

Northwest Territories

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Project Progress Report

Project Title

Accelerating recovery of boreal caribou habitat via lichen seeding for oil and gas related remediation.

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Project Objectives and Rationale

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.

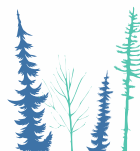
Objective: We will address this knowledge gap by determining under what landscape conditions caribou habitat recovery can be accelerated by lichen seeding.

Project Progress

(1) Synthesis of literature, data and imagery on wildfire and permafrost disturbance interactions in NWT and forage taxa recovery trends

Permafrost and Fire Disturbance Interactions – Permafrost and fire literature and in-hand data were surveyed to identify core knowledge gaps for the southern NWT region and quantify on-going permafrost decay rates at fire impacted sites. This effort resulted in a novel manuscript detailing on-going permafrost thaw rates across southern NWT with relationship to fire history and the implications for organic soils. This synthesis has also been incorporated into an international effort characterizing the relationship between local environmental conditions and ongoing permafrost decay and is expected to significantly contribute to a high impact manuscript detailing the mechanisms advancing boreal region permafrost loss in relation to fire history at the global scale.

Forage taxa recovery trends post-disturbance - Using in-hand data we have been developing models of wildlife forage recovery following fire and across a range of environmental and permafrost conditions. This includes two main efforts. The first is the characterization of lichen biomass recovery following fire. This work brought together data from NWT and a related project in Saskatchewan, thereby traversing a broad latitudinal



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gradient from northern SK to the Sahtú region and a range of permafrost conditions. This study provides a critical baseline for the current work as it established the lichen biomass recovery curves that have informed study site selection and expected recovery rates. The second effort involves modelling the post-fire recovery of forage taxa in the NWT. This focuses on a range of wildlife taxa with a goal of understanding periods of time during which caribou may face biotic pressures due to shared use of an area by other wildlife. This effort is part of a MSc project that will be complete by August 2021 and includes both a full review of the literature on wildlife forage preferences in boreal Canada and a new manuscript presenting the models described above.

(2) Lichen Seeding Greenhouse Experiment

We have established a short-term lichen seeding trial under greenhouse conditions to characterize species specific establishment rates (i.e., hyphae growth rates) and physiological stress responses to different surface substrates found in disturbed study sites throughout the NWT. Specifically, we have setup a total of 80 microcosms, contrasting the responses of five *Cladonia* species most valuable to boreal caribou (*Cladonia mitis* and *C. arbuscula*, *C. rangiferina* and *C. stygia*, *C. stellaris* and *C. uncialis*), across four surface substrates (peat, gravel, sand, bare rock), with four replicates of each treatment (5 species × 4 substrates × 4 replicates = 80). The microcosms are all held under standardized light, moisture, and temperature conditions to account for these key abiotic drivers of lichen establishment rates. The results from this effort will further inform our field seedling approach, while providing novel information on variation in stress tolerance within key caribou lichen forage species.

(3) Lichen Seeding Field Experiment

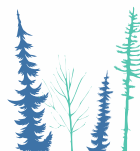
This field season we are establishing experimental lichen seeding trials in southern NWT at 75 disturbed sites that vary in terms of 1) permafrost presence or absence, 2) 2014 fire burn severity, and 3) stand age at the time of fire. Using the most stress tolerant lichen species that are valuable forage to caribou (informed by the greenhouse experiment) we will seed lichen at six replicate 1 m × 1 m plots along established 30 m transects previously used to characterize a suite of site characteristics (i.e. soil carbon content, organic layer depth, surface vegetation structure, stand dominance, site drainage). The lichen will be applied as homogenized 3 – 7 cm fragments under two different application rates during June 2021. Lichen establishment will be quantified annually at the end of the growing seasons by tracking metrics of physical establishment, vigor, and biomass as developed by Duncan (2011).

(4) Communication of Results to Date

The results of the aforementioned permafrost and fire synthesis were presented at the international American Geophysical Union meeting, with very positive reception from the academic community and government representatives from USA and Canada. The manuscript itself is now in the final stages of preparation with an actionable plan in place to submit the document to the journal Environmental Research Letters for publication. The aforementioned lichen biomass recovery manuscript has already been through the review process and is in press at Ecosphere. The results from the lichen biomass recovery paper were also presented virtually to the GNWT Wildlife and Forest Resources Divisions.

(5) Community engagement and Knowledge Sharing

We are in discussions with two NWT communities on whose lands we are conducting this research to determine their level of engagement in the abovementioned research. We have leveraged funding from NASA's Arctic Boreal Vulnerability Experiment to support an internship that will target hiring and training a



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community member as part of the research team and are collaborating with a CIMP-funded project through which there is funding for a community researcher. Active involvement in this research by the community will help to facilitate knowledge sharing. If possible, we will engage in knowledge sharing through community meetings and on-the-land events as well as through the development of digital stories and plain language documents.

