2026 Volume 11 | Issue 87

Government of
Northwest Territories

Research Bulletin

NWT Cumulative Impact Monitoring Program

Evaluating the Threats and Mitigative Actions: Lake Monitoring Approaches for the Peace-Athabasca Delta

Summary

The Peace-Athabasca Delta, at the Slave River's headwaters, is traditional territory of Indigenous Nations and a haven for biodiversity. Despite protection within Wood Buffalo National Park, a UNESCO World Heritage Site, concern has grown that hydroelectric dams, oilsands mines and climate change are reducing freshwater availability and polluting the Delta. A petition by Mikisew Cree First Nation in 2014 to downgrade the park's status to 'World Heritage in danger' has renewed calls for a lake monitoring program to track environmental changes, determine the cause(s), and evaluate mitigative actions. In 2015, we launched an intensive 7-year research program to monitor freshwater availability and contaminants across the Delta.

Why is This Important?

Long-term monitoring datasets help to inform and evaluate land and water use decisions and policies. For example, water releases from the W.A.C. Bennett Dam on the Peace River are being considered to increase freshwater availability in the Delta. Also, new legislation may allow the release of treated oilsands mine wastewater into the Athabasca River to enable landscape remediation. These decisions come with costs and risks for communities and landscapes farther downstream, so their effectiveness must be evaluated.

What Did We Do?

From 2015-2021, we studied 60 lakes, including seasonal (spring, summer, fall) measurement of properties of water to identify the importance of snowmelt, rainfall, river flooding and evaporation on lake water balance. To track freshwater availability across space and time, we used isotope tracers to determine evaporation-to-inflow (E/I) ratios, which compares how much water is lost by evaporation to how much water flows into a lake.

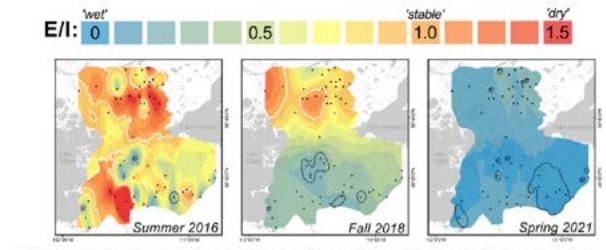
To assess for pollution, we determined the natural (baseline) concentrations of contaminants in lake sediment deposited before oilsands mining began and compared this to concentrations in sediment deposited afterwards.

What Did We Find?

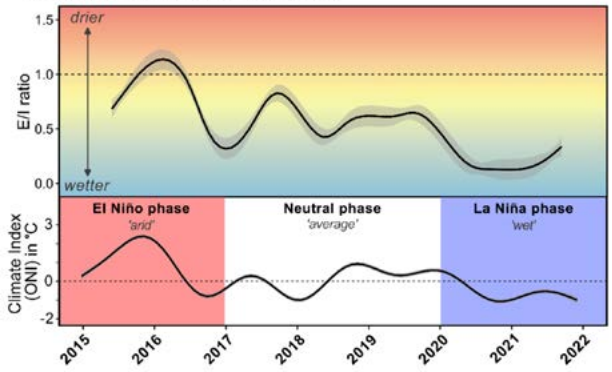
Freshwater availability: Maps of E/I ratios show where lakes are prone to drying from evaporation (orange and red areas) and where lakes receive large input of river floodwater and precipitation (blue areas). The 7-year record reveals strong influence of climate on freshwater availability in the Delta.

Contaminants: Lake sediment analyses identify enrichment of vanadium, a metal abundant in bitumen and mine wastes, at a lake within the oilsands region. Vanadium enrichment was not detected at lakes in the Peace-Athabasca Delta.

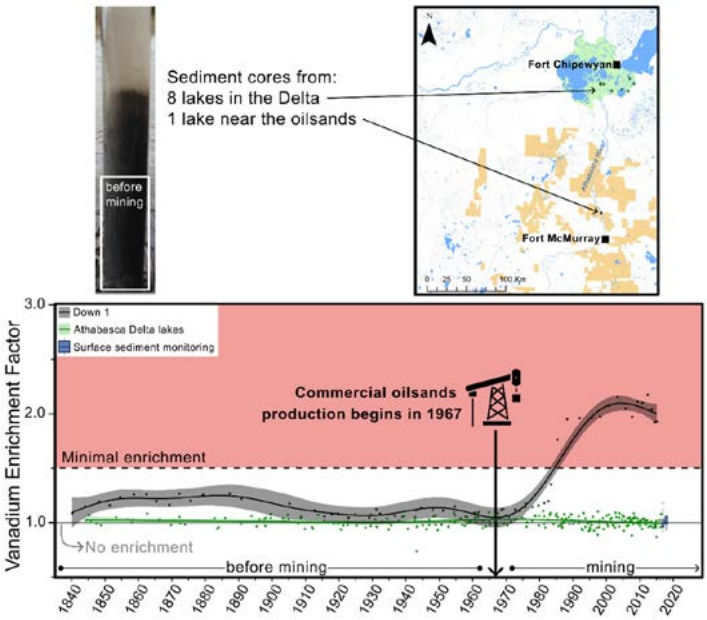
Maps of isotope-inferred evaporation-to-inflow (E/I) ratios show where lakes are re-filling, stable and drying:



Time series of E/I ratios and a climate index reveal strong control of climate on freshwater availability:



Analysis of lake sediment cores show enrichment of vanadium at a lake in the heart of oilsands development after mining began. But no enrichment is detected at lakes in the Delta.



What Does This Mean?

The methods directly address long-recognized monitoring needs, including recommendations from UNESCO which will conduct another fact-finding mission in 2026 to decide on the World Heritage status of Wood Buffalo National Park. The methods also provide decision-makers with tools to evaluate the effectiveness of new policies, mitigative actions and legislation used to better protect the Delta.

For More Information

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