost thaw on water

Permafrost thaw in peatlands results in changes to vegetation and soil and can affect water resources. This project examined peatlands in the Dehcho region. It was found that peatlands with increased permafrost thaw provided less water for streamflow because of increased water loss from plants and soil by evaporation. The effect of permafrost thaw on water availability is unknown, as other studies in the Dehcho have found that changing hydrologic connectivity can increase water availability. Continued permafrost thaw may lead to surface water with higher concentrations of dissolved organic matter and the production of methylmercury. Further research is needed to understand the risk to surface water.

Why is this research important?

Permafrost thaw in peatlands is increasing in the Dehcho region, causing peat plateaus with black spruce, shrubs, and lichens to become wetter as vegetation is replaced with mostly mosses and sedges. This can influence water availability and quality. Dissolved organic matter from peatlands contains nutrients and mercury and can colour the water in streams and lakes. As permafrost thaw continues, the release of dissolved organic matter from peatlands could impact surface water and fish.

What did we do?

From 2018-2020, we sampled 30 creeks and 20 lakes along the Mackenzie River Valley to understand how changing permafrost conditions influence water quantity and quality. At Wrigley, we measured the exchange of energy, water, and greenhouse gases between the peatland and the atmosphere. We also compared the water chemistry of forested peat plateaus with burned peat plateaus and recently formed thawed wetlands.

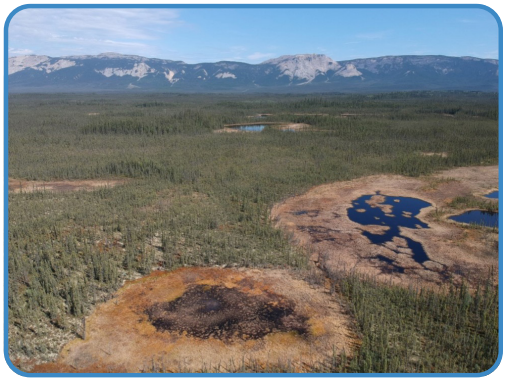

Figure 1. The Smith Creek peatland outside Wrigley. The treed areas are peat plateaus with permafrost underground, while the open bog areas are permafrost-free. Credit: D. Olefeldt

What did we find?

We found that peatland permafrost thaw:

- Dries out the peatlands because more water is lost from the plants and soil by evaporation.
- Increases dissolved organic matter in creeks, making the water appear browner in colour.
- Releases inorganic nutrients, which are more likely used by plants within the peatlands rather than being transported downstream.
- Creates sites with high production of methylmercury in the peatlands however high concentrations of methylmercury were not found to be draining from the peatlands. More information is needed to determine whether this leads to higher concentrations of methylmercury in surface water and fish.

What does this mean?

Increased permafrost thaw will affect water availability and may affect drinking water treatment for communities that rely on surface water from peatland-rich watersheds. Peatland permafrost thaw can also impact water quality, but further research is needed to understand the risk of increased mercury delivery to surface water.

Figure 2. Lauren Thompson (PhD candidate, University of Alberta) deploying sensors for monitoring of water quality in Smith Creek, near Wrigley. Credit: D. Olefeldt

What's next?

Continuing research will identify which watersheds in the Dehcho region are most sensitive to altered water quality due to impacts of peatland permafrost thaw. The focus of this research is to identify and understand potential linkages between mercury in soils and creeks and mercury concentrations in fish.

Dissolved organic matter is released from soils as they decompose. Just like tea, the dissolved organic matter then colours soil water and streams in shades between yellow and dark brown. Nutrients and elements such as methylmercury can be part of the dissolved organic matter.

Recommended Reading

Thompson, L.; Kuhn, M. A.; Sonnentag, O.; Olefeldt, D. *Mercury Patterns in Permafrost Peatland Streams and Ponds, American Geophysical Union*, Fall Meeting **2019**, abstract #B51I-2353, https://ui.adsabs.harvard.edu/abs/2019AGUFM.B51I2353T/abstract

Schulze, C.; Voigt, C.; Sonnentag, O.; Hernandez Ramirez, G.; Thompson, L.; Kuhn, M. A.; Heffernan, L.; Olefeldt, D. *Effects of Wildfire and Permafrost Thaw on Nitrous Oxide Fluxes from Boreal Peatlands in western Canada*, American Geophysical Union, Fall Meeting **2019**, abstract #B23K-2476, https://ui.adsabs.harvard.edu/abs/2019AGUFM.B23K2476S/abstract

Contacts

Dr. Oliver Sonnentag, Université de Montréal, oliver.sonnentag@umontreal.ca

Dr. David Olefeldt, University of Alberta, olefeldt@ualberta.ca

NWT Cumulative Impact Monitoring Program (CIMP199)
nwtcimp@gov.nt.ca