Popular Summary

Potential implications of beetle-related timber salvage on the integrity of caribou winter range

R. Scott McNay[1], Randy Sulyma[2], Joan Voller[3], and Viktor Brumovsky[4]

Presentation Abstract

Habitat supply modelling was used to forecast the likely effects of timber salvage related to mountain pine beetle (*Dendroctonus ponderosae*) on the integrity of critical habitat used by threatened herds of woodland caribou (*Rangifer tarandus caribou*). We simulated mountain pine beetle attack and four different timber harvest options from current conditions over 90 years into the future to compare the relative supply of timber and winter range within landscapes used by caribou. The management options assessed included: (1) a base case mimicking current era constraints on industrial forest development, including general wildlife measures undertaken within winter ranges, no special significance of the mountain pine beetle epidemic, and timber was harvested if it met merchantability standards; (2) a scenario in which licensees preferred salvage of pine (*Pinus contorta*) over other timber as long as there was no significant development of infrastructure and winter ranges were specifically avoided; (3) a scenario similar to the previous one, but with harvest constraints in winter ranges temporarily suspended; and (4) a scenario similar to the previous, but with an increase in allowable annual cut. The results of these management scenarios were tabulated, compared, and the implications on timber and habitat for caribou discussed. The comparisons potentially guide salvage of timber killed by mountain pine beetle and help raise significant issues concerning conservation of winter range for woodland caribou.

KEYWORDS: *mountain pine beetle, north-central British Columbia, timber salvage, ungulate winter range, woodland caribou.*

Contact Information

1 Wildlife Infometrics Inc., 3–220 Mackenzie Boulevard, Mackenzie, BC V0J 2C0.
Email: scott.mcnay@wildlifeinfometrics.com

2 Wildlife Infometrics Inc., 3–220 Mackenzie Boulevard, Mackenzie, BC V0J 2C0.
Email: randy.sulyma@wildlifeinfometrics.com

3 Wildlife Infometrics Inc., 3–220 Mackenzie Boulevard, Mackenzie, BC V0J 2C0.
Email: joan.voller@wildlifeinfometrics.com

4 Wildlife Infometrics Inc., 3–220 Mackenzie Boulevard, Mackenzie, BC V0J 2C0.
Email: viktor.brumovsky@wildlifeinfometrics.com

JEM — VOLUME 9, NUMBER 3

McNay, R.S., R. Sulyma, J. Voller, and V. Brumovsky. 2008. Potential implications of beetle-related timber salvage on the integrity of caribou winter range. *In* Mountain Pine Beetle: From Lessons Learned to Community-based Solutions Conference Proceedings, June 10–11, 2008. *BC Journal of Ecosystems and Management* 9(3):121–126.

Introduction

Managing woodland caribou habitat, in light of the mountain pine beetle (MPB) outbreak, is bound by much uncertainty (Cichowski 2007; Whittaker and Wiensczyk 2007) surrounding the response of understorey vegetation, predator–prey relationships, the connectedness of seasonal ranges, and the risk that caribou must undergo in moving among seasonal ranges. Complicating the situation further is the forest management response to mitigate the outbreak, which could include changes to forest policy (B.C. Ministry of Forests and Range 2005).

Our goal was to reveal potential implications of different forest management options on the integrity of caribou winter range. Broad areas of ungulate winter ranges (UWRs) will undoubtedly be affected by salvage of MPB-killed timber, but to what extent and for how long? Our specific objectives were to help provide information about:

- the potential influence of the MPB outbreak on woodland caribou UWRs;
- timber salvage options that would optimize quality of UWRs and recovery of MPB-killed timber; and
- the potential need for review of UWR management direction.

Methods

We used results from simulated MPB disturbance (Walton *et al.* 2007) and hypothetical forest management options using the Spatially Explicit Landscape Event Simulator (SELES; Fall and Fall 2001) to forecast spatially explicit characterizations of the landscape from 2007 to 2100. These conditions were assessed using the Caribou Habitat Assessment and Supply Estimator (McNay *et al.* 2006) to identify effects on UWR values. Model runs were applied in recovery plan areas for three herds of woodland caribou (the Chase, Scott, and Wolverine herds) extending over 3.2 million ha in north-central British Columbia (McNay *et al.* 2008). We constructed sets of forest management options that, to the extent possible, represented real choices in determining the most efficient salvage of MPB-killed timber. A natural disturbance scenario provided a baseline reference.

The following four management scenarios were undertaken:

1. base forest management intended to mimic legislated UWR policy;
2. salvage by exploiting existing infrastructure emphasizing salvage of dead pine provided less than 1 km of new road was needed;
3. enhanced pine salvage emphasizing salvage by increasing the amount of access roads that could be built to a maximum of 30 km and allowing harvest in UWRs; and
4. enforced pine salvage with and allowable annual cut uplift.

Results

Supply of Ungulate Winter Range

The abundance of quality UWR was maintained in the short-term (next 5 years) regardless of the scenario applied. Scenario 1 maintained the most favourable UWR results for the Chase and Scott herds, and Scenario 2 provided the best results for the Wolverine herd (Figure 1). For the Chase and Wolverine herds, the amount of UWR began to decline significantly around 4 years from present and continued to decline throughout the salvage period and into the post-salvage period (after 2021). The abundance of UWR was maintained above the natural disturbance benchmark for the Chase and Scott herds regardless of the scenario applied. However, for the Chase herd, all scenarios approached the benchmark by 2040. The aggressive salvage scenarios (i.e., 3 and 4) resulted in a reduction of UWR for the Wolverine herd below the natural disturbance benchmark and this level was predicted to remain for the following 15 years.

When risk of predation and forage characteristics were considered in the assessment of UWR, the amount of quality range declined sharply from current conditions for all scenarios. For the Chase and Wolverine herds, the amount of UWR declined and then remained below the amount expected under natural disturbance (Figure 1). When predation risk was assessed, the variation among scenario results was apparently lower than when it was not considered.

Timber Supply

With the exception of Scenario 4, timber harvest was generally consistent (Figure 2). All scenarios, except Scenario 1, were successful at maintaining a high proportion of pine in the harvest (Figure 2). For all scenarios, the downward trend of the annual volume of timber harvested started at about 2017, declining significantly after 2015, and continued declining until 2070.

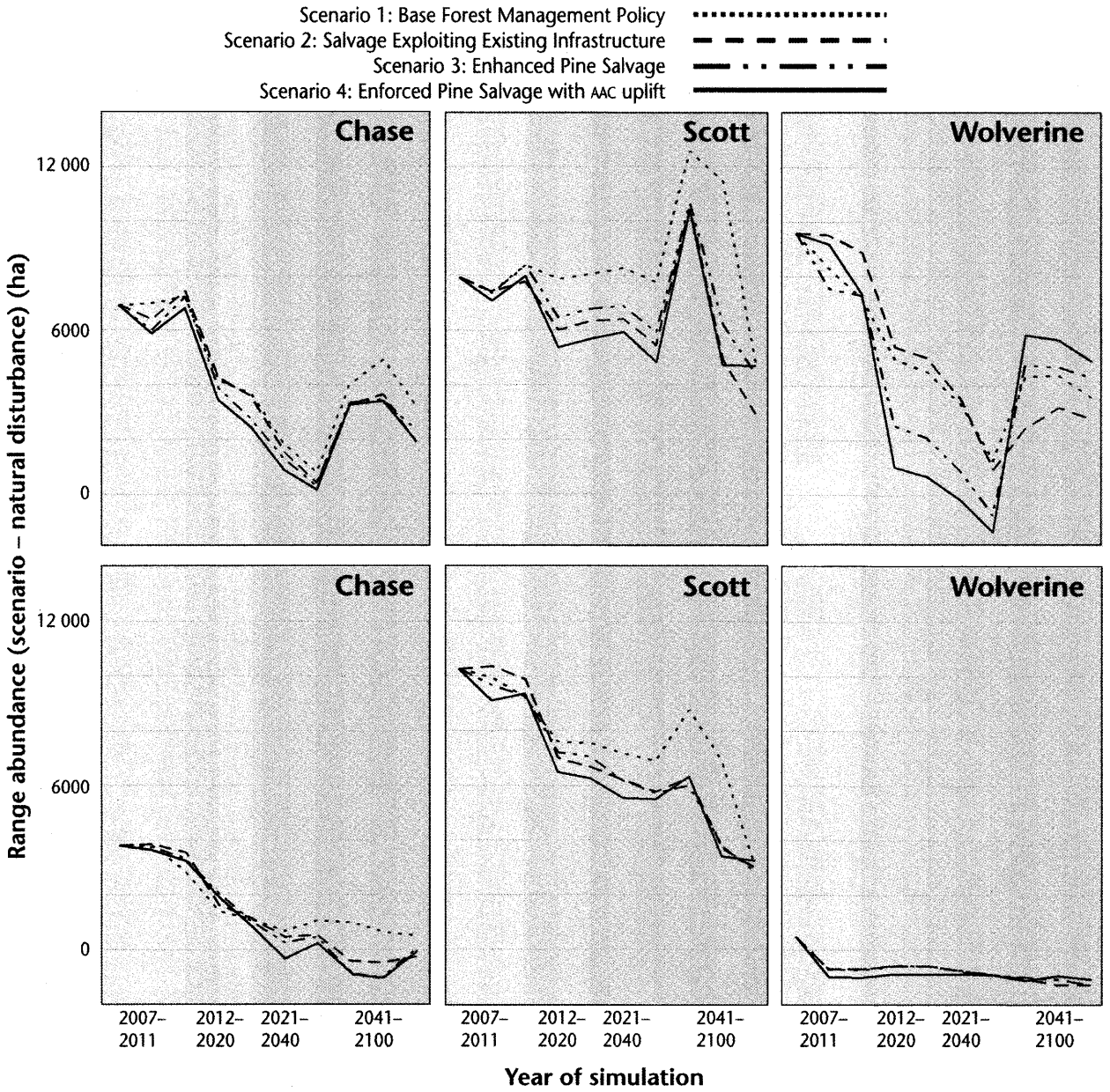

FIGURE 1. Simulation results (year 2007–2100) for management scenarios depicting the likely effects of salvaging timber killed by mountain pine beetles on the supply (range abundance) of modelled winter range used by woodland caribou herds (Chase, Scott, and Wolverine) in north-central British Columbia. Modelled range was based on areas of quality forage (top graphs) and areas of quality forage that were also free from predation risk (bottom graphs)

During the salvage period, the increase in harvest across the scenarios did not have a large influence on the amount of UWR; yet, on average, 40% more pine was recovered annually in Scenario 4 as compared to Scenario 1 (Figure 3). Conversely, the UWR constraints of Scenario 1 resulted in the lowest average annual harvest volume. In the post-salvage period, however, Scenario 1 maintained more UWR on average than the other scenarios, although the longer-term wood supply was relatively unaffected (Figure 3).

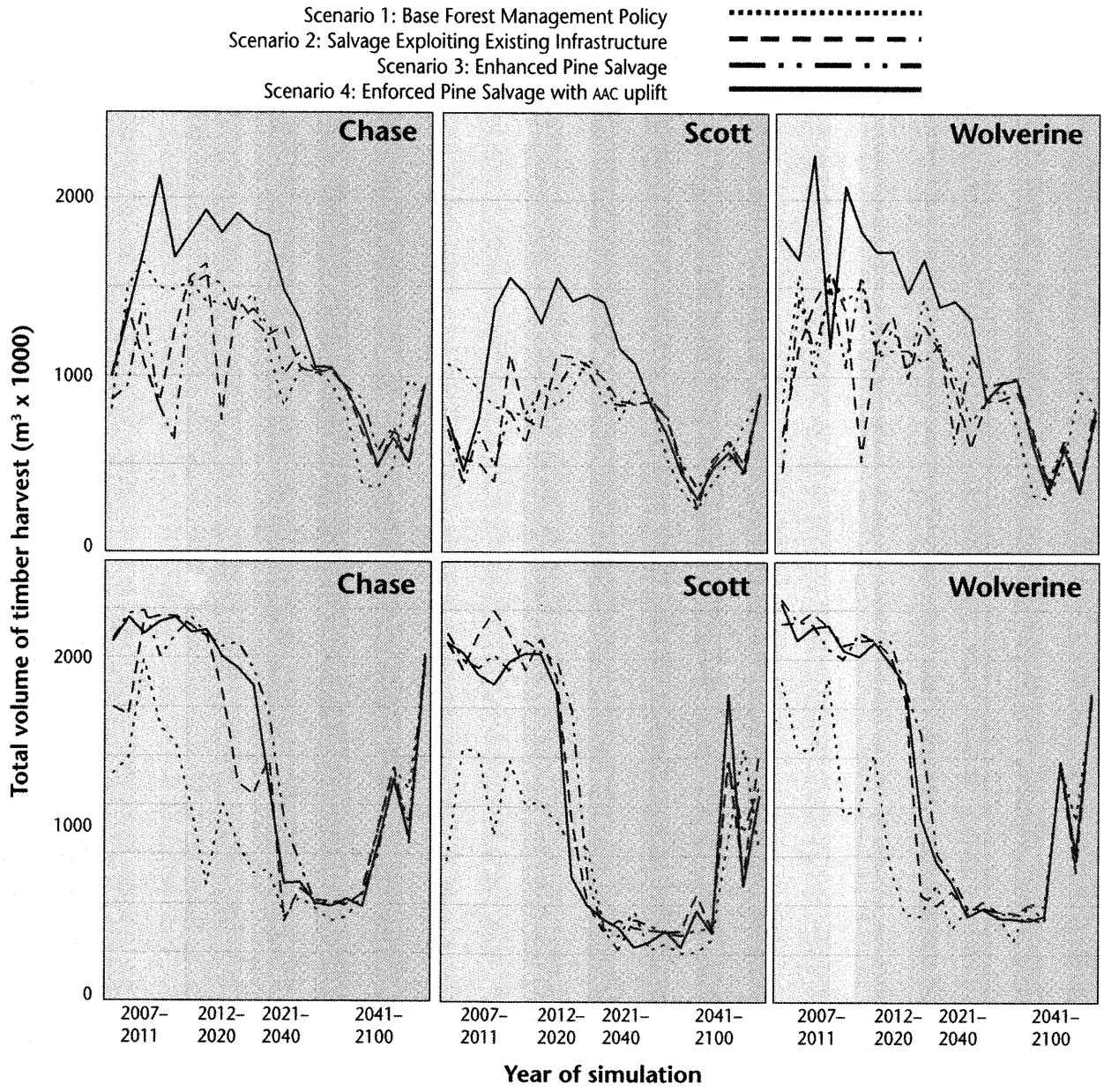

FIGURE 2. Simulation results (year 2007–2100) for management scenarios depicting the likely effects of salvaging timber killed by mountain pine beetles on the supply of timber (top graphs) and the amount of pine harvested (bottom graphs) within the range of woodland caribou herds (Chase, Scott, and Wolverine) in north-central British Columbia.

Discussion

The age distribution of pine-lichen forests within the study area was known to be skewed to stands between 70–140 years of age (B.C. Ministry of Forests 2001), implying the occurrence of widespread natural disturbances before the turn of the last century. The implication was an abundance of favourable conditions for UWR relative to the supply that can be sustained. Decline in the abundance of UWR was therefore inevitable and this was evident before consideration of the MPB outbreak (McNay *et al.* 2008). Although the natural disturbance benchmark is a useful construct (Delong and Tanner 1996; Fowler and Hobbs 2002), the apparent historic disturbance in our study areas reminds us that because of their associated level of uncertainty future forecasts should be used with caution.

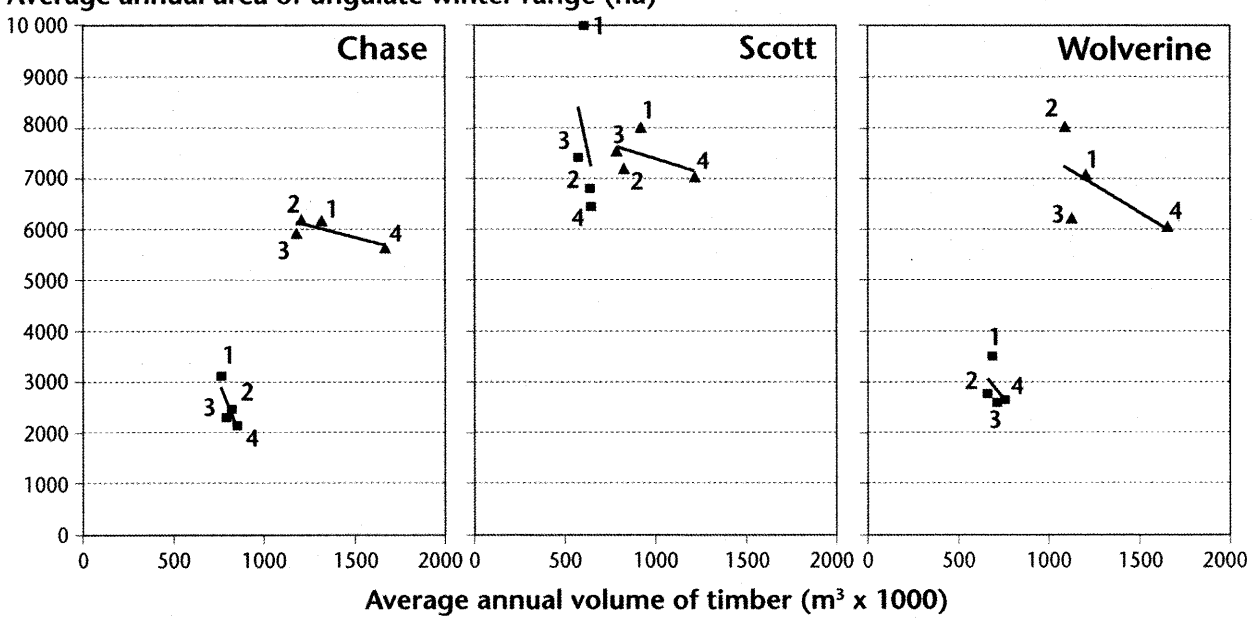

FIGURE 3. Simulation results (▲ salvage period year 2007–2020, ■ post-salvage period year 2021 to 2100) for management scenarios depicting the likely effects of salvaging timber killed by mountain pine beetles on the supply (range abundance) of modelled winter range available to herds of woodland caribou (Chase, Scott, and Wolverine) in north-central British Columbia.

Much of the pattern evident in the simulation results can be anticipated from the rules characterizing the scenarios (i.e., the models followed the scenario rules as expected). Although we attempted to construct scenarios that would diverge in results, in general we did not observe the expected variance. The disturbance intensity created by the MPB outbreak and the associated salvage logging caused an immediate reduction in UWR even when harvest of UWR was avoided. Even so, all timber supply trends converged indicating that none of the scenarios were likely to allow for the complete harvest of beetle-attacked pine. The reduction in timber supply in the latter part of the salvage period appeared to be influenced more by the degradation of wood quality than the availability of it. If wood quality was not an issue, volumes for Scenarios 1–3 should have remained higher than for Scenario 4 during the post-salvage period. Increased allowable harvest, when focussed on pine, seemed to be justified because the timber supply appeared related primarily to fibre availability.

Supply of UWR oscillated at a level of risk beyond which most habitat managers would be comfortable. Furthermore, inclusion of predation effects indicated that UWR will fall below the natural disturbance benchmark. Even when the abundance of suitable UWR rebounded in the long term, predation risk apparently remained high. Original plans for UWRs involved two management zones:

- a zone managed for terrestrial forage lichens, and
- a larger buffer area managed to minimize predation risk.

However, most UWRs were implemented without this buffer. The relative lack of difference among the simulation results when predation risk was considered indicated the lack of buffer areas was significant.

Counterintuitively, avoidance of UWRs by licensees (Scenario 2) is anticipated to result in a stronger deficit of the range in the long term and emphasizes the need for regular management of UWRs. Direct comparisons between supply of range and timber among the four scenarios support the notion that there were obvious tradeoffs to consider. Low variation among the UWR results in the short term indicate that the development of additional strategies could be implemented to maximize the benefit to wood fibre production. In the longer term, developing a management scenario with a lack of consideration for quality range appeared to produce poorer range conditions than strategies designed to maintain range values.

Research and Management Recommendations

The tactical management of UWRs (Scenario 1) and relaxation of harvest restrictions in certain UWRs (Scenario 3) may promote the maintenance of UWR in the long run and promote greater liquidation of MPB-killed trees. Since none of the simulated scenarios were able to harvest all MPB-killed pine, we recommend strategic selection of areas adjacent to UWRs that should not be harvested in the short term (i.e., defacto buffer areas to reduce predation risk). Also, strategic selection of harvest areas within UWRs will provide opportunities for recruitment of new UWR and help reduce the anticipated longer-term deficit in UWR supply. Selection of protected UWR should focus on areas where terrestrial lichens are judged to be the climax, rather than successional, vegetation structure. These sites tend to be relatively less productive for timber growth. By comparison, disturbance zones could be focussed where MPB attack is judged to lead to future decreases in snow interception or to accumulations of dead timber that will restrict caribou movement. These sites tend to be relatively more productive for timber growth. Alternative strategies that involve complete lack of disturbance in UWRs other than by the MPB (e.g., Scenario 2) are not likely to support the establishment of relatively stable UWR supply. If UWR is avoided, government will need to find methods to ensure the restoration of range conditions.

Acknowledgements

Thanks to L. Hulstein, S. Kuzio, A. Fall, and R. McCann. Funding was received from the British Columbia Forest Investment Account–Forest Science Program.

References

British Columbia Ministry of Forests. 2001. Timber supply review Mackenzie timber supply area analysis report. Timber Supply Branch, Victoria, B.C.

B.C. Ministry of Forests and Range. 2005. TFL 53 AAC increased in response to beetle infestation. URL: ***http://www2.news.gov.bc.ca/news_releases_2005-2009/2005for0102-000947.htm***

Cichowski, D.B. 2007. Literature review: Effects of mountain pine beetles on caribou. Alberta Sustainable Resource Development, Edmonton, Alta.

Delong, C. and D. Tanner. 1996. Managing the pattern of forest harvest: Lessons from wildfire. Biodiversity and Conservation 5:1191–1205.

Fall, A. and J. Fall. 2001. A domain-specific language for models of landscape dynamics. Ecological Modelling 141:1–18.

Fowler, C.W. and L. Hobbs. 2002. Limits to natural variation: Implications for systemic management. Animal Biodiversity and Conservation 25(2):7–45.

McNay, S., D. Heard, R. Sulyma, and R. Ellis. 2008. A recovery action plan for northern caribou herds in north-central British Columbia. FORREX Forest Research Extension Partnership, Kamloops, B.C. FORREX Series No. 22. URL: ***http://www.forrex.org/publications/forrexseries/fs22.pdf***

McNay, R.S., B.G. Marcot, V. Brumovsky, and R. Ellis. 2006. A Bayesian approach to evaluating habitat for woodland caribou in north-central British-Columbia. Canadian Journal of Forest Research 36:3117–3133.

Walton, A., J. Hughes, M.A. Eng, A. Fall, T. Shore, B. Riel, and P. Hall. 2007. Provincial-level projections of the current mountain pine beetle outbreak: Update of the infestation projection based on the 2006 provincial aerial overview of forest health and revisions to the "model" (BCMPB v4). B.C. Ministry of Forests and Range, Victoria, B.C.

Whittaker, C. and A. Wiensczyk. 2007. Caribou response to mountain pine beetle management: An expert workshop in Prince George, B.C. April 26, 2007. FORREX, Kamloops B.C.