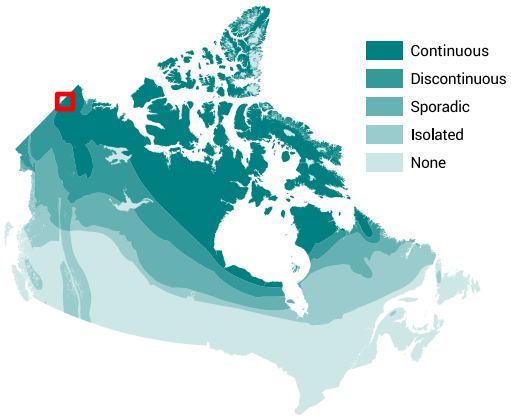
Reconstructing post-drainage evolution of an old, drained lake basin to better understand the impacts of warming on modern basins in Old Crow Flats, Yukon



Danielle Chiasson[1], Pascale Roy-Léveillée[1], and Najat Bhiry[1]
1. Centre d'études nordiques, Université Laval, Québec City, Québec, Canada.

Study locations:
Old Crow Flats, Yukon.

Keywords: Drained lake basin, thermokarst lake, tundra, peat, permafrost aggradation, radiocarbon dating.

This research provides a detailed environmental reconstruction of a thermokarst lake that drained catastrophically prior to anthropogenic climate warming. Little is known about the long-term evolution of drained lake basins (DLBs), so this more comprehensive timeline is important because it allows for comparisons between the pre-warming and current evolution of vegetation and permafrost in DLBs, and for a better assessment of climate warming's effects on rapid landscape change in thermokarst landscapes. Results will be shared with the Vuntut Gwitchin First Nation, who are concerned about the impacts of contemporary lake drainages on landscape evolution in their traditional territory.

Research summary

Old Crow Flats (OCF) is undergoing rapid changes due to increased rates of catastrophic lake drainage and landscape-scale shrubification. This study assessed whether modern trends in DLBs of OCF, such as willow shrubification and impaired permafrost recovery, are exclusive to anthropogenic climate change or part of the natural evolution of the post-drainage thermokarst cycle. Peat samples from the margin and the centre of the basin were collected to reconstruct local vegetation histories through radiocarbon-dated macrofossil records. Results show that the basin drained catastrophically approximately 700 calibrated years before present (aka 1250 AD). While tall willows develop in contemporary drained basins, there was no evidence of willow species in the reconstructed vegetation succession. Surface uplift linked with permafrost aggradation caused persistent differences in topography, hydrology, and vegetation within 300 years post-drainage. By deepening our understanding of millennial-scale development of basin conditions, better predictions of future basin development can be made and shared with the Vuntut Gwitchin First Nation.

Taking action

This study demonstrates that the rapid development of willow thickets in modern DLBs may be a contemporary phenomenon and the product of climate warming. Shrub expansion is already well documented across the Arctic and consequently altering permafrost conditions. Future warming could also slow permafrost aggradation in newly exposed sediments of DLBs following drainage. Although permafrost recovery has been documented in recently drained basins of OCF, ongoing monitoring of permafrost conditions in modern basins is recommended. DLBs are also highly heterogeneous and require additional paleoreconstructions and

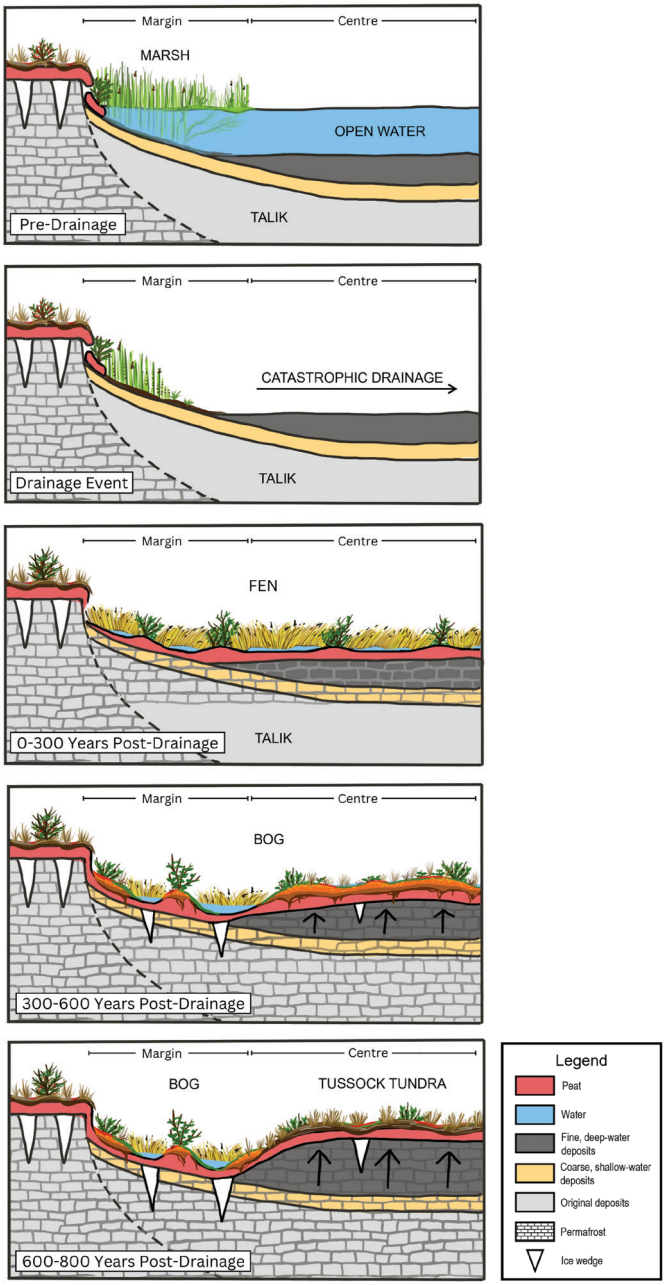


Figure 1. Conceptual model of post-drainage basin floor evolution and vegetation succession. Black vertical arrows represent frost heave at the basin centre.

monitoring that represent various stages of ecological and geomorphological basin evolution. These are some of many reasons why DLBs are important features to help better understand changing Arctic systems under a warming climate.

Connections to other projects

4 This project is part of Theme 4 - *Hazards and impacts associated with permafrost thaw* and contributes to understanding how climate change impacts traditional territories. This project was connected to other projects in Old Crow Flats, including Nicole Corbiere's project *Catastrophic thaw lake drainages and the mercury cycle* and Maria Shaposhnikova's project *Mapping and understanding how ice conditions change in thermokarst lakes over multiple decades*.

Partners, team members and support

Thanks to Caleb Charlie, Nicole Corbiere, and Samuel Gagnon for their excellent assistance and data collection in the field. I would also like to thank Josuah Tremblay at the laboratoire de paléoécologie terrestre de l'Université Laval for his invaluable laboratory support, knowledge, and guidance in my macrofossil analyses.

Acknowledgment, thanks and funding

We gratefully acknowledge that this research was done in the beautiful Traditional Territory of the Vuntut Gwitchin First Nation. We would like to thank the Vuntut Gwitchin Government and the community of Old Crow for their ongoing support of this project. Funding for this project was supported by the National Sciences and Engineering Research Council of Canada (NSERC), NSERC PermafrostNet, and Polar Knowledge Canada.

References

Chiasson, D., Roy-Léveillée, P., and Bhiry, N. (2024). 'Post-drainage evolution of an old drained lake basin in Old Crow Flats, Yukon, Canada', in Beddoe, R. and Karunaratne, K. (eds.) 12th International Conference on Permafrost Proceedings. 12th International Conference on Permafrost, 16-20 June 2024, Whitehorse, Yukon, Canada. Volume II: Extended Abstracts, 405–406. Available at: https://www.permafrost.org/wp-content/uploads/ICOP2024-Proceedings-Volume-II-Extended-Abstracts.pdf

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