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# EXECUTIVE SUMMARY

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## Identifying Factors Affecting the Succession and Availability of Terrestrial Lichen Communities in the Omineca Region of North-central British Columbia

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## Y091186 – Identifying factors affecting the succession and availability of terrestrial lichen communities in the Omineca region of north-central British Columbia

### Purpose and Management Implications

Our goal was to implement a 3-year research project to gather new information and knowledge that would help redirect and refine the management of >190,000 ha of ungulate winter range established for use by woodland caribou. Currently, winter ranges are at risk due to uncertainty about the potential impact of the MPB epidemic on UWR values. Also the economic downturn in the forest industry has limited the potential for the regular disturbance required for sustainable lichen supplies on some sites. Prescribed burning is anticipated as a test case to replace the disturbance that otherwise would have occurred from wildfires or logging.

### Project Basic Information

- Start date: April 2008
- Length: 3 years
- Former project number: NA
- Other funding sources:
  - Canadian Forest Products Ltd., Land-Based Investment Program
  - BC Ministry of Environment, Conservation Corp Program
  - BC Ministry of Environment, Forests For Tomorrow Program
- Methodology overview: We conducted field sampling to: a) assess the condition of forage in specific ungulate winter ranges, b) identify factors that would help indicate the succession pathway of terrestrial lichen communities, and c) select and establish plots for long-term monitoring of lichen forage. In addition, we refined a model of low-elevation winter range and used it to stratify UWR into those areas that required management versus those that did not. In collaboration with partners, we also developed an adaptive management plan for restoration of UWR, selected a candidate site for treatment, and conducted pre-treatment monitoring. A workshop was held with proponents to establish potential methods for implementing a prescribed burn and to insure that a burn plan could be developed for the candidate area.
- Project scope and regional applicability: Northern British Columbia
- Interim conclusions:
  - Lichen community development:
    - There are at least two patterns of vegetation community development in dry pine-lichen forests: 1) successional types that succeed to feather moss over the course of 140 or more; and, 2) pyro-climax types that appear to persist as lichen dominated sites regardless of stand age.
    - Sites with > 15 % cover of shrub lichens were generally characterized as pyro-climax lichen types, and sites with < 15% cover of shrub lichens were the successional type.
    - Sites characterized by the pyro-climax type were flatter, and had shorter trees with more open crowns (lower crown closure) compared to sites characterized by the successional type, and these attributes provided significant relationships that could be evaluated in a geographic information system to classify entire ungulate winter ranges as one of either type.
    - The soils at pyro-climax sites had a greater content of coarse fragments than the successional sites.
    - Within UWR U-7-007 we estimate there are approximately 8,247 ha of the pyro-climax lichen type and 18,785 ha of the successional type. This result can be used to prioritize areas requiring management to promote a sustainable supply of forage opportunities for northern caribou.
  - Snow interception on UWR used by woodland caribou:
    - Pine-dominated forests used as UWR by woodland caribou prior to the MPB epidemic, intercepted snow resulting in snowpacks that averaged 1.4cm less (per 10% increase in cc) than those in open areas.
    - UWR use, however, varied uniformly across the full range of canopy closure which was one of the primary factors leading to reduced snow depths.
    - We speculate that caribou might have been using increasing closed canopy stands as winter progressed and snow accumulations got deeper.
    - We also speculate that MPB-killed pine trees will not provide such opportunities for dynamic foraging behavior in the future. We predict that animals will be forced to leave low-elevation winter ranges earlier in the winter season than they would have previous to the MPB epidemic.
  - Lichen response to MPB:
    - We speculate that vegetation community development will be different on pyro-climax lichen sites compared to successional sites. We predict that after mountain pine beetle attack pyro-climax sites will persist as lichen dominated but successional sites will succeed to either creeping shrubs or feather mosses.
  - Prescribed burning as a management tool:

- Prescribed burning provides an alternate disturbance mechanism (as opposed to forest harvesting or wildfire) for perpetuating lichen communities on successional lichen sites.
- We speculate that prescribed burning will reset ecological conditions creating vegetation communities similar to those found after wildfire.
- Prescribed burning can be used to reduce impediments for caribou movement through as stand as mountain pine beetle killed stems begin to fall over.
- Implementation of prescribed burning is constrained by the lack of terrain features and by the uniform forest conditions that are experienced in pine-lichen forests because it is not necessarily possible to control fire spread beyond a treatment area.
- Site treatments, such as a stem knockdown with crawler tractors can be used to prepare selected sites for successful implementation of prescribed burning. Strategic site selection for initial areas to treat (i.e. stem knockdown and burn) can be used to shape a landscape and permit burning of adjacent areas without having to conduct site treatments.
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#### Abstract

The development of forest floor plant communities in pine-lichen forests varies throughout central British Columbia. The variation results from climatic and site level factors which can sometimes combine to produce harsh growing conditions limiting the success of vascular plants and bryophytes but allowing for development of terrestrial lichens. These harsh conditions often occur in pine-lichen forests, however, lodgepole pine trees have been extensively impacted by the mountain pine beetle (*Dendroctonus ponderosae*) (MPB) epidemic and the indirect effect of this epidemic on terrestrial lichen development is unclear. Pine forests in the southern portion of central BC have been attacked for several years and most trees have already lost their foliage, but forests in the northern extent of the region (i.e., the Omineca) are still at the early stages of MPB attack which is not anticipated to climax until 2010. Opportunities to learn about the implications of the MPB attack still exist in the Omineca by comparing sites of pre- and post-beetle attack. Understanding the indirect effect of MPB is important because terrestrial lichen communities are a fundamental feature of Ungulate Winter Ranges (UWR) used by woodland caribou (*Rangifer tarandus*). In the Omineca, UWR policy has been developed on the principles that lichen development is characterized by: a) site factors which influence the availability of soil moisture and nutrients for competing vascular plants; and b) a chronosequence during which lichens are most dominant 70 to 140 years after a wildfire but are eventually replaced by feather mosses after 140 years. We believe, however, that the ecological relationships which characterize lichen communities are more variable than previously considered and that an understanding of the variation and the interaction with MPB effects can be improve management to better insure mid- and long-term maintenance of lichen forage supply for caribou. Because lichens availability also depends on snow conditions, and snow is at least partially influenced by the forest overstory, an understanding of pre- and post-MPB forest canopy effects on snow conditions can help anticipate any additional potential dynamics in the future supply of forage for caribou due changes caused by the MPB. We undertook research within caribou UWRs in the Omineca to: 1) distinguish terrestrial lichen successional patterns, 2) characterize snow interception prior to MPB attack, 3) establish long-term monitoring sites for comparing pre- and post-beetle attack abundance and availability of terrestrial forage lichens, and 4) establish an adaptive management plan for testing alternative approaches to managing the supply of terrestrial forage lichens.

Observations made during field surveys completed over the past decade indicate some terrestrial lichen sites become dominated by feather moss communities quicker than the predicted 140 years while other sites appear as though they do not undergo change in the vegetation community beyond the lichen stage. We conducted surveys of lichen abundance on 22 sites throughout UWR U-7-007 and measured site attributes to determine if trends in development of terrestrial lichens could be observed. The observed data were used to delineate a threshold abundance of lichen at 15% cover. Sites with lichen cover below the threshold were considered to be a successional lichen type (i.e., likely to change a feather moss phase later in the cycle of vegetation succession). Those with lichen cover above the threshold were considered a pyro-climax type (i.e., lichens would continue to dominate the understory vegetation community). Eleven sites were classified in each type and logistic regression was used to evaluate site attributes generating an algorithm that was then used to classify the entire area of U-7-007. We found 18,785 ha were successional and that 8,247 ha were the pyro-climax lichen type. This new information will assist land managers to distinguish where management intervention is a priority to sustain terrestrial forage lichens and where future lichen supplies can be left to natural processes. Further spatial analyses of the two lichen types and any planned management intervention could also benefit conservation of other range values (e.g., minimizing predation risk) and help inform caribou recovery planning in general.

We were able to recover and re-analyze information about snow interception collected in 1999-2003 from 43 plots dominated by lodgepole pine prior to having been attacked by MPB. These plots were confirmed to have had foraging activity from radio-collared caribou within a few days prior to when plots were established. Canopy cover on these plots averaged about 41% but ranged from 14-93%. Confounding influences on snow interception caused by

elevation, sampling period, and magnitude of individual snowfalls was addressed by contemporary (i.e., paired across year, month, and elevation class) estimates of unrestricted snow accumulation ( $n = 3,251$ ). In general, forests dominated by lodgepole pine that were used by woodland caribou as foraging habitat restricted snow accumulation from that measured in open areas at a rate of 1.4 cm for every 10% increase in canopy closure. We also noted that caribou tended to use pine forests with a wider range of canopy closure than those of our restricted investigation of snow interception leading us to speculate that caribou could have been switching to increased protection from snow as the winters progressed. At a 1-m snow accumulation in the open, switching from a 10% closed pine stand to a 60% closed pine stand could apparently make a difference 7-8 cm in snow accumulation. Our next step will be to investigate whether this happened consistently or not and to assess snow interception on any of the same plots that have been subsequently killed by the MPB.

The effects of MPB on lichen community development have not been unequivocal creating difficulties when developing management strategies for UWR. It is currently uncertain if additional disturbance events in MPB stands are necessary to perpetuate lichen communities, or if the stands with dead overstories are best left unmanaged. In the Omineca, we speculate that MPB response will vary by lichen succession type so we established long-term vegetation monitoring quadrats on six sites situated throughout the Mackenzie forest district to help address this question. Three were located in successional lichen types and three in pyro-climax types. At each site 24 - 42 0.5m<sup>2</sup> (0.71 mX 0.71m) vegetation quadrats were permanently located. Ocular estimates of the cover of plant species were made and photographs were taken of each quadrat. The cover of shrub lichens ranged between 1.6% and 5.1% at the successional sites<sup>1</sup> and from 17.8 to 31.2% at the pyro-climax sites. All sites sampled were similar age, and sampling was done at each site prior to, or at the early onset of MPB attack. We summarized the data collected, which will be used as a base to compare subsequent observations against. Understanding the effects of MPB on lichen stands will aid managers of northern caribou winter range in the development of management strategies that ensures a sustainable supply of forage for northern caribou.

Implementation of UWR policy in the Omineca has relied on forestry operations to provide specific disturbances to rejuvenate terrestrial forage lichens. Occasional disturbances are necessary because vegetation communities other than lichens tend to dominate during latter stages of vegetation succession; at least on some sites. However, effective implementation of the policy has been confounded by the indirect effects of the MPB epidemic and stalled by the lack of forest development resulting from the poor economic climate currently existing within the BC forest industry. Prescribed burning of beetle-killed pine forests may provide an alternate disturbance mechanism since pine-lichen forests are typically associated with fire dominated natural disturbance regimes. The overall goals of this phase of the project were to eventually : 1) implement a prescribed burn treatment within a portion of caribou UWR that was deemed to require disturbance and 2) produce ecologically similar vegetation/site conditions as would have existed after wildfire. We report on the planning phases presenting an adaptive management plan to guide project implementation. Part of this implementation was tested in a partnered, companion project where we selected a study site located in the southwest portion of the Vanderhoof Forest District to implement a prescribed burn treatment. Although the range selected was characteristic of that used by caribou during winter it had only low to moderate value. Nevertheless, portions of the range appear to have advanced to the latter stages of vegetation succession and were deemed to require disturbance. Adaptive management of the site was therefore considered appropriate but the use of prescribed burn for this purpose had no precedence and management results were uncertain. Partly due to the risk of fire escape, and partly due to uniformity of forest cover and the terrain in the area, it was decided that research questions would be evaluated using a passive adaptive management framework whereby a single treatment site would be prepared in the winter of 2008/09 for burn ignition in the fall of 2009. Indicators for monitoring implementation will evaluate cost effectiveness, burn completeness, and the success of fire containment within the treatment boundaries. Indicators for monitoring ecological factors will be based on vegetation community development and the volume of debris reduced through burning. We have prepared a plan that provides an overview of the project particulars identifying the technical and administrative details associated with treatment implementation, and monitoring. Activities required for project establishment have been scheduled throughout 2008 and 2009 and include: collecting baseline monitoring data, completing site preparation (stem knockdown), and burn implementation. We expect that post-treatment results will be collected in 2010 and follow-up monitoring is scheduled for 2013.

The development of existing UWR policy was based on the best science when it was prepared, but with the understanding that continual improvement was part of the policy development process. Documenting site-level variation of pine-lichen forest and the effects of MPB are necessary steps to progress forward with the management strategies incorporated into UWR policy. In this document we provide information and guidance for resource managers helping ensure that policy works to maintain stable caribou populations throughout central BC.

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<sup>1</sup> The cover at one successional site, Kennedy Siding, was higher than 5.1% but due to survey methodologies the calculated value could not be used to represent a mean percent cover for the site.