UW College of Agriculture and Natural Resources

Global Perspectives Grant Program

Project Report Instructions

A brief written report must be submitted electronically to the AES office **within one month of returning from your trip**. Photographs supplementing the report are encouraged and are appreciated by the donor. Failure to submit a report may jeopardize future funding from AES.

In addition to forwarding these reports to our benefactor, reports will also be published on the AES website—do not include any photos that require permission to post to our webpage. Reports must be written in a style **understandable by the lay person** and may be edited for readability before being published to the AES website or the University of Wyoming Foundation report.

Format: Use 12 point type, single line spacing, and one inch margins. Submit your report to aes@uwyo.edu as a single PDF file.

Include the following information:

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1. COVER PAGE

Award Period (e.g. Spring 2012): **Summer 2023**

Principle Investigator(s)Kristina Hufford Department: ESM Email: khufford@uwyo.edu

Project Title from Application: _____

Amount spent: 4210.00

Non-technical summary (max 1500 characters plus spaces): Provide a one paragraph non-technical summary that most people can understand.

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2. REPORT: Maximum of two pages of text; in addition, please also include **photos**. Must be written in a style understandable by a general audience.

Include:

1. Main results of activities planned in the proposal**.**
2. Describe any future plans
3. Outline potential impacts to a) the College of Agriculture and Natural Resources, b) the University of Wyoming, and c) the State of Wyoming
4. Photos

QUESTIONS? Contact Joanne Newcomb in the Agricultural Experiment Station office at aes@uwyo.edu or (307) 766-3667.

Crossing Borders: Alberta Oil Sands Reclamation

Dr. Kristina Hufford, Associate Professor, Ecosystem Science & Management

The oil sands in Alberta, Canada are one of the largest oil reserves in the world. When oil deposits lie within 70 meters of the surface, oil is extracted using open-pit mining. Most oil, however, is too deep for direct mining and instead is extracted using in-situ recovery methods that heat the bitumen (or dense oil) deposits until they are fluid and can be pumped to the surface. Approximately 20% of bitumen reserves are surface mined and the remaining 80% are extracted with in-situ methods.

Downtown Calgary, summer 2023.

Environmental impacts of Canadian oil sands extraction share some similarities with oil and gas development in the western United States. The land surface is altered by exploration which clears vegetation and installs roads, while extraction requires additional installation of well pads, pipelines, and other infrastructure. Oil sands mining occurs in the boreal plain ecozone, a vast area of spruce forests and wetlands, primarily open lakes, fens, and bogs. Reclamation after disturbance is challenging, and researchers are working to improve methods of restoring vital wetland ecosystems.

In summer of 2023, I travelled to Calgary, Canada to learn more about oil sands reclamation with my host Dr. Felix Nwaishi at Mount Royal University, and his collaborator Dr. Bin Xu at the Centre for Boreal Research. After arriving in Calgary, a city of over one million and the headquarters of some of Canada's biggest oil companies, I drove over 5 hours north to Lesser Slave Lake, located along the southwestern edge of the Wabasca oil sands deposit. There, I joined the team from Mount Royal University during their summer field season.

To test restoration methods in peatlands near the town of Slave Lake, Dr. Nwaishi and Dr. Xu set up several research sites in mid-winter and sub-zero temperatures when the frozen ground could hold construction equipment. Mineral fill was removed and different treatments applied to restore hydrologic function and peatland vegetation. During my visit, the ground had thawed and all members of the team donned a similar uniform of rubber boots, hats and head nets to ward off flying insects, and bear repellent. We started by scouting new research sites along disturbed wetlands and seismic lines, linear strips of cleared vegetation where small explosives are detonated and seismic frequencies are monitored for oil deposits. Walking in a fen required new skills on my part, and it felt much like standing on top of a large featherbed while stepping from pillow to pillow through mounds of sphagnum moss. In one instance, I lost a boot and dug it out while my companions declared a "booter" and we all laughed at my wet sock. While losing a boot wasn't a new experience after years of field research, I had a pleasant surprise when I discovered no mud and only clear, clean water under the moss. Dr. Xu pulled up some of the sphagnum and

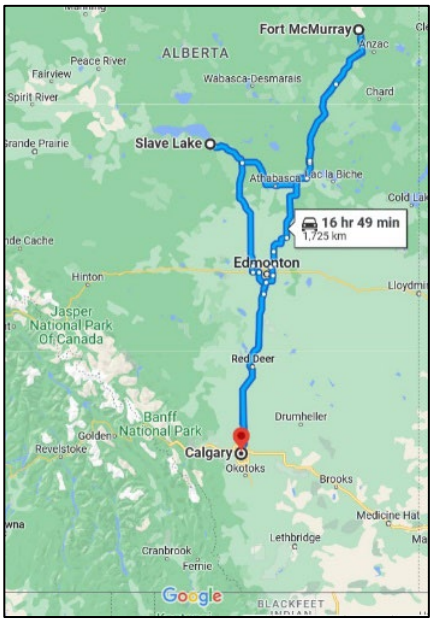

Stepping through sphagnum moss.

demonstrated how it acts like a sponge to absorb water, and serves as a dominant indicator species in bogs and fens.

The next few days, we visited the site where my hosts had removed fill and replaced the peat surface substrate or moss layer from a donor site nearby. Felix and Bin constructed their own boardwalk out of thick boards to avoid sinking into the site and disturbing the vegetatation. I remarked at the height of the tall black spruce along the site's edge, thinking they looked healthy. Felix explained that the tallest spruce were actually a sign of disturbance. Moisture levels high enough to support healthy fens result in much smaller trees stunted by the high water table. When well pads were located at the site, they weren't oriented along underlying hydrology and cut off underground water flows. As a result, taller trees occur on the dryer edge and short, highly stunted trees occur where the water levels are too high. The research is ongoing, but early results indicate that reintroduction of peatland species is critical for recovery, while restoration of hydrologic function is difficult and dependent on elevation, chemistry and available moisture. Similar to solutions I've discussed with practitioners in Wyoming, Felix pointed out that better practices at the initiation of the disturbance, such as improving wellpad orientation so to avoid distrupting underground water flow, could significantly reduce the damage to wetland ecosystems, lessening restoration costs and long-term environmental impacts.

Sphagnum moss can hold more than twenty times its weight in water.

My trip to Alberta didn't end at Slave Lake, and I drove another four hours northeast to visit Fort McMurray and observe the open pit mines in the Athabasca oil sands deposit. Fort McMurray lies at the center of oil sands extraction, producing more than two million barrels of oil a day. I toured sites near active mining and observed older, industry-initiated reclamation, much of which was upland spruce forest. After traveling south through Edmonton and back to Calgary, I departed Canada with plans to incorporate newfound knowledge of oil sands reclamation in teaching and research, including approaching restoration closer to home with the purpose of minimizing damage and improving outcomes. Much of my stay in Canada was impacted by wildfires and I often drove through a haze of wildfire smoke that served as a constant reminder of the challenges we face as restoration scientists and land managers. I will stay in touch with my Canadian colleagues and I hope to visit again one day to combine our efforts and learn more about the tools I can employ to restore the environment in regions impacted by large-scale disturbances.



Alberta, Canada is a large province and travel to the oil sands regions required a 16 hour trip north and back to Calgary.

Additional photos

The grantee prepared for a summer day in the boreal forest.

Black spruce along a reclaimed well pad.

Field crews survey a reclaimed well pad research site near Lesser Slave Lake. Slave Lake got its name from stories told by First Nations in the region.

Wetland vegetation.

Boardwalk at the research site.

Syncrude's plant in the distance near Fort McMurray and observed from an older reclamation site.