NORTHWEST TERRITORIES ENVIRONMENTAL STUDIES RESEARCH FUND

ANNUAL REPORT AND BUDGET 2023-2024

NWT ESRF | Powering Northern Energy Research

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ESRF
POWERING NORTHERN ENERGY RESEARCH

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Andrew Applejohn
Chair, NWT Environmental Studies Research Fund

Message from the Chair

I am very pleased to present the 2023-2024 annual report for the Northwest Territories Environmental Studies Research Fund (ESRF).

The NWT ESRF provided an additional year of support to the Wilfrid Laurier University multi-year project *Accelerating Recovery of Boreal Caribou Habitat via Lichen Seeding for Oil and Gas Related Remediation*. In addition, funding was provided for a sump monitoring workshop organized by the Inuvialuit Lands Administration and approval was given for a new five-year program from the University of Alberta, *Numerical Modelling of the Permafrost Thawing and its Repercussions in the NWT*.

I would like to take the opportunity to thank Richard Binder, who is stepping down as a public member on the NWT ESRF Management Board, for his time working with us. His extensive experience and advice, particularly with regards to energy industry activities in the Beaufort Delta region, will be greatly missed.

Management Board Membership

Chair: Andrew Applejohn – GNWT Member

Vice-Chair: Ken Hansen – Industry Member

Viktor Terlaky, Industry, Tourism, and Investment – GNWT Member

Chad Grummett – Industry Member

Ray Case – Public Member

Vacant – Public Member

Introduction

The Northwest Territories Environmental Studies Research Fund (ESRF) is a research program established to finance environmental and social studies relating to oil and gas activity in the NWT that will help inform decision making. The fund is supported through the collection of levies from all interest holders of petroleum lands in the onshore areas of the NWT – Exploration Licences, Production Licences, and Significant Discovery Licences alike. Levy rates are determined by the ESRF Management Board on an annual basis, and interest holders are invoiced based upon their total land holdings (total number of hectares under licence) within the onshore NWT. The Management Board is composed of representatives from government (2), industry (2) and public (2) of the NWT.

Summary of Activities 2023-2024

Communications

Project Reports added in 2022-2023 are available at **https://www.nwt-esrf.org/publications**:

- University of Waterloo, Regional hydrologic and ecologic characterization, and baseline assessment 2023-2024 report.
- Wilfrid Laurier University, Accelerating recovery of boreal caribou habitat via lichen seeding for oil and gas related remediation 2023-2024 report.
- University of Alberta, Numerical Modelling of the Permafrost Thawing and its Repercussions in the NWT 2023-2024 report.
- Inuvialuit Environmental Monitoring Sump Workshop report.
- J. Tigner, Moose winter habitat selection and boreal woodland caribou winter range prediction in the Central Mackenzie Valley, NWT April 2024

Management Board Meetings

The Management Board met in person in Yellowknife, NT on November 21, 2023.

Key program direction for the 2023/2024 fiscal year included:

1. Levy rate for industry would remain the same.
2. Three proposals approved for funding:
   - University of Alberta - Numerical Modelling of the Permafrost Thawing and its Repercussions in the NWT.
   - Inuvialuit Lands Administration - Inuvialuit Environmental Monitoring and Sump Workshop.
   - Wilfrid Laurier University (additional funding for existing project) - Accelerating recovery of boreal caribou habitat via lichen seeding for oil and gas related remediation.

2023-2024 Funded Projects

Numerical Modelling of the Permafrost Thawing and its Repercussions in the NWT

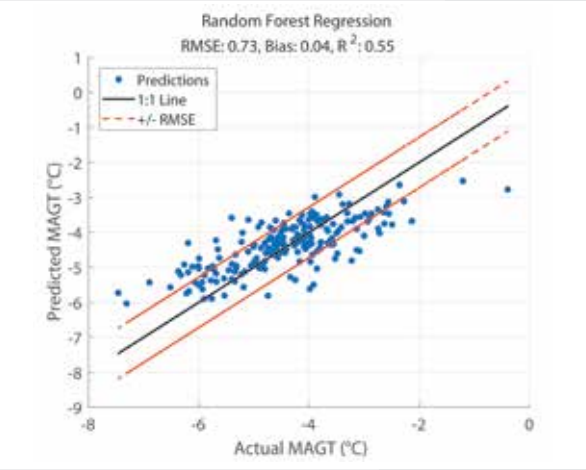
Project Lead: Dr. Vadim Kravchinsky
Organization: University of Alberta

PROJECT SUMMARY:

Over the past few years, significant advancements in machine learning (ML) techniques have enabled us to analyze complex environmental data with unprecedented efficiency and precision. ML models excel at uncovering relationships between dependent variables and various explanatory factors. Unlike traditional physics-based models, ML models provide a flexible framework for exploring environmental conditions related to topography and land cover, aspects that are often challenging to capture using only physical parameters. This report presents our first-year results on numerical modelling of permafrost thawing based on various parameter records from the Northwest Territories. We tested the capabilities of ML algorithms in analyzing permafrost thaw dynamics in the study area and implemented the ML techniques Random Forest and Neural Networks using the Matlab programming language for numeric computing. Our regression analysis of the selected data demonstrated the ML techniques' capability to construct temperature change predictions from training with actual observational data. The Neural Networks algorithm exhibited rapid learning and optimization capabilities, effectively capturing the complex relationships governing permafrost thaw rates. Error distribution analyses further confirmed the precision and reliability of the preliminary ML models in predicting temperature variations. The application of the Random Forest algorithm for predicting Mean Annual Ground Temperature revealed satisfactory predictive power and suggested directions for improvement and refinement in the next reporting year. Our study lays the groundwork for more detailed future analyses and enhancing predictive model accuracy for permafrost thaw dynamics using ML techniques.

NWT ESRF Funding:

$215,625 over five years.
Project report available at
https://www.nwt-esrf.org/publications



Random Forest Regression result illustration for the mean annual ground temperature (MAGT) prediction from the observed data.

Inuvialuit Environmental Monitoring and Sump Workshop

Project Lead: Charles Klengenberg
Organization: Inuvialuit Land Administration

PROJECT SUMMARY:

Interest in oil and gas sumps and other regional research has increased in the Beaufort Delta region due to the release of the 2020 Arktis report, IRC Drilling Sumps Failure and Climate Change Report, the completion of the Inuvik to Tuktoyaktuk Highway, and with Arctic scientists now focused on North America due to Russia's war on Ukraine. There is increased concern over the condition of sumps and the environmental risk they pose as the region warms and permafrost, which was intended to contain drilling wastes, thaws. Inuvialuit land users and Environmental Monitors discussed in a holistic context the connections between water quality, permafrost change, increased beaver activity, fish habitat, and other local landscape changes.

Valuable long-term experience was brought forward by a variety of organizations at the workshop, and many of the participants have conducted research and monitoring activities with sumps in a variety of roles. Sump assessments by industry tend to generally follow a similar approach to the Inuvialuit Water Board (IWB) sump assessment protocol, and this similarity in approaches has helped generate data that have advanced sump terrain science and knowledge about sump performance over the past 20+ years. Presentations were given on sump assessment and monitoring approaches, and the science that has evolved.

A greater role for Environmental Monitors in contributing to regulatory monitoring decision making was encouraged. Environmental Monitors currently have different levels of training, which could enable them to lead certain types of fieldwork. These include snow surveys, ground thaw depth measurements, EM31/EM38 surveys, certain drone/UAV applications, and in some cases soil and water sampling. There is a need for simple, repeatable, frequent monitoring at sumps. There is also a lot of interest in applying new technology such as expanded drone use and remote monitoring of sumps.

There is growing interest in developing Inuvialuit capacity to lead and support environmental research within the Inuvialuit Regional Corporation.

NWT ESRF Funding: $25,000
Full report available at
https://www.nwt-esrf.org/publications

Demonstration of drone by Aurora Research Institute at ILA-hosted environmental monitoring workshop, April 2023, Inuvik Photo credit Elizabeth Kolb, Inuvialuit Lands Administration

Multi-year Funded Projects UPDATES

Accelerating Recovery of Boreal Caribou Habitat via Lichen Seeding for Oil and Gas Related Remediation

Project Lead: Dr. Jennifer Baltzer
Organization: Wilfrid Laurier University

PROJECT SUMMARY:
Boreal caribou represent a culturally imperative food source for Indigenous populations throughout much of the Northwest Territories (NWT); however, habitat degradation, predation, and cascading impacts from climate change have reduced boreal caribou populations across Canada by over 30% in the past 20 years – resulting in their current designation as a Schedule 1 "threatened" species under the *Canadian Federal Species At Risk Act*. In the NWT there is concern over the cumulative effects of climate warming-related acceleration of disturbances (wildfire and permafrost thaw) coupled with development activities on boreal caribou populations. Successful remediation of sites that have been naturally disturbed by wildfire or associated permafrost decay could, in part, mitigate modern habitat loss, reducing stress on targeted boreal caribou populations. Lichen seeding techniques represent a novel remediation strategy, however, we have limited knowledge of the environmental conditions (i.e., permafrost presence, fire severity, stand age, etc.) that best promote seeded lichen establishment, particularly in discontinuous permafrost systems common to the Northwest Territories.

OBJECTIVE:
We will address this knowledge gap by determining under what landscape conditions caribou habitat recovery can be accelerated by lichen seeding.

NWT ESRF Funding: $75,000 over three years (additional $25,000 provided in 2023-2024 to original $50,000 over two years)

Project Year 3 update report available at **https://www.nwt-esrf.org/publications**

Lichens coming out of the woodwork. Photo credit: Elise Brown-Dussault

Lichens in a typical quadrat. Photo credit: Elise Brown-Dussault

Regional Hydrologic and Ecologic Characterization and Baseline Assessment of Remote Northern Canadian Terrain in Advance of Shale Oil and Gas Development

Project Leader: Dr. David Rudolph
Organization: University of Waterloo

PROJECT SUMMARY:

During the 2023-2024 field and research period, project activities remained on a no-cost extension to the initial 5-year ESRF project. During the 2023 field season, the research team was able to re-visit the Bogg Creek watershed field site. Access was not possible during the 2 previous years but during spring 2022, the airborne electromagnetic geophysical survey (AEM) was flown over the field site, with initial results being presented in the 2022 Annual Report. The focus during the past year included 4 main areas, three of which were new initiatives and two were continuing from previous years. The first of the new activities involved the collection of shallow soil cores at several locations to further characterize subsurface soil conditions and permafrost water content and mineralogy. In concert with the soil coring, soil gas emissions were collected with surface flux chambers and soil gas probes with the specific intent to analyze the carbon composition and age of soil gas leaving the ground surface at several locations within the study area. The second new activity was related to the application of terrestrial Electrical Resistivity Tomography (ERT), Ground Conductivity Meter (GCM), and Ground Penetrating Radar (GPR) at

Coring of active zone and shallow permafrost within the Bogg Creek Watershed field site. Photo credit: Hugo Crites

a series of targeted locations within the watershed area. Ongoing work included advancing the interpretation of the AEM survey data with new software and ground truth data and continuing development and application of numerical modeling tools for simulating freeze-thaw processes within the discontinuous permafrost landscape. The modeling work continues to explore the influence of transient groundwater flow phenomena on surface water systems, land form change and ecology and has been extended to accommodate solute fate and reactive transport during permafrost thaw.

The work remains focused within the Bogg Creek watershed, near Norman Wells in the Central Mackenzie Valley (CMV), NWT.

NWT ESRF Funding: $100,000/year for five years (time frame extended due to Covid delays)

Full project update available at **https://www.nwt-esrf.org/publications**

Soil gas sampling procedure with soil gas probe within the Bogg Creek Watershed field site. Photo credit: Hugo Crites

Ground penetrating radar across drill pad clearing within the Bogg Creek Watershed field site. Photo credit: Oliver Conway-White

Financial Statement of the NWT ESRF for the Fiscal Year 2023-2024

Revenue *		
Industry Levies	**$**	**201,884**
Expenses		
Administration		
Compensation & Benefits	$	-
Travel	$	(722)
Communications & Promotions	$	-
Publications	$	(2,374)
Other	$	(2,172)
Total Administration Expenses	**$**	**(5,268)**
Science Program		
Lichen Seeding For Oil and Gas	$	(25,000)
Sump Monitoring Workshop	$	(25,000)
Permafrost Numerical Modelling	$	(23,850)
Total Science Program Expenses	**$**	**(73,850)**
Total Expenses	**$**	**(79,118)**
Total 2023-2024 Surplus (Deficit)	**$**	**122,766**

Proposed Budget of the NWT ESRF for the Fiscal Year 2024-2025

Revenue *		
Industry Levies	**$**	**200,000**
Expenses		
Administration		
Compensation & Benefits	$	(28,000)
Travel	$	(15,000)
Communications & Promotions	$	(2,000)
Publications	$	(3,000)
Total Administration Expenses	**$**	**(48,000)**
Science Program		
Groundwater	$	(100,000)
Permafrost Numerical Modelling	$	(52,000)
Remediation Research	$	(100,000)
Total Science Program Expenses	**$**	**(252,000)**
Total Expenses	**$**	**(300,000)**
Total 2024-2025 Surplus (Deficit)	**$**	**(100,000)**

* Industry levies are shown in the Main Estimates in the year they are invoiced and these amounts are to fund the projects for the following fiscal year.

Summary		
Opening Balance (April 1, 2023)	$	218,127
Revenue **	$	201,884
Expenses	$	(79,118)
Closing Balance (March 31, 2024)	**$**	**340,893**

Summary		
Opening Balance (April 1, 2024)	$	340,893
Revenue **	$	200,000
Expenses	$	(300,000)
Closing Balance (March 31, 2025)	**$**	**240,893**

** The ESRF budget and actuals are provided each year in the main estimates as information. As 2024-25 progresses and information on the current budget is updated, the revised main estimates for 2024-25 will be reflected in the 2024-25 main estimates.

Levy Breakdown 2023-2024

Description	Hectares		Amount
Significant Discovery Licences	607,202	$	196,126.25
Production Licences	11,711	$	3,782.65
Pioneer Production Licences	321	$	103.68
Total	**619,234**	**$**	**200,012.58**
Location	**Hectares**		**Amount**
Mackenzie Delta / Arctic Islands	130,173	$	42,045.88
Central Mackenzie Valley	434,012	$	140,185.88
Southern NWT	55,049	$	17,780.83
Total	**619,234**	**$**	**200,012.58**

The levy rate for 2023/2024 was $0.323 per hectare.

Notes

Notes

NWT ESRF

The NWT ESRF Management Board welcomes suggestions for direct research needs from industry. Please send to the NWT ESRF Secretariat at nwtesrf@gov.nt.ca for consideration and evaluation.

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