

Title: Effects of a Mountain Pine Beetle epidemic on Northern Caribou habitat use, migration and population status

Project Description: The Tweedsmuir-Entiako caribou population summers in the North Tweedsmuir Park area, and winters in the Entiako and East Ootsa areas. During winter, caribou select mature lodgepole pine forests where terrestrial lichens are abundant, and forage primarily by cratering through the snow to obtain terrestrial lichens. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has recently listed all caribou in the Southern Mountains National Ecological Area (SMNEA), which includes the Tweedsmuir-Entiako population, as Threatened. The Recovery Strategy for Northern Caribou in the SMNEA in BC identifies research on the effects of mountain pine beetles on Northern Caribou as a priority. One of the greatest threats currently facing most Northern Caribou populations in BC and Alberta is the impact of the extensive mountain pine beetle outbreak. Since this scale of mountain pine beetle attack has been unprecedented on caribou ranges in recent history, there is no information available on the effects of mountain pine beetles on caribou, making it difficult to develop management prescriptions that minimize impacts to caribou. The Tweedsmuir-Entiako caribou population is the first caribou population to experience the current mountain pine beetle epidemic. All Northern Caribou populations in BC and Alberta are at risk of experiencing the mountain pine beetle epidemic due to climate change and a northerly expansion of mountain pine beetle distribution. Therefore, information collected on the Tweedsmuir-Entiako population will benefit all Northern Caribou populations.

The current mountain pine beetle epidemic was detected in the East Ootsa and North Tweedsmuir Park areas in the mid 1990's. By the late 1990's, mountain pine beetle numbers reached epidemic levels on both summer and winter ranges. By 2006, most mature lodgepole pine stands in the Tweedsmuir-Entiako caribou winter range were in the "grey attack" phase of the epidemic.

Three of the most critical questions that need to be answered regarding effects of mountain pine beetles on caribou are:

- How will caribou winter habitat be affected by mountain pine beetle attack? (i.e. how will terrestrial lichens respond? will snow accumulation increase due to a loss of canopy and/or will eventual blowdown lead to impeded movements?)
- How will caribou habitat use and winter range use be affected by extensive mountain pine beetle attack? (i.e. will caribou avoid using mountain pine beetle-attacked habitats for traveling or foraging during winter and migration and/or will they alter foraging strategies in beetle killed areas?)
- How will caribou population dynamics be affected by extensive mountain pine beetle attack? (i.e. will mortality rates and causes, and/or population growth change following the mountain pine beetle epidemic).

In 2001, a project was initiated in the East Ootsa and Entiako areas to monitor the response of terrestrial lichens to mountain pine beetle attack and forest harvesting, and to monitor changes in coarse woody debris as an indicator of movement barriers. Preliminary data from 2003 and 2005 suggested that kinnikinnick is proliferating on some sites and affecting terrestrial lichen abundance. By 2007, the increase in kinnikinnick growth slowed with significant kinnikinnick mortality observed on some plots. However, until fieldwork for this caribou habitat use project was initiated in 2005/06, no information had been collected on how caribou habitat use is changing in response to mountain pine beetle disturbance or whether population dynamics have been affected. Mountain pine beetle disturbance could presumably start affecting caribou habitat use now that trees have lost their dead needles, potentially changing snow interception. It is important to examine both changes in caribou habitat and changes in caribou habitat use and population dynamics to determine the overall impacts of mountain pine beetles on caribou.

The purpose of this project is to address the second question - How will caribou habitat use and winter range use be affected by extensive mountain pine beetle attack? Caribou select habitat at different spatial scales and therefore will likely respond to disturbances on different spatial scales. At the landscape scale, caribou may avoid large areas within their ranges if large-scale disturbances or increased human activity occurs. Also at the landscape level, caribou occasionally shift their range use patterns, presumably to avoid overgrazing of lichens. Therefore, large-scale disturbances such as this mountain pine beetle epidemic could affect their ability to shift ranges. At the stand level, caribou may continue using individual stands affected by disturbance if they are interspersed within undisturbed areas. For example, caribou may continue to use mountain pine beetle killed stands if they are able to travel to them in unaffected stands. That is, they may tolerate barriers to movement within the stands that they forage in if sufficient movement is possible in adjacent stands.

In addition, the population currently appears to be declining and therefore winter range use patterns need to be addressed in the context of a declining population. Since recovery planning needs to address both critical (current) and recovery habitat, the ability of caribou to use beetle-attacked winter range will be an important consideration for the recovery group when determining the amount and configuration of recovery habitat required compared to what is currently available.

This project "Effects of a Mountain Pine Beetle epidemic on Northern Caribou habitat use, migration and population status" was initiated in 2005/06 with funding from Ministry of Environment, Morice & Lakes Innovative Forest Practices Agreement (IFPA) and Houston Forest Products. In 2006/07, monthly radio-telemetry flights were funded by FIA-FSP MPB funding (Project M07-5047), and other activities were funded by Ministry of Environment and the Morice & Lakes IFPA. FIA-FSP MPB funding continued for 2007/08 for monthly radio-telemetry flights as Project M08-6047 and for 2008/09 as Project Y09-1159. Other activities in 2007/08 and 2008/09 were funded by Ministry of Environment - Mountain Pine Beetle Response funding, the Morice & Lakes IFPA, and Habitat Conservation Trust Fund.

The Ministry of Environment has been tracking radio-collared caribou in the Tweedsmuir-Entiako area for 20 years, resulting in a large pre-mountain pine beetle attack database. Preliminary information from this project from 2006/07 and 2007/08 suggests that caribou habitat use and winter foraging strategies in grey mountain pine beetle attack are similar to strategies prior to mountain pine beetle attack. Data collection is currently being conducted in 2008/09, the final year of fieldwork for the project, and data analysis and completion of a final report is planned for 2009/10.

Another similar project (Response of woodland caribou to partial retention logging of woodland caribou ranges attacked by mountain pine beetle; FSP M07-5049) is being conducted on the Kennedy-Siding caribou population. The two projects are complimentary since this project focuses on caribou habitat use during the "grey" phase of the mountain pine beetle epidemic, while the Kennedy-Siding caribou project focuses on caribou habitat use during the "green" and "red" attack phases of the epidemic and also investigates the effects of mountain pine beetle management/salvage logging.

Project Current Year Objectives:

Objective: (1) To analyze data collected from 2006/07 to 2008/09.
(2) To compare information collected during this study (during the grey phase of the mountain pine beetle epidemic) with information collected prior to the mountain pine beetle epidemic.

- (3) To complete a final report for data collected from 2006/07 to 2008/09.
- (4) To develop winter habitat management strategies for caribou populations experiencing mountain pine beetle outbreaks.

Current Year Objectives – FSP funding:

- (1) To support a portion of the project biologist fees.

Long Term Objectives:

- (2) To assess the effects of the mountain pine beetle epidemic on Northern Caribou migration and winter habitat use.
- (3) To use information collected during this study to provide wildlife and forest managers with baseline information on the effects of epidemic mountain pine beetle numbers on caribou.
- (4) To develop winter habitat management strategies for caribou populations experiencing mountain pine beetle outbreaks.

The first year of this project (2005/06) focused on purchasing radio-collars and collaring animals. The second (2006/07), third (2007/08) and fourth (2008/09) years focused on collaring animals, conducting winter ground investigations, and conducting monthly radio-telemetry flights. A final report will be completed in Year 5 (2009/10).

The objectives for the 2009/10 Forest Sciences Program funding portion of the project are:

- to support a portion of the project biologist fees; and,
- to complete a final report.

Experimental Design and Methods: Long-term and short-term objectives will be achieved through a 3-year field study of radio-collared caribou. This project was initiated in 2005/06 (Year 1) with data collection starting in 2006/07 (Year 2). Year 4 (2008/09) is the final year of data collection and Year 5 (2009/10) will focus on the final data analysis and report. Information collected in 2006/07, 2007/08, and 2008/09 will be used to fulfill the 4 current year objectives for 2009/10 and the 3 long-term objectives.

To assess the effects of the mountain pine beetle (MPB) epidemic on caribou habitat use at the landscape level, ideally, caribou seasonal movements and habitat use would be studied prior to, during and following MPB attack. The Ministry of Environment has been tracking radio-collared caribou in the Tweedsmuir-Entiako area for 20 years. All data collected during the 20-year period has been analyzed and summarized in Cichowski and MacLean (2005).

In 2006/07, monthly radio-telemetry flights were conducted starting April 2006, fall and winter calf survival surveys were conducted in November and March respectively, and 3 sets of winter site investigations were conducted from January to March 2007. In 2007/08 monthly radio-telemetry flights were conducted along with 4 monthly winter site investigations (December 2007 – March 2008), 3 calf survival surveys (June, October, March), and mortality investigations. Additional funding also allowed an additional radio-telemetry flight for each of the 4 winter months (December to March). In 2008/09 monthly radio-telemetry flights were conducted from April to November and a fall calf survival survey was conducted in October. For December to March, bi-weekly radio-telemetry flights, 4 monthly winter site investigations (December 2008 – March 2009), and a winter calf survival survey/GPS collar removal (March) have been scheduled. Not all mortality investigations were conducted due to a shortfall in funding. Currently, 5 GPS collars and 13 VHF collars are active in the study area. The following methods describe fieldwork that was conducted in Year 2 (2006/07), Year 3 (2007/08) and Year 4 (2008/09) and data comparisons for pre- and post mountain pine beetle attack.

All radio-collared caribou were located by fixed-wing aircraft during 12 monthly flights conducted from April to March. During flights, the following information was collected for each radio-collared caribou found: GPS location, elevation, habitat description, tree status (i.e. red attack, green attack, grey attack, etc.), group size and presence of calf (if the caribou and group were seen), and other relevant information. GPS data for GPS collars will be downloaded when collars are retrieved in March 2009. All data was entered into a database following telemetry flights and checked for errors. Initial analysis at the end of March included an overview of data collected during the fixed-wing flights and any GPS data collected from GPS collars. Winter habitat selection (radio-collared caribou locations vs. habitat availability) was analyzed using caribou habitat and forest cover basemaps with Chi-squared and the Bonferonni z statistic. Winter habitat selection from this project will be compared to data collected prior to the mountain pine beetle epidemic.

Stand and site level responses of caribou winter habitat use to MPB attack was investigated by snowtracking. Following 4 radio-telemetry flights conducted from December to March, radio-collared caribou locations were used to locate caribou using areas in or adjacent to MPB attack. A helicopter was used to access sites. Fresh tracks were followed or backtracked and feeding site type (terrestrial vs. arboreal lichen feeding), general habitat class (pine, pine/spruce, spruce, etc.), disturbance class (none, forest harvesting, MPB-green, MPB-red, MPB-grey, etc.), snow depth, canopy closure and % vegetation cover in feeding craters was recorded at each feeding site. In addition, snow was excavated every 100 steps where caribou were traveling and not cratering and the same measurements were recorded at those sites. A GPS location was taken at each feeding crater and snow pit. These data will be compared to similar data collected from the 1985 to 1988 intensive winter habitat field study to assess whether caribou have changed foraging and stand level habitat selection patterns. Data from 1985 to 1988 will be entered into the same database format as data from the current study.

To address annual range use in context of a declining population, basic information on population parameters was collected with a focus on adult mortality, calf survival and recruitment, and population growth. Population parameters will be compared to those from the previous 20 years of data to assess population growth. Adult mortality will be based on annual adult radio-collared caribou mortality rates. Mortality signals from adult radio-collared caribou were investigated when feasible, to determine the fate of the collared caribou (mortality, slipped collar, etc.), to determine the cause of mortality when possible, and to retrieve the collar. Adult survival rates will be calculated using two methods; the first based on the proportion of radio-collared caribou that were still alive at the end of the year, and the second using the Kaplan-Meier estimator, which calculates survival with associated confidence limits based on monthly survival for the radio-collared caribou sample. Calf survival and recruitment were assessed by tracking the status of calves associated with radio-collared adult female caribou. A helicopter was used to locate each radio-collared caribou to see whether she had a calf. Calf survival surveys were conducted 3 times during the year: in June to determine neonatal calf survival (the June calf survival survey was only conducted in Year 3 - 2007/08); in October to determine summer calf survival; and in March to determine winter calf survival and overall calf recruitment. Population growth rate will be calculated based on adult radio-collared caribou survival and calf recruitment. All population data will be compared to population data from 1983 to 2003. Data will also be added to a Population Viability Analysis that was recently developed for the population (Cichowski and MacLean 2005).

Winter habitat management strategies for caribou populations experiencing mountain pine beetle outbreaks will be developed based on results from this study

and on discussions with other caribou biologists/managers. Caribou biologists/managers consulted will include Ministry of Environment staff (Mark Williams and Rick Marshall, Skeena Region; Chris Ritchie and Doug Heard, Omineca Region; John Youds, Cariboo Region), and Ministry of Forests and Range wildlife habitat research ecologists (Doug Steventon, Smithers; Dale Seip, Prince George; Harold Armleder, Williams Lake).

The last year of the project focuses on data analysis, completion of a final report and developing winter habitat management strategies for caribou populations experiencing mountain pine beetle outbreaks. The combination of snowtracking and using radio-collared animals provides a multi-scale approach to assessing habitat use (Cichowski 1993, Johnson 2000) and has been successfully used in the study area in the past (Cichowski 1993). Because the methods used for habitat selection and foraging behaviour for this project are the same as methods used prior to the mountain pine beetle epidemic, the results from this project could be compared directly to pre-mountain pine beetle conditions. The activities proposed for this project provide a feasible approach to addressing project objectives.

Cichowski, D.B. 1993. Seasonal movements, habitat use, and winter feeding ecology of woodland caribou in west-central British Columbia. BC MOF, Victoria, BC, Land Manage. Handb. No. 79. 54p.

Cichowski, D. and N. MacLean. 2005. Tweedsmuir-Entiako Caribou Population Technical Background Information Summary. Prepared for MOE, Smithers, BC. 199p.

Johnson, C.J. 2000. A multi-scale behavioural approach to understanding the movements of woodland caribou. PhD Thesis. UNBC, Prince George, BC. 210p.