

## **Fire – lichen dynamics and the influence of climate change**

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### **Introduction:**

#### Background

Some of the central Arctic caribou herds have declined by more than 50% over the last decade and management agencies are struggling to find possible explanations and solutions. The decline threatens northern communities with strong cultural and subsistence ties to the land and the caribou resource it sustains. A lack of understanding of mechanisms that underlie population fluctuations limits predictions of change in population size and the implications of recent events, such as disturbance or climate change that may further regulate or possibly limit populations.

Predictive climate models forecast a substantial change in the weather of the northern boreal forest and the arctic tundra regions of Canada<sup>1</sup>. Increases in temperature and precipitation could modify snow conditions, increasing the energetic costs and decreasing the nutrient returns of foraging for terrestrial lichens, the primary forage species for *Rangifer* during winter<sup>2</sup>. Also, climate warming is expected to alter fire regimes across the winter range of caribou<sup>3</sup>, leading to more frequent and larger fires. Consequently, the abundance and distribution of terrestrial lichen may change<sup>4,5</sup>.

Fire is a dominant disturbance agent in boreal forests and is an important driver of vegetation dynamics<sup>6,7</sup>. Longer fire-free intervals (>40 years) have been shown to favour lichen species selected by caribou (e.g., *Cladina stellaris*)<sup>8,9</sup>. These lichens are associated with late-successional seral stages in boreal forests<sup>10</sup>, and in the short term are lost following fire<sup>5,6</sup>. Over the long term, however, fire may increase lichen abundance by controlling dominant competitors, such as moss and shrubs, and rejuvenating stagnated lichen mats<sup>8,11,12</sup>. At a larger spatial scale, the distribution of caribou may be a function of recent burns. Decreasing length of fire-free intervals, which may occur under global warming, would decrease the

abundance of forage lichens. If frequent enough, repeated fires would preclude establishment of lichens and reduce the abundance and distribution of winter range and thus caribou.

#### Purpose and Objectives

This study is part of a larger project that will integrate field-based research on caribou ecology, fire dynamics, and human use patterns of caribou within a landscape model designed to understand and forecast the long-term implications of climate change for the distribution of barren-ground caribou on the Bathurst herd's winter range. Specific objectives are to quantify the long-term fire history of the winter range and the succession dynamics of lichen-dominated habitats in relation to climatic factors.

Beneficiaries of this work include resource managers who will be better informed about methods for strategic fire planning to maintain habitat mosaics under climate change. By better understanding habitat dynamics, this work will provide more certainty for communities in the North dependent on healthy, abundant, and widespread caribou populations.

#### Personnel

Graduate Student, Mr. Nayeem Karim. Mr. Karim is in the first year of his PhD program, and will carry out the bulk of the field work. He has a Masters degree from Lakehead University. Mr Karim is in the process of writing a full proposal for his PhD studies, and he is using tree core samples collected last year by another student, to refine his proposal. He is using tree ring analysis to determine stand initiation dates (time since fire).

Dr. Kathy Lewis, UNBC. Dr. Lewis is a disturbance ecologist who has been using tree ring analysis for several years, to reconstruct past disturbance regimes. She is the direct supervisor of the PhD student, and is actively involved in data collection and analysis.

Mr. Kris Johnson, Government of NWT. Mr. Johnson is a fire behaviour and ecology specialist. He is on the supervisory committee of the PhD student, has provided data on fire history, and is involved in the overall study design and implementation.

Dr. Chris Johnson, UNBC. Dr. Johnson is a wildlife ecologist who studies resiliency of ecosystems from a wildlife perspective. He is on the supervisory committee of the PhD student, and he has extensive experience with field-based research on the Bathurst caribou. He is assisting with the study design and implantation, and with field logistics.

Mr. Bruno Croft, Government of NWT. Mr. Croft has considerable experience with caribou populations in the area, their biology and habitat requirements. He will provide assistance with field sampling logistics.

### Related Work

This study is part of a larger project as described above. The data collected from this study will stand-alone and provide information on changes in fire regimes due to climate and the impacts on lichen communities. This study will play an important role in the conclusions of the larger project.

### **Methods:**

The PhD student has undergone extensive training in tree ring analysis through his course work at UNBC. In addition, he has been working with his committee to develop his PhD thesis proposal. Field work has been limited to a one-week field trip due to the timing of this funding. During that field trip, the student met with Mr. Kris Johnson, and with community members in Gameti, and visited several field sites. A local pilot was hired to access field sites, and the field work was organized in part by the Dept. of Environment and Natural Resources, NWT and in part by UNBC researchers.

The project purpose and objectives, and a proposed methodology were presented at the Bathurst Caribou Management Plan workshop (March 2009), and feedback was received and will be integrated into the final thesis proposal.

The student also has received tree cores from another student working on the caribou ecology (T. Barrier) component of the larger project, which she collected last year from a large number of sites. He is in the process of analyzing those cores in a pilot study, which will be used to further refine his thesis proposal.

No formal surveys or interviews were held with Elders, but the student did have a chance to meet with members of the Gameti community on an informal basis, to introduce himself and the purpose of his research project. More consultations are planned in conjunction with the field work this summer.

### **Results:**

This project supported the “Monitoring and Research” category primarily although in future work it will also provide opportunities for capacity building and training. The valued components that were studied directly are “vegetation” and “caribou”. Future work will continue on these valued components, and will also include “climate change” to determine if the fire regime has changed recently as a function of climate change.

Data collection will begin this summer, so at this point few results are available. Results from the pilot study suggest that live trees in the study area will enable about 300 years of reconstruction history, that tree growth is sensitive to climate which facilitates cross-dating to determine year of origin, and that trees in the area respond particularly well to precipitation levels in June – which could be related to fire frequency.

Final results will be presented to the communities the WRRB and at the annual Bathurst Caribou Management Plan workshop. Reporting will also be conducted using several other different approaches. We will write a report that will be understandable by the general public, and we will prepare a scientific article for publication in a journal. Both publications will be available at the Environment and Natural Resources offices, and through our websites at UNBC.

**Discussion / Conclusions:**

- a. This project is part of a larger study, and is a multi-year undertaking. Most of the data collection will take place during the next two field seasons. Once completed, this project will enable better understanding of the relationship between fire regime and quality of caribou winter range, and will enable predictions of future effects of climate change on fire regime and lichen abundance.

The over-riding reason for this project is to improve our ability to manage winter range for caribou which relates directly to “human health and community wellness” of caribou-dependent communities in the north. This project will educate people on cumulative impacts by providing a better understanding of fire regime – lichen dynamics and the past and predicted effects of climate change on this relationship. This information can then be used to predict changes to caribou winter range due to climate change. The sampling protocols developed in this study can be used to develop community-based lichen monitoring programs to improve estimates of anticipated change in winter range quality.

- b. The purpose and objectives of the project were communicated to the Bathurst Caribou Management committee during an annual workshop, and informally to several community members in Gameti. In addition, formal meetings with the research team have been held, to discuss objectives and methods, and some of those team members are directly involved in caribou management. No reports, other than this one, have been prepared yet. The student’s PhD thesis proposal will be developed into a shorter, less technical information sheet that can be used to provide information to community members during the field season this summer, and it will be posted on the website of K. Lewis.

**References:**

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