

Understanding the Effects of Mountain Pine Bark Beetle on Woodland Caribou in Alberta

An initial research proposal to Alberta Sustainable Resources Development

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EXECUTIVE SUMMARY

Numerous research and management efforts are currently underway, with a goal to understand and mitigate the causes of decline of woodland caribou in Alberta. However, with the recent expansion of mountain pine beetle (MPB) into Alberta lodgepole pine forests, this may pose an additional threat to woodland caribou, one that is neither well understood, nor being addressed by current studies.

Beetle-killed stands have the potential to alter woodland caribou habitat in several ways, with this potential impact differing on a temporal scale with disturbance (i.e., green, red, grey attack phases and the final fall-down phase of mountain pine beetle killed stands).

The objectives of this proposal are to understand and assess:

- 1) The main effects of MPB on caribou whether, through direct effects on forest structure in beetle killed stands, or by human response to MPB through salvage logging and/or changes to forest harvest.
- 2) The impact of MPB-killed pine stands on vegetation and habitat features that are important to caribou, such as arboreal and terrestrial lichen production, and understory plant composition and ecology.
- 3) The annual change in distribution of MPB-killed stands across the study area.
- 4) The response of primary prey, such as moose, and their predators, such as wolves, to pine beetle killed stands.

Overall, this project's objectives are to assess the conservation implications of MPB outbreaks in west-central Alberta for woodland caribou, and to provide forest managers with both an

understanding of these implications and the management tools necessary to address MPB infestations while minimizing the impact on caribou habitat.

The proposed research is notable in that it will build upon ongoing efforts currently undertaken by the Canadian Rockies' Caribou Conservation Project (CRCCP) and the Foothills Model Forest Grizzly Bear Research Program (FMFGBRP). As such, we are well-positioned to take advantage of the significant research infrastructure that has already been organized and developed in regards to field logistics, personnel, remote sensing, and caribou data, and thereby address critical new conservation issues at a relatively modest cost.

PROJECT OVERVIEW

Woodland caribou populations are classified as threatened in Alberta and British Columbia, and listed federally in Canada under the Species at Risk Act (SARA). They are declining throughout their range, likely due to anthropogenic activities that are altering predator-prey dynamics (Thomas and Gray 2002, ACRT 2005). As old-growth specialists evolved to forage on arboreal and terrestrial lichens in the winter, caribou are threatened both directly by habitat loss due to human activities, and indirectly through increased densities of ungulates that favor early seral habitats (Hebblewhite et al. 2007). In Alberta, threats to woodland caribou populations are hypothesized to be caused primarily by increased wolf predation, ultimately related to large-scale landscape alteration as a result of forestry and oil and gas development. Landscape change by beetles has the potential to add to these negative cumulative impacts to caribou.

The recent expansion of mountain pine beetle (MPB) into Alberta lodgepole pine forests poses an unknown potential threat as another agent of landscape change (Bunnell et al. 2004, Chan-McLeod 2006, Cichowski 2007). Historically, lodgepole pine forests in western Canada were primarily fire-disturbance driven, with MPB outbreaks thought to be relatively rare. However, with reduced natural mortality of MPB occurring, likely because of milder winters, outbreaks have become a dominant forest disturbance in many pine stands in Alberta and British Columbia. Especially troubling is the spatial overlap of MPB outbreaks in Alberta and the present distribution of woodland caribou.

Beetle-killed stands may alter woodland caribou habitat in several ways, and the impact on caribou will differ over time since disturbance (i.e., green, red, grey attack phases and the final fall-down phase of mountain pine beetle killed stands; (Bunnell et al. 2004, Chan-McLeod 2006, Cichowski 2007).

MPB could directly influence:

1. Key elements of caribou habitat such as terrestrial and arboreal lichen abundance in beetle-killed stands;
2. Understory plant species composition;
3. Snow depth during winter because of reduced snow interception by the pine canopy;
4. Successional pathways following disturbance, potentially leading to changes in the availability of caribou habitat decades in the future.

MPB-affected stands could also indirectly influence caribou habitat through:

1. Change in densities of alternate prey such as moose or deer,
2. Landscape-scale changes in wolf distribution and abundance related to point 1,

3. Changes in migration routes and choice of caribou calving areas (Bunnell et al. 2004, Chan-McLeod 2006, Cichowski 2007) because of changes in the availability of older forest stands.

The human response to pine beetle-killed stands may range from aggressive pre-outbreak control measures, post-outbreak salvage logging to recover some financial benefits from lost timber revenue, to hands-off management where MPB-killed stands are allowed to regenerate along natural post-outbreak trajectories (Bunnell et al. 2004, Chan-McLeod 2006, Cichowski 2007). Salvage logging or other post-outbreak management actions (e.g. thinning) may be associated with increased roads and access. Through other research in Alberta, we know that roads and increased human access may also indirectly alter caribou-wolf predator-prey dynamics, increasing predation rates on caribou (Thomas and Gray 2002, ACRT 2005). **Thus, given the size of the projected outbreak area for MPB in Alberta, the overlap of MPB with critical woodland caribou habitat, and the potentially dramatic effects of MPB killed stands on woodland caribou, it is imperative to gain an increased understanding of the effects of MPB on woodland caribou in Alberta.**

There are two major research projects currently underway in west-central Alberta whose activities we hope to build upon through collaborative cooperation with the aid of ABSRD. In 2007, FMFGBRP initiated a five-year project (2007-2011) with funding from the Forest Resource Improvement Association of Alberta and Alberta Sustainable Resource Development to map and monitor MPB outbreaks and related mitigation activities in this project's proposed study area in order to understand their impacts on grizzly bear populations. The work fits into the FMFGBRP's overall objectives to produce knowledge and planning tools that will aid land use and forest management activities, and facilitate the recovery of grizzly bears in Alberta. Also in 2007, the CRCCP was initiated: a four-year (2007-2010) research effort with funding from the Canadian Association of Petroleum Producers, Shell, Parks Canada, and Weyerhaeuser Ltd. to understand landscape-scale impacts of oil and gas and forestry on caribou populations in west-central Alberta. The CRCCP's goals are to help recover caribou populations by understanding and defining critical habitat for caribou within the Federal and Provincial SARA frameworks. The broad objectives of both projects are to work cooperatively with industry, universities and governments in order to understand the links between human activities, natural disturbance, and species at risk in a fashion that promotes sustainable development and sound wildlife management. **By working collaboratively, we have an excellent opportunity to enhance our caribou conservation efforts to include a number of critical MPB-related research objectives.**

Research Objectives

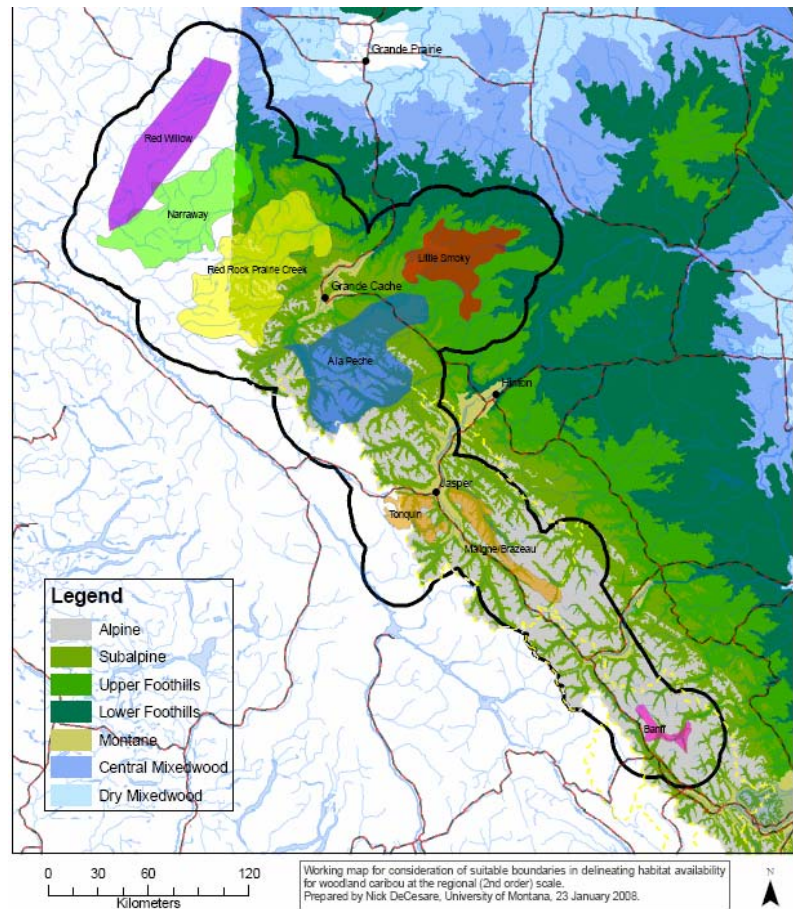
- 1) Will the main effects of MPB on caribou be through direct effects on forest structure or will it be mediated by human response through salvage logging and/or changes to forest harvest?
- 2) How do MPB-killed pine stands differ in vegetation and habitat features important for caribou such as arboreal and terrestrial lichen production and understory plant composition and ecology?
- 3) How does the distribution of primary prey such as moose and predators such as wolves change in pine-bark beetle killed stands?

- 4) How can Forest managers mitigate the impacts of beetle killed stands on caribou in west-central Alberta?

Experimental Design

The CRCCP is investigating the impacts of human development on seven caribou herds in west-central Alberta (see Figure). The proposed research project aims to understand the effects of MPB outbreaks on caribou, and will focus on the two main herds where a MPB outbreak is presently occurring; the Red Rock Prairie Creek and Narraway Herds; and, as a control, on two herds where MPB is not presently occurring at outbreak levels, the A La Peche and Little Smoky herds.

If possible, in cooperation with BC-MOF and Dale Seip (MOF research biologist), we will also investigate effects of MPB on the Red Willow caribou herd. This MPB-Caribou focal area includes the Red Willow, Narraway, Red Rock Prairie Creek, A La Peche and Little Smoky Caribou Ranges in the figure at right. **By comparing critical habitat variables in caribou ranges with and without outbreaks of MPB, we will be able to test for thresholds in response of caribou to different levels of MPB outbreak.**



Methods

This project will capitalize on economies of scale provided by ongoing mapping work in the Foothills Model Forest Grizzly Bear Research Program, as well as our regional caribou research on the effects of energy development and forestry on wolf-caribou dynamics. We will use a combination of field vegetation sampling, animal telemetry location data from caribou, wolves and moose, and spatial modeling with Geographic Information Systems (GIS). Our final goal will be to provide ABSRD with spatial GIS tools to manage the effects of MPB outbreaks on caribou habitat in a cumulative effects framework alongside ongoing forest management and oil and gas development.

We will use field vegetation data collected across a chronosequence of stand-ages of MBP-killed pine stands in Alberta and British Columbia to address the first research objective of how MPB killed stands will affect vegetation components of caribou habitat. We will work collaboratively with the FMFGBRP to leverage the significant mapping investments that have

already been made in the study area. Greg McDermid will continue to lead the development of cutting-edge remote sensing applications designed to detect, model, and map MPB outbreaks throughout the study in cooperation with the Canadian Forest Service and the University of British Columbia.

To understand the consequences of MPB-killed stands for caribou, we will use resource selection functions (RSF) (Boyce 1999) such as developed by the FMFGBP (Nielsen et al. 2004a,b, 2006) using GPS collar data from caribou deployed in the four focal caribou-MPB study areas. We will use wolf GPS data and a combination of moose GPS data and moose aerial surveys conducted in cooperation with AB-F&W across the four caribou ranges in Alberta to test how MPB-killed stands influence these key players in caribou recovery.

Finally, we will assess the conservation implications for woodland caribou of MPB outbreaks in west-central Alberta using a combination of spatial models of mountain pine bark beetle outbreak areas, caribou-wolf-moose resource selection functions, and GIS-based future cumulative effects simulations to compare the effects of future management scenarios on caribou conservation strategies (Fall 2001, McNay et al. 2006).

Combined, we will develop spatial GIS-based tools that will allow forest managers to predict the future impacts of MPB in the context of the cumulative effects of ongoing forest harvest, access management and oil and gas development, on caribou in west-central Alberta (Fall 2001, McNay et al. 2006).

Synergistic Benefits of MBP-Caribou Research

By integrating this MPB-oriented caribou research into ongoing efforts being undertaken by the CRCCP and FMFGBRP, Alberta will gain from economies of scale in field monitoring, GIS and remote sensing investments, technical expertise in statistical, GIS, and population modeling, and ties to federal, provincial and regional caribou management and recovery. Together, we have assembled a research team that includes two post-doctoral fellows, two PhD students, one MSc student, two laboratory technicians, and skilled field personnel. We are presently planning a regional conference on transboundary woodland caribou management for all project partners for 2009/2010 to integrate caribou conservation. Finally, through our collaboration with the FMFGBP led by project partners Gordon Stenhouse and Greg McDermid, we will produce caribou landscape management tools that are integrated with grizzly bear management in landscape scale application of the multi-Species-at-Risk management approach.

About the Research Team

Mark Hebblewhite is presently principle investigator of the west-central Caribou research in Alberta and British Columbia, and is an assistant professor in the Wildlife Biology Program, College of Forestry and Conservation, University of Montana, Missoula, MT. He is presently a scientific advisor to the federal Species-at-Risk recovery team for boreal woodland caribou for environment Canada, Ottawa¹, a scientific member of the Alberta Caribou Committee Research and Monitoring Subcommittee, and an ad-hoc member of the Parks Canada caribou recovery planning team. Dr. Hebblewhite's expertise lies in applied spatial ecology, predator-prey dynamics, and large-scale, transboundary conservation projects.

¹ <http://www.ec.gc.ca/scitech/default.asp?lang=En&xml=264E55C8-DD3B-4BE7-A679-DD42748388DE>

Marco Musiani is Assistant Professor with the Faculty of Environmental Design, University of Calgary (UofC). He studied at the University of Siena, Italy, and received his PhD at UofC. NSERC supported his PostDoc at the University of Rome, Italy. Dr Musiani held: NSERC (2 times); Killam Scholarship (2 times); Government of Canada Award; Government of Poland Award; and Italian National Research Council Scholarships (3 times). Dr. Musiani has a proven record as PI for ecology and management projects in Italy, Poland, ex-Yugoslavia (United Nations project), Canada, and the U.S. His research is also contributing to understanding the patterns of genetic diversity of migratory and non-migratory wolves and caribou throughout Canada.

Luigi Morgantini, Ph.D. is the Chief Biologist and Forest ecologist coordinator for Weyerhaeuser Company in Alberta and an Adjunct Professor at the University of Alberta. Luigi holds a Doctorate in Science from the University of Rome (Italy) (1974), and a M.Sc. (1979) and a Ph.D. (1988) in Wildlife Management from the University of Alberta. In 2001, he received the Wildlife Habitat Canada Forest Stewardship Award for his leadership in caribou conservation in Alberta and, in 2002, the Alberta Emerald Award for life-long environmental Stewardship. He has been involved with wildlife research and land use issues in Alberta since 1974. In 2004, he was part of the Team that developed the Alberta Woodland Caribou Recovery Plan and is currently a member of the Alberta Caribou Committee Governance Board. As the chief biologist for Weyerhaeuser Company he leads his company caribou research involvement. His interests include many aspects of ungulates ecology and behaviour, the assessment and mitigation of oil and gas developments and forest management impacts on wildlife

Greg McDermid, PhD, is a remote sensing scientist who joined the department of Geography at the University of the Calgary in January, 2005. He has studied at the University of Calgary (B.Sc., 1991; M.Sc. 1993) and the University of Waterloo (Ph.D., 2005) in areas of physical geography, GIS, and environmental remote sensing. Greg's research activities are highly relevant to this project as they revolve around environmental modeling and monitoring using remote sensing and geographic information systems. He is also a principal investigator in the Foothills Model Forest Grizzly Bear Research Program, where he works on the application of remote sensing and other geospatial tools for large-area, multi-jurisdictional resource management.

Gordon Stenhouse has 26 years of wildlife management and research experience. As the FMFGBP leader he has gathered the support and agreement from both industry and government to move forward with new grizzly bear conservation initiatives in Alberta. Mr. Stenhouse, and his research team have carried out the most comprehensive grizzly bear research program in Alberta during the past 7 years which has lead to important new knowledge and tools to aid in land use and forest management activities. The products that have been developed to date within this project are examples of what is being proposed for the new areas adjacent to the current study area. This program received an Emerald Award from Alberta Innovation and Science in 2004 in recognition of the innovative approach to sustainable forest management. More recently (October 2005) this program received a two-year grant from Innovation and Science to continue ongoing work linking landscape conditions to grizzly bear population health.

BENEFITS TO ALBERTA FORESTRY AND THE FOREST INDUSTRY

1. **Annual and quarterly progress reports showing progress to date in caribou use of mountain pine bark beetle outbreak areas.**
2. **Contributing to ongoing MPB outbreak mapping.**
3. **Extension of field research in BC on the effects of MPB-killed stands on key caribou vegetation and habitat components.**
4. **Caribou and wolf RSF (habitat maps) for west-central Alberta, as well as moose and wolf RSF maps as a function of mountain pine bark beetle-killed stands.**
5. **Development of a GIS-based spatial cumulative effects assessment modeling tools to help Alberta forest managers mitigate negative effects of MPB-outbreaks on critical habitat for SARA-listed woodland caribou.**
6. **Recognition for contribution to research in research, public presentations, communications, and websites.**

Budget Narrative

This project will capitalize on economies of scale provided by our ongoing regional research project on the effects of energy development and forestry on wolf-caribou dynamics.

Funds are requested for a dedicated post-doctoral research scientist to lead and coordinate all objectives for the MPB-caribou research, under the supervision of project supervisors Hebblewhite, Musiani and Morgantini. The GIS technician will work with McDermid's lab at the University of Calgary and the FMFGBP to ensure compatibility with existing spatial datasets and the annual updating of mountain pine bark beetle outbreak areas through remote sensing. Funds are also requested to augment and continue the FMFGBP efforts to lead remote sensing mountain pine bark beetle mapping.

Partial contribution to the overall project field coordinator will ensure collection of new caribou, wolf and moose data throughout the MPB-caribou project, and additional field assistants in summer will address the effects of MPB killed stands on lichen availability.

Funds are also requested to support field research activities associated with vegetation sampling, travel, conference and workshop attendance, as well as a portion of the ongoing research and monitoring costs associated with capturing, radiocollaring, and tracking GPS collared wolves, moose and caribou – SHELL, PTAC/CAPP and Weyerhaeuser already have contributed over \$500,000 in capital costs for GPS collars in the study area – funds from AB-Forestry are required to help maintain the sample sizes required in the study area for the MPB-caribou related research objectives.

Ongoing Project Partnerships

The proposed Beetle-Caribou project will build on ongoing research by both the CRCCP and FMFGBRP and will be able to take advantage of various economies of scale in research, field logistics, remote sensing, and especially data collected on caribou in the study area. However,

without additional funding, the Beetle-Caribou project will not get initiated, and the opportunity to address key caribou-beetles management questions will be lost.

Synergistic funding for the FMFGBP is provided by FRIAA, AB-SRD, the Foothills model forest and numerous other funding agencies (see http://www.fmf.ca/pa_GB.html for more details). Specifically, the funding for the MPB remote sensing component that will be critical to augment as part of this proposal is provided by the Canadian Forest Service, FRIAA, NSERC-CRD, and the Foothills Model Forest in collaboration with Nicholas Coop at UBC and Mike Wulders at the Canadian Forest Service with funding commitments through to 2011. Synergistic Funding for ongoing caribou research on the effects of energy and forestry development on caribou wolf relationships from 2007 to 2010 and is provided by: CAPP, Weyerhaeuser Company, Shell Company, Parks Canada, the University of Calgary, the University of Montana and the University of Calgary.

Beetle-Caribou Proposal Budget
Proposed Start Date May 1, 2008

	Year		
<u>Description</u>	<u>2008</u>	<u>2009</u>	<u>2010</u>
<u>Personnel</u>			
Post-doctoral Research Scientist - UofCalgary	\$37,500	\$58,500	\$29,250
GIS research technician – Foothills Model Forest Grizzly Bear Project (FMFGBP)	\$28,125	\$58,500	\$19,305
Field Research Coordinator – UofCalgary/FMFGBP	\$13,650	\$13,650	\$13,650
Principle Investigator – UofMontana	\$6,884	\$7,159	\$7,445
<u>Remote Sensing Monitoring of MPB</u>			
GIS & Remote sensing imagery, processing, hardware - FMFGBP	\$20,000	\$20,000	\$20,000
<u>Travel/Field Expenses</u>			
4x4 Truck Rental	\$10,000	\$10,000	
2 4x4 ATV rental & gas	\$8,000	\$8,000	
Bi-annual cooperators workshop travel	\$4,000	\$8,000	\$6,000
Conference travel	\$2,000	\$4,000	\$6,000
<u>Equipment</u>			
High performance computer	\$6,000		
Miscellaneous field equipment	\$5,000	\$2,000	\$2,000
GPS collar refurbishment, re-deployment costs	\$0	\$6,000	\$3,000
<u>Contracted Services</u>			
Caribou Forestry Interface Expert Support	\$10,000	\$10,000	\$10,000
Helicopter support for Beetle sampling – administered through FMFGBP	\$20,000	\$20,000	\$20,000
Fixed-wing aerial telemetry	\$12,000	\$12,000	\$12,000
Summary of Direct Costs	\$183,159	\$237,809	\$148,650
UofC Overhead (15%)	\$27,474	\$35,671	\$22,298
Total Project Costs	\$210,632	\$273,480	\$170,948

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MPB infested trees on caribou spring-fall ranges – Belcourt valley – July 2007