

Final Report: Monitoring and Understanding Movement and Distribution of Bathurst Caribou

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2. Introduction:

a. Background and Objectives:

The Bathurst Caribou herd is in a decline with numbers falling from 1996 levels of 349,000 ($\pm 94,900$) to the more recent estimates of 186,000 ($\pm 40,000$) in 2003, and 128,000 ($\pm 50,000$) in 2006. This decline is troublesome for dependent northern communities and biologists charged with understanding this dynamic. Various hypotheses have been proposed to explain these declines including 1) over consumption and depletion of summer range in combination with climate related increases in harassment by parasitic insects; and, 2) reduced availability of lichen on the winter range resulting from more frequent fire activity.

For most *Rangifer* populations there is a long-standing and well observed relationship between behaviour and insect harassment^{1,2}. Biting and parasitic insects interfere with foraging activities, alter habitat use, and elevate energetic expenditures associated with avoidance^{3,4,5}. In particular, oestrid flies (e.g., nose bots and warble flies) can greatly alter the activity budgets of caribou. Even where high-quality forage is abundant, evasive activities (e.g., leg stomping, nose dropping, running) can limit time spent foraging.

Research on the behavioural interactions of caribou, mosquitoes, and oestrid flies has included developing predictive indices of weather condition and insect abundance as well as quantification of caribou activity in relation to harassment⁵. Although there are numerous studies, most from Europe, the results often vary between sites. Furthermore, while many of these researchers worked at the scale of the foraging patch on the short-term daily interactions of caribou and insects, very little research has quantified the broader landscape-scale effects of harassment⁶.

Winter can be a limiting season for populations of caribou^{7,8} and other ungulates⁹. We cannot dismiss the interactions with forage quality across other seasonal ranges¹⁰, but deep snow can negatively affect body condition of females ultimately leading to low birth weights of calves¹¹. And, evidence from other *Rangifer* subspecies suggests that high densities of caribou can deplete terrestrial lichen, the most common food type during winter¹². Given that the population of the Bathurst herd was at near record levels during the mid 1990s, and the past decade saw a large portion (~69%) of the winter range burned it is plausible that the observed decline is a density dependent response to a deficiency of winter forage^{13,14}. Assumed interactions between herd dynamics, winter range supply and fire is a key hypothesis with long-term strategic implications relative to climate change.

Monitoring and Research Direction

A research program should focus not only on the seasonal ecology of caribou, but also on linking ecology with population dynamics. The recently implemented body condition monitoring program for the Bathurst herd is an opportunity to relate the ecology of caribou on their seasonal ranges to body condition, a proxy of population productivity. Furthermore, with the goal of monitoring long-term trends, a research program should illuminate the range ecology of caribou while providing tools and techniques for tracking change into the future as well as investigating past trends. The proposed investigations are designed to be integrative, explore previously collected data, and develop links with other monitoring protocols.

We are in the process of developing a monitoring protocol that will provide a better understanding of foraging behaviour and movements of caribou on the winter and summer range in the context of fire and insect harassment, respectively. Where we find significant avoidance of burns or high costs in energetic expenditures, relative to insect avoidance behaviours, we will assess body condition data for linkages to population-level effects. This work is occurring over a 3-year period on the winter and post-calving/summer ranges of the Bathurst herd, as identified by collared caribou. Completion of this project will require us to achieve a number of data-related objectives specific to the two hypotheses identified above:

Winter Range:

- 1) Identify forest types and snow conditions selected by caribou during winter at the scales of the feeding site, patch and landscape that define winter range habitats.
- 2) Quantify historical changes in the total area of winter range habitat (as identified in #1).
- 3) Relate caribou movements to the avoidance or use (movement corridors, foraging) of past burns of various age classes.

Summer Range:

- 1) Measure mosquito and oestrid fly abundance in conjunction with weather parameters that might influence insect activity.
- 2) Develop a broad, easily applied index that represents the relative abundance of mosquito and oestrid flies as a product of weather and habitat/location.
- 3) Quantify the movement patterns and energetic costs of avoidance for caribou encountering parasitic insects.

b. *Study Area:*

Research and monitoring activities this fiscal year were conducted across the previously identified winter range of Bathurst caribou and will continue this summer across the postcalving/summer range⁶. The Bathurst herd is an excellent study population to meet these objectives for a number of practical and scientific reasons. The herd is actively co-managed leading to strong linkages between research and application; relevance and support from communities, governments, and local biologists; and opportunities for co-funding research. Bathurst caribou are the subject of 11+ years of ongoing monitoring of movements. These data will assist with understanding macro-factors and long-term variation in distribution. The herd has an exceptionally large and variable migration² pattern covering an annual range of $\approx 412\,000\text{ km}^2$. Diversity of vegetation and variation in snow, climate, fire history, fire regime, and human disturbance across the range provide opportunities for quasi-experiments. Finally, the herd has experienced a significant decline in the last 10 years, providing an opportunity to observe and test hypotheses explaining interactions between distributions and abundance at large spatial scales.

c. *Personnel Involved:*

Field work this winter was conducted by Tara Barrier (BSc), an MSc graduate student at the University of Northern British Columbia. Tara has a large amount of experience in project management, relevant field methods, and ungulate ecology. Bruno Croft and Chris Johnson provided technical and logistical support. Bruno Croft (MSc) is the Caribou Monitoring Specialist with GNWT. His primary focus is the Bathurst herd and duties include periodic caribou surveys, annual measures of population productivity (e.g., cow-calf estimates, body condition monitoring, etc.), facilitation of research on monitoring and caribou ecology, and community relations. Chris Johnson (PhD) is an Associate Professor at the University of Northern BC. Chris has 12+ years experience working with various *Rangifer* subspecies and has published extensively in the fields of wildlife and landscape ecology.

3. Methods:

Winter Range:

During February and March of 2008, a pilot study was conducted to assess the snow conditions and general habitat characteristics of sites on the Bathurst winter range where caribou were observed foraging. Research was based out of Yellowknife, Northwest Territories, and spanned 16 days. Field methods addressed a range of objectives pertaining to the foraging ecology of caribou. Specifically, these site investigations will allow us to:

- 1) develop regional relationships between lichen biomass, lichen composition, and forest type on the winter range of Bathurst caribou;
- 2) identify forage species and snow conditions that influence selection of feeding sites and patches by caribou; and
- 3) generate estimates of lichen abundance across the winter range.

These reconnaissance-level investigations will be followed by summer vegetation inventories in June of 2008. Although future field methods (winter and summer of 2009) are currently under revision, primary goals will be similar: to identify limiting factors to Bathurst caribou during winter, presumably interactions of fire, lichen, and snow.

We used a small fixed-wing aircraft to locate caribou and investigate foraging sites. For each group of caribou encountered, we recorded the approximate number of caribou, proximity to water, and area of foraging. After landing at a site, we mapped the perimeter of the foraging patch using a Global Positioning System. Snow depth, density, and hardness were measured using a ruler, cylinder of known volume, and a custom ramsonde penetrometer¹⁵ adjacent to 5 randomly sampled foraging craters (Figure 1). Five control sites were also randomly sampled for snow depth, density, and hardness within the foraging patch. Each control site was at least 2 m from a crater. The 10 randomly selected craters and control sites were marked with flagged nails for revisitation during the summer of 2008.

Given the short duration of the pilot study, we were unable to involve community observers directly during field investigations. On several occasions community members were contacted and agreed to accompany Tara Barrier during field work. However, unanticipated scheduling conflicts resulted in last-minute cancellations. During Year 2 of the winter range investigations, we will work to secure community representatives as both observers and field staff.

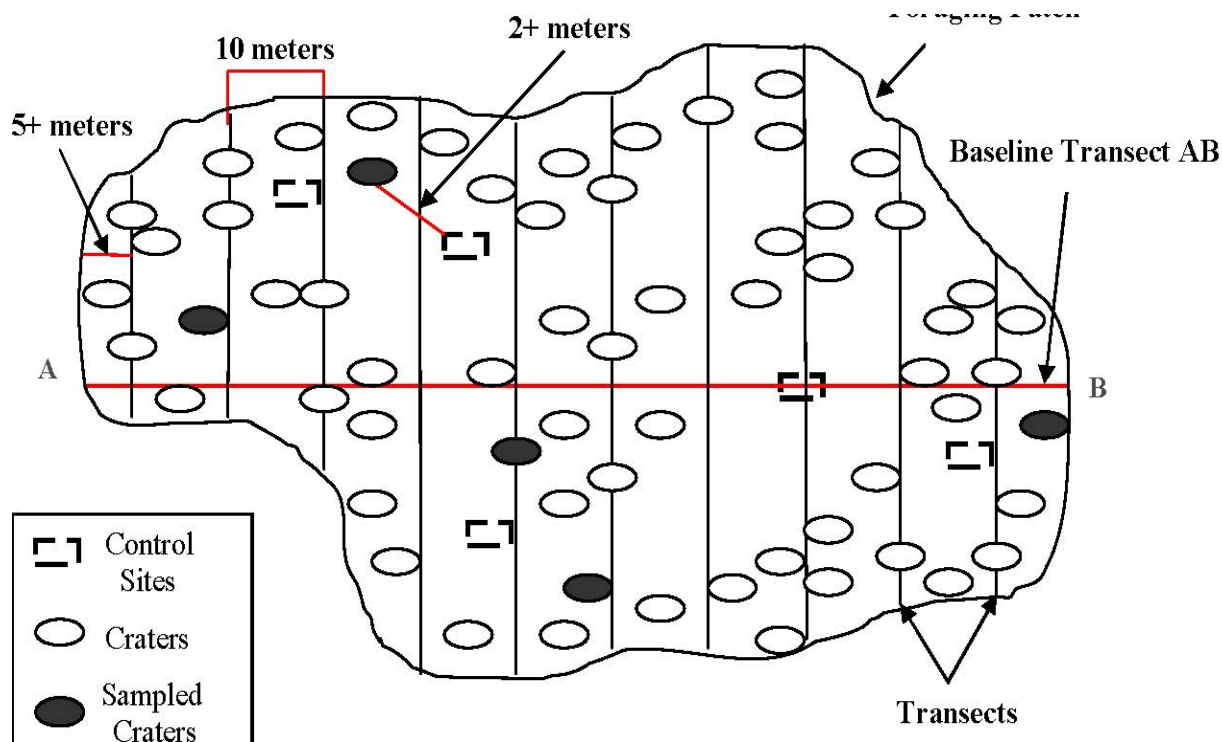


Figure 1. Sampling scheme for 2008 winter and summer investigations (Krebs 1989). Snow depth, density, and hardness were measured adjacent to 5 randomly selected craters and control sites. We marked all 10 sites with flagged nails for assessment of lichen composition and abundance following snow melt. During summer, transects will be used in conjunction with point-line intercept methods to estimate percent cover and biomass of forage lichen in the foraging patch.

Summer Range:

As proposed, CIMP funding from 2007 was used to support investigations of caribou foraging behaviour and insect avoidance activities on the post-calving/summer range. Given the fiscal-year constraints (i.e., March 31) that money was used to fund activities (aircraft charter) associated with fitting Bathurst caribou with highly precise GPS collars. Those data will provide a more refined description of caribou activity and movement on the winter range (2008-2010) as well as during summer and other seasons.

4. Results:

Between February 26 and March 5, we used a small fixed-wing aircraft to locate caribou and investigate foraging sites at 5 geographically distinct locations. All sites were located 100 to 150 km north of Yellowknife, Northwest Territories. We had anticipated sampling a greater number of sites, but poor weather (cold, visibility) and the short duration of the study period were limiting. Tara Barrier's time in Yellowknife was constrained by course obligations at UNBC. During Year 2, we will have greater flexibility in meeting sampling targets.

Average snow depth at cratered and non-cratered sites was 45.36 cm and 47.04 cm, respectively. Snow hardness was also lower at cratered (2.29 kg) than at non-cratered (2.84 kg) sites. Contrary to our hypothesis, snow density was higher at cratered (0.66 g/cm³) than at non-cratered sites (0.37 g/cm³). While there were no statistically significant differences for snow depth, hardness, or density between cratered and non-cratered sites (Fig. 2), we believe this was due to low sample sizes and variable snow conditions. New protocols are currently being developed that will allow us to increase sample sizes by focusing on both snow and lichen indices at a larger geographic scale. We intend to sample for differences in snow and lichen among patches (>1000 m separation) of similar vegetation classification where caribou are observed foraging and not (i.e., controls).

Forest types at foraging patches corresponded with observations on other winter ranges of barren-ground caribou¹⁶. Our ad hoc survey of the winter range north of Yellowknife and site investigations near burns revealed that caribou do not appear to use burns except as secondary travel routes. We observed evidence of caribou foraging in 2 main vegetation types, according to the Northwest Territories Land Cover Classification (GNWT – RWED). These include 1) scattered conifers on bedrock and 2) spruce-lichen boreal forest. Summer investigations will reveal whether caribou selected for microsites yielding high lichen biomass within these foraging patches. During summer, we will also measure total lichen biomass at each foraging patch. We will then stratify and pool 2008 and 2009 lichen biomass estimates of foraging patches according to vegetation type. This will allow us to determine the total amount of lichen available to Bathurst caribou on the winter range. Such data will facilitate the development of a monitoring index for tracking winter range productivity over time.

5. Discussion/Conclusions:

As stated in the proposal, the funding requested from CIMP will contribute to a larger collaborative research and monitoring project designed to aid in the understanding and management of limiting factors for Bathurst caribou. The direct field work completed this winter, although limited in scope, is the first stage in achieving the research and monitoring objectives for the winter and summer range projects. As an example, the balance of funding will aid with the deployment of 10 GPS collars, but the products of those expenditures will not be realised for 18 months.

We will fully implement our study design for both the winter and summer ranges over the next year. Following the application of our full suite of methods, we will report more substantive results to communities, management boards, and government. With reference to the broader objectives supported by CIMP in general and this project in particular, we recently received notification of a successful grant application to support this work. In partnership with GNWT Fire Management, we obtained a Strategic Partnership Grant from the Natural Sciences and Engineering Research Council. The CIMP funded field investigations reported here were the first step in fulfilling the broader objectives of that research partnership: understanding, predicting, and monitoring the impact of wild fire on long-term winter range availability for caribou. As a component of that larger study, we will document the implications of fire and range reduction on caribou-dependent communities.

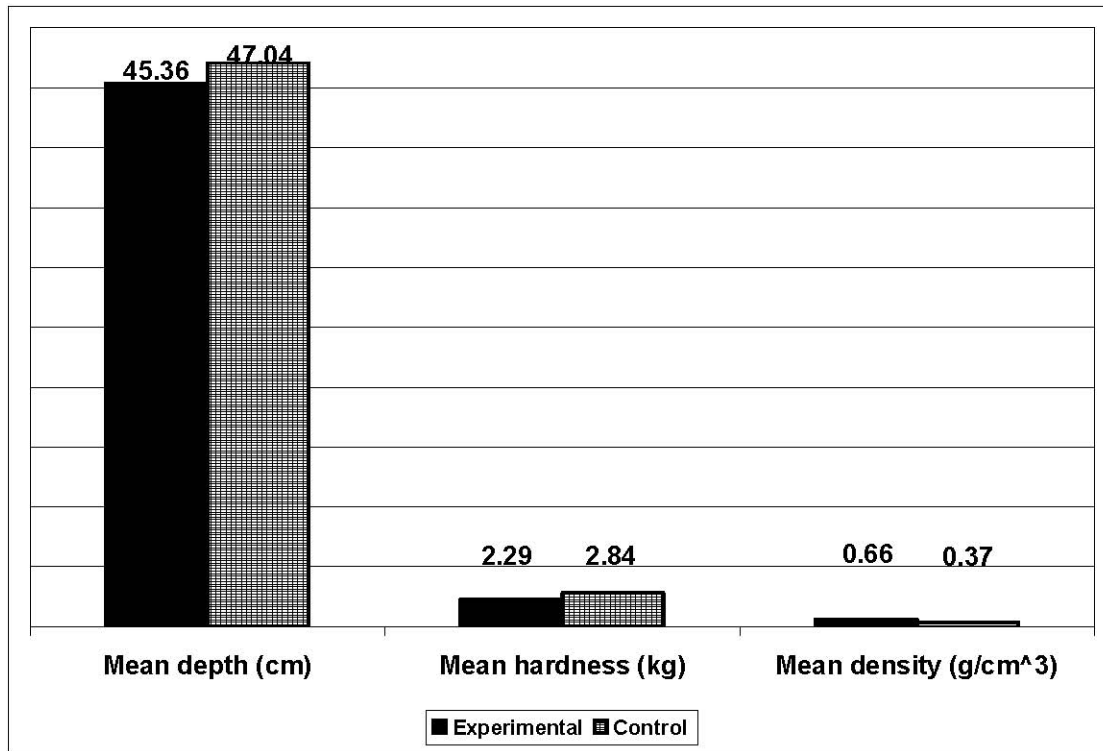


Figure 2. Average snow depth, density, and hardness at cratered (experimental) and non-cratered (control) sites. Measurements represent pooled data from 5 foraging patches where Bathurst caribou were observed feeding (February 26 to March 5, 2008).

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