Mountain Caribou Strategy

Cariboo-Chilcotin Land Use Plan

Mountain Caribou Strategy Update Note #1

CCLUP Mountain Caribou Strategy – 5-Year Review

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Prepared for:

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Executive Summary

The 2000 Caribou Chilcotin Land Use Plan Mountain Caribou Strategy document states that maintenance of Mountain Caribou habitat and populations can only occur if the following issues are concurrently addressed; maintaining adequate suitable habitat within caribou range, managing predation levels on caribou and limiting and regulating motorized and road access in caribou habitat. The primary purpose of this document is to review the progress on implementation of the strategy since its endorsement in 2001. Following five years of Mountain Caribou Strategy implementation, the Cariboo Regional Mountain Caribou population appears to be stable and is estimated at 320 animals. These 320 mountain caribou comprise the Wells Gray North and Barkerville sub-populations in addition to a portion of the North Cariboo Mountains sub-population. Wildlife Habitat Areas (WHAs) encompassing all of the 'no harvest' and 'modified harvest' areas were legally established in 2004 with General Wildlife Measures (GWM) for these areas being established in 2005, providing legal backing for the direction contained in the CCLUP Mountain Caribou Strategy. Silvicultural systems research has continued to monitor the effectiveness of modified harvest techniques in caribou habitat. Data collected over ten years from harvest indicate that foraging habitat can be maintained with this management approach. The 2000 CCLUP Mountain Caribou Strategy recommended snowmobile avoidance or heavily regulated snowmobile use in highly sensitive caribou areas. However, following meetings between government groups and local snowmobile clubs a less restrictive set of voluntary closure and caution zones was established in 2001. Snowmobile use of voluntary closure and caution zones within caribou habitat was monitored from 2002 to 2006. The Quesnel Highland wolf project commenced in 2001 to reduce the number of wolves preying on caribou through a combination of lethal control (via ground trapping) and sterilization of dominant pairs. This radio-collaring, reduction and sterilization program in conjunction with increasing moose harvest within caribou range is aimed to decrease adult caribou mortality and increase calf survival. From 2001 to 2004 caribou numbers within the Wells Gray North sub-population appeared to increase and calf recruitment was consistently above levels necessary to replace natural adult mortality. The continuity of the wolf management program was interrupted by lack of funding between April 2004 and November 2005 but the program has recently been reactivated with some new funding.

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Introduction

As part of the implementation of the Cariboo-Chilcotin Land Use Plan (CCLUP), the Cariboo Mid-Coast Interagency Management Committee (IAMC) tasked the Caribou Strategy Committee with the development of a regional caribou strategy for Mountain Caribou. The recommended CCLUP Mountain Caribou Strategy (MCS), developed over a period of 5 years, was put forward for the IAMC's consideration in October 2000 and was later endorsed by the IAMC in February 2001. At the time of endorsement, the IAMC saw the strategy as "our best advice on meeting the Cariboo Chilcotin Land Use Plan Higher Level Plan requirements for caribou and timber access", but specified that implementation of the strategy would require monitoring and periodic review.

The purpose of this report is to provide the first review of progress on implementation of the strategy since its endorsement in 2001. The principal questions that will be addressed will include:

- What is the status of the Mountain Caribou population in the CCLUP area?
- What monitoring and research work has been undertaken on the population since 2001?
- What progress has been made in implementing the specific recommendations in the MCS?
- Are there any emerging issues with respect to implementation of the MCS that require further work and refinement to the strategy?

Refer to **Appendix 4** for a quick summary of progress on implementation of the strategy.

National Recovery Planning for Mountain Caribou – Some Background Information

In May 2002, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Woodland Caribou within the Southern Mountains National Ecological Area as Threatened – this designation included the entire Mountain Caribou meta-population in Canada, which includes the Mountain Caribou sub-populations residing in the CCLUP area.

The national Threatened designation for Mountain Caribou set the recovery planning process in motion. In September 2002, the province released '*A Strategy for the Recovery of Mountain Caribou in British Columbia'*, which provides general direction for Mountain Caribou recovery based on the best available science at the time. The Mountain Caribou recovery strategy recommended that the Mountain Caribou range be further sub-divided to allow the development of more locally appropriate Recovery Implementation Plans. The recommended subdivisions were:

1. South Selkirks and South Purcell herds
2. Revelstoke, Central Rockies, Monashee and Central Selkirks herds, and
3. Northern populations of Mountain Caribou (includes the CCLUP area).

A Recovery Implementation Group (RIG) was established for the northern populations which met several times between January 2003 and June of 2005. The group was tasked with developing a plan that had the best chance of leading to *full recovery* of Mountain Caribou within the Hart and Cariboo Mountains. Full recovery was defined as *maintaining a self-sustaining population of Mountain Caribou distributed throughout the recovery area in perpetuity* (from the RENEW recovery handbook, (i.e. *restoring a species to a viable, self-sustaining population level)* National Recovery Working Group 2004).

The recovery group acknowledged that the major threat to Mountain Caribou is increased predation that appears to be related to habitat changes that increase the number and distribution of early seral ungulates and their associated predators within caribou habitat. They also noted that it is necessary to ensure that caribou have adequate supplies of arboreal lichens, their primary winter food source. In addition, they determined that disturbance and displacement of caribou from core winter range by snowmobiling and helicopter skiing may also be detrimental to these animals, and hinder recovery.

Key recommended recovery actions from the RIG included:

1. Prohibit forest harvesting and all road building within core caribou habitat, except in exceptional cases that are discussed in the report.

2. Restore the forested lands adjacent to core caribou habitat to a natural age class distribution that will sustain natural levels of early seral ungulates and predators.

3. Liberalise hunting to reduce early seral ungulate populations to levels that would occur in a natural forest age class distribution until habitat conditions recover.

4. Reduce wolves and cougars – through targeted reductions of specific packs or individuals – in areas where caribou herds are critically endangered until the habitat has recovered.

5. Manage snowmobiling including prohibiting snowmobiling within most core caribou habitat, with the exception of special zones that have been identified within the report.

6. Manage helicopter skiing including prohibiting heli-skiing within some key portions of core caribou habitat, and adopting practices that minimise disturbance in other areas of core caribou habitat.

Although there was consensus among the group that full implementation of these recovery actions provides the best chance of achieving the identified objective, there remained significant concerns among some members that the objective was not socially feasible.

In October of 2004 the Species at Risk Coordination Office (SaRCO) initiated a process to accelerate the recovery of Mountain Caribou in BC. In support of this work, SaRCO requested the provincial mountain caribou recovery teams and RIG's suspend their meetings until there was a decision framework in place supported by the provincial government.

Concurrently, SaRCO initiated a science-informed process to develop broad Mountain Caribou recovery options. Specific activities that have been initiated by the SaRCO for Mountain Caribou recovery include:

1. Establishing a Provincial Mountain Caribou Recovery Science Team to assist with the development of recovery decision tools and to advise government on interim actions necessary to retain all potential recovery options while the recovery planning process is underway;
2. Establishing a moratorium on new commercial recreation tenures in Mountain Caribou habitat zones as well as approving variances to the Kootenay Boundary LUP and Revelstoke HLP;
3. Undertaking habitat and population modeling to support the development of recovery options;
4. Gathering caribou experts to acquire additional information and solicit professional judgment on management alternatives, which could be used to help inform the recovery options; and
5. Releasing a consultation package in October of 2005 that included a map outlining 12 caribou planning areas and a summary of 5 recovery options for Mountain Caribou.

SaRCO is currently working with the Mountain Caribou Recovery Science Team to identify the management actions that would be required to either recover or maintain herds in each planning unit. Once this work is complete, government will cost out these proposals for each planning unit and summarize the public and stakeholder consultation results.

Part I. Status Updates for Mountain Caribou in the CCLUP Area

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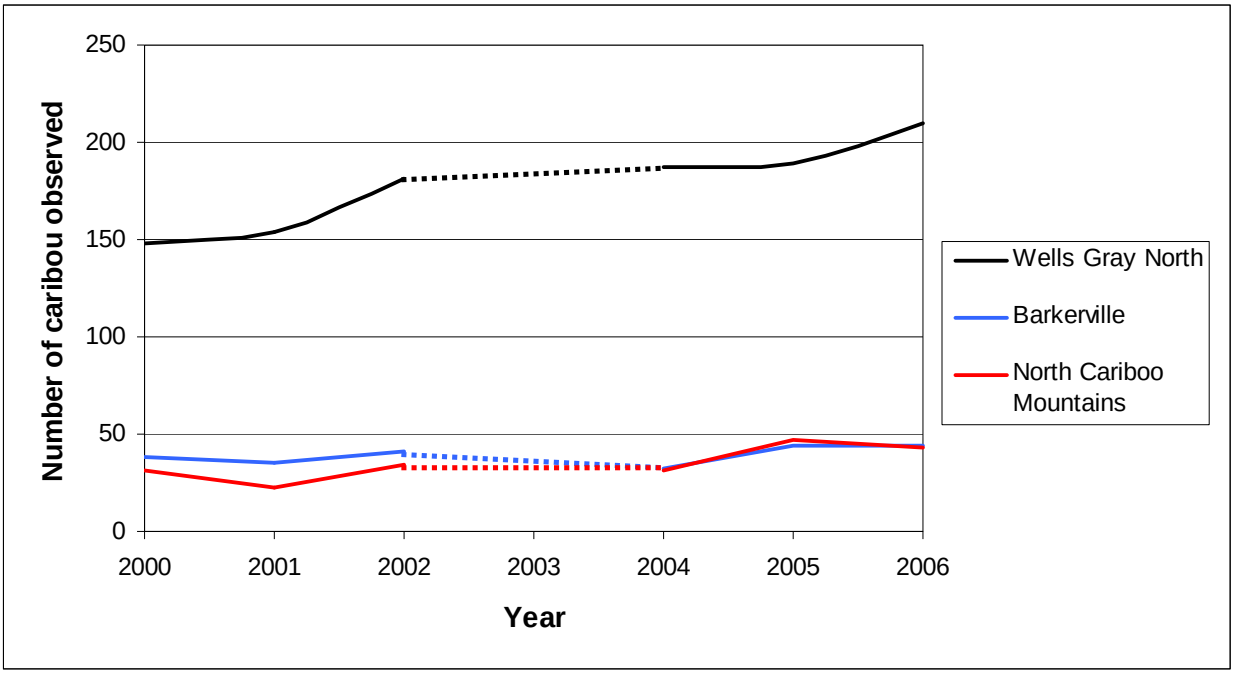
Population Trend

There are 13 Mountain Caribou sub-populations identified within British Columbia (Simpson 1997). The Cariboo Region includes the Barkerville, Wells Gray North and a portion of the North Cariboo Mountains sub-populations. In 2002 a statistical analysis of the caribou populations within Region 5 was conducted (Young and Freeman 2003). The 1993-2002 trend for the Wells Gray North sub-population indicated a *declining* population with a percent change of -28.7%. The seven-year, short-term trend was *decreasing* (-39.8%) and the current two-year trend was ~*stable* (10%). In 2002 the population estimate for the Wells Gray North sub-population was 220 caribou.

Short-term and current trends of the Barkerville sub-population (analyzed in 2002) were ~stable at 16.0% and 0%, respectively. The long-term trend 1987-2002, was also hypothesized to be ~*stable* with very low growth. The 2002 population estimate for the Barkerville sub-population was 50 caribou. Within Bowron Park (a section of the North Cariboo Mountains sub-population), thirty-four caribou were observed in March 2002.

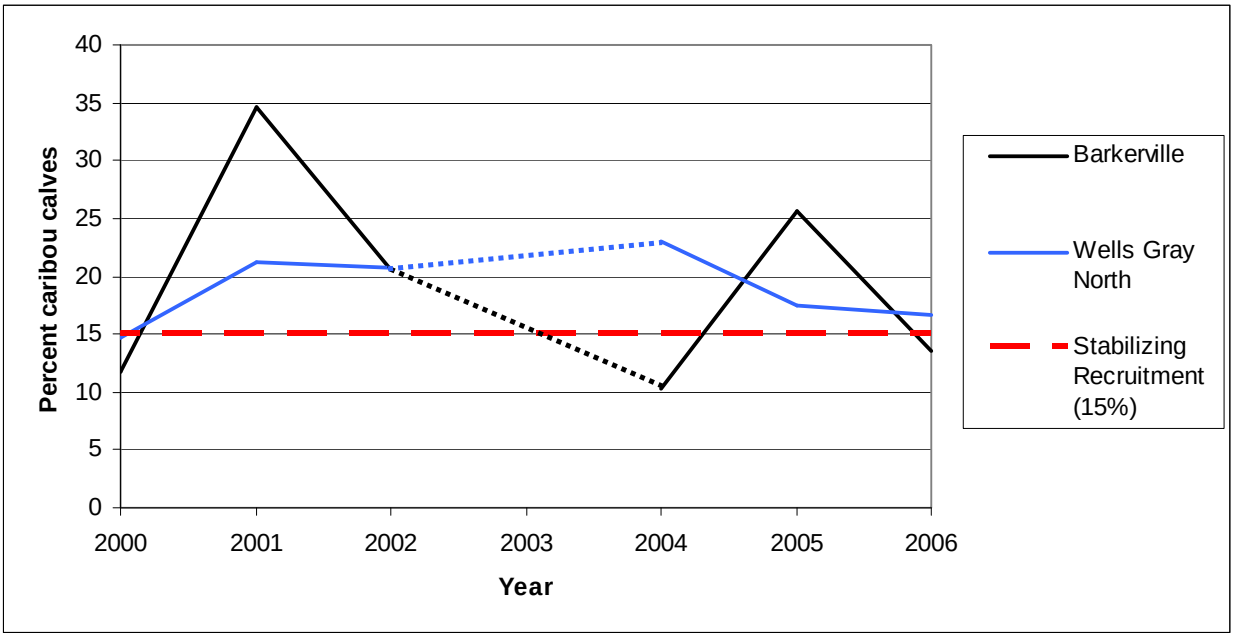
Since 2000, the number of caribou observed during annual late winter surveys has remained relatively stable (Figure 1). The most recent population survey for mountain caribou in Region 5 was completed in March 2006, when fifteen radio-collars were functioning (Freeman et al. 2006). The calculated survey estimates of 239 caribou for the Wells Gray North sub-population and 51 caribou for the Barkerville sub-population are slightly higher than the survey estimates calculated in 2002 (Freeman et al. 2006). The 2003 survey was incomplete due to poor weather conditions and caribou use of lower, more forested habitats (due to low snow pack).

Figure 1. Number of Mountain Caribou observed (adults and calves) during aerial surveys for the Wells Gray North, Barkerville and North Cariboo Mountains sub-populations (2000-2006).



In 2006, the Wells Gray North and Barkerville sub-population calf percentages were 16.7 and 13.6 respectively. Since 2001, calf recruitment in the Wells Gray North sub-population has consistently been at or above Bergerud's (1992) required stabilizing recruitment of 15-16% to balance the natural mortality of adults (Figure 2). It is important that frequent inventories continue to be conducted in order to detect any major changes in caribou numbers, especially the calf component. The observed improvement in caribou calf recruitment during the past 5 years may be associated with the wolf management project which was initiated in the Quesnel Highland area in 2001.

Figure 2. Percent Mountain Caribou calves observed during aerial surveys for the Wells Gray North and Barkerville sub-populations (2000-2006).



Silvicultural Systems Research (including Wildlife Habitat, Biodiversity, Silviculture and Hydrology Research)

Research into Mountain Caribou issues has been ongoing in the Cariboo region since the late 1980's. Much of the work involves silvicultural systems trials that led to the recommendations in the CCLUP Mountain Caribou Strategy. The ongoing research is designed to test if the recommended partial cutting can indeed suffice to maintain caribou habitat and be a viable way to manage high elevation forests. The work falls into three stages: 1) a pilot trial harvested in 1990-1991, 2) a replicated trial harvested in 1992-1993, and 3) an adaptive management trial (first cutblock harvested in 2001). Each phase of the research continues; however, the emphasis is now on the replicated and adaptive management parts. From 2000 to present, more than 15 research documents have been produced on various aspects of the ongoing work conducted in the Quesnel Highland and the impacts of adaptive forest management (see References section).

One of the objectives of the Mount Tom adaptive management trial was designed to address caribou response to the partial cutting at a landscape scale (Armleder et al. 2002). To accomplish this objective, the plan was to harvest ~1200 ha (by 2005) and leave a ~2000 ha uncut control. Unfortunately, only about 35 % of the target area will have been harvested by the spring of 2006. The Mountain Pine Beetle epidemic and continuing issues with stumpage have been major causes for the delay. The revised plan is that the entire trial will be harvested by the spring of 2008. The response of approximately four radio-collared caribou residing in caribou habitat in the vicinity of the study area over the following ten years will be measured. Maintenance of these four caribou will likely involve the collaring of 10-15 animals between 2008 and 2016.

Research continues on the following topics: lichen abundance, timber harvesting, windthrow, micro-climate, stand structure, natural and planted regeneration, site preparation, vegetation and snow dynamics. Ongoing research on breeding birds and small mammal response to the partial cutting treatments also continues (Waterhouse et al. 2004). These related studies are vital considering that the Cariboo-Chilcotin Land Use Plan includes over 50,000 ha of modified harvesting in Mountain Caribou range.

The latest five years of research has provided a more complete picture of the recommended silvicultural system. The group selection openings are regenerating (Lajzerowicz et al. 2006, Newsome and Lajzerowicz *in prep.*, Steen et al. *in prep.*, Steen et al 2005*)*, the lichen biomass is remaining on the residual stand, the prescription is windfirm (Waterhouse et al. 2006 in prep., Newsome et al. 2000), the harvesting approach is viable (Durham 2001) and the treatments are generally not in conflict with other organisms.

Reforestation at the higher elevations of the ESSF is challenging. However, if planted in optimal locations, such as raised micro-sites, seedling growth although not rapid should be sufficient to reach the operational goal of 80 cm for spruce and fir in 20 years. At all but the highest elevation site (1580-1700 m) spruce and fir growth is adequate in the 0.13 ha openings but seedling growth in the small (0.03 ha) openings is only acceptable at the two lower elevation sites. The research supports the conclusion that the operational recommendation of openings of 0.2 to 1.0 ha in size with a mean of 0.5 ha should meet with success.

The latest examination of lichen abundance data shows an increase in the lichen biomass left on the residual trees ten years after partial cutting compared to uncut trees in the control areas

(Waterhouse et al. *in press*). Also, there is a slight shift from *Alectoria sarmentosa* to *Bryoria* spp. with the partial cutting. This is significant as Bryoria spp. are the preferred forage lichens for caribou.

Extensive research has also been conducted into the microclimates created by modified harvest strategies (Stathers et al 2001, Teti 2001, Teti 2003, Teti 2004). The results-to-date from all the research trials continue to support the conclusion that group selection as described in the strategy should be successful in maintaining caribou habitat in a managed forest environment (Armleder et al. 2000, Stevenson et al. 2001). However, even group selection harvesting will increase access and the threats to caribou that this brings. Additionally, although partial cutting produces less desirable habitat for other ungulates than clearcutting, it still increases summer forage for other ungulates for some time after harvesting.

Habitat Use Monitoring

Through the analysis of radio-telemetry relocations, seasonal patterns of habitat use by Mountain Caribou in the CCLUP area have been monitored consistently from 1984 to 1988 (Seip 1992) and from 1993 to 2000 (Young et al. 1998, Young and Freeman 2002). In April 2002 the final radio-telemetry report was completed for the Quesnel Highland Caribou project (Young and Freeman 2002). Radio-telemetry data was incorporated into the development of a habitat suitability model for the area (Apps and Kinley 2000) which assisted in determining areas most suited for modified-harvest and no-harvest designation as directed by the CCLUP's Mountain Caribou Strategy. Fixed wing telemetry flights, for the purpose of relocating radio-collared Mountain Caribou have not occurred since March 2004, with the exception of pre-inventory flights in March 2005 and March 2006. Short term funding, obtained through the Quesnel Highland Wolf Project was used in part to relocate collared caribou once per month from December 2005 to the end of March 2006.

Access Management

Backcountry recreation activities, snowmobiling and heli-skiing in particular, are considered to be a major conservation concern due to the potential for displacement of caribou from their winter habitat. To address the snowmobile access part of this issue, the local snowmobile clubs from Quesnel, 100 Mile House and Williams Lake entered into two subsequent voluntary multi-year agreements with the Ministry of Agriculture and Lands and the Ministry of Environment. A monitoring plan (December 2002 to April 2006) was included in this agreement to collect baseline data on snowmobile use in the *Voluntary Closure Zones* and *Caution Zones* as identified and mapped by the MSRM (Price 2003). Voluntary closure zones were defined as areas of critical caribou habitat and were to receive no snowmobile activity. Caution zones were defined as areas of sensitive caribou habitat that were to remain open to snowmobile activity.

A ten year helicopter skiing tenure was granted to Canadian Mountain Holidays in the Quesnel Highland in 2001. Good management practices may reduce the impact of heli-skiing operations on mountain caribou survival (BCHSSOA 2003, CMH 2005). However, the Hart and Cariboo

Mountains RIG recommends no heli-skiing in about one quarter of the current tenure in areas of high caribou use.

Population and Habitat Threats

Although it is widely agreed that predation (primarily by wolves) poses the greatest immediate threat to Mountain Caribou within the CCLUP area, there is also the requirement for unfragmented habitat in order for caribou to space themselves from con-specifics and for them to meet forage requirements, particularly in the winter months. The relationships between increasing moose populations and increasing wolf predation on caribou will be discussed in future sections. The potential impacts of forest pest infestations such as Mountain Pine Beetle and continued clear-cut harvesting that is occurring at lower elevations in matrix habitat may also pose an indirect threat to Mountain Caribou populations.

Fixed wing flights to map Spruce Beetle infestations have been conducted across CCLUP Mountain Caribou habitats in 2004, 2005 and 2006. This mapping exercise indicates that portions of caribou winter habitat have been attacked by spruce beetle, particularly areas within Bowron Lakes and Cariboo Mountains Provincial Parks and south of Quesnel Lake. It is likely that areas of critical caribou winter habitat that are only moderately infested by spruce beetle will continue to be capable of supporting the dietary needs of the local caribou population. This is due in part to the mixed nature of the forest stands, leaving significant amounts of healthy sub-alpine fir trees with preferred lichens.

Balsam beetle attacks sub-alpine fir trees at higher elevations in areas critical to Mountain Caribou especially during the late winter months. While attack levels should be monitored this beetle usually does not cause intensive mortality that would negatively impact caribou habitat. Due to the low merchant value of the timber at this elevation, little research or mapping has been done and the extent of forest pest infestation at high elevations is not thoroughly documented.

At lower elevations continued clearcut harvesting of cedar-hemlock forests and beetle killed lodgepole pine forests is increasing the extent of early seral forage for moose and this could result in higher wolf densities in areas adjacent to critical caribou habitats. Since wolves prey on caribou incidentally, this close proximity of increased alternate prey and predator populations increases the risk of predation to Mountain Caribou.

Part II. Progress on Strategy Recommendations

Habitat Strategy

In 2000 the CCLUP Mountain Caribou Strategy recommended the location of 86,836 ha of 'no harvest' and 53,509 ha of 'modified harvest' for caribou habitat. In February 2001, this recommendation was endorsed by the Cariboo Region IAMC. Wildlife Habitat Areas (WHAs) encompassing all of the 'no harvest' and 'modified harvest' areas were legally established under the Forest and Range Practices Act (FRPA) in December 2004, with General Wildlife Measures (GWM) for these areas being established in July 2005 (Appendices 2 and 3). This information can be found online at:

http://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=show_approved

Timber Harvest Strategy

The recommended timber management approach for 'no harvest' and 'modified harvest' caribou areas was incorporated into the legal General Wildlife Measures for the WHA's in 2005. General Wildlife Measures establish the forest practice requirements within the caribou WHA's and these are based on the recommendations contained in the CCLUP Mountain Caribou Strategy (2000). Refer to Appendix 2 for details.

Alternate Prey Management

Most of the Mountain Caribou habitat within the CCLUP area falls within Wildlife Management Unit 5-15. For moose management purposes Management Unit 5-15 is divided into four zones: A, B, C and D (Appendix 1). Moose hunting is administered by Limited Entry hunting throughout the zones. An open season for mule deer buck hunting exists throughout the entire unit. There is also opportunity to harvest antlerless mule deer through Limited Entry hunting. As a result of a series of mild, low snow depth winters, and implementation of Limited Entry instead of general open season hunting, moose and mule deer numbers have increased significantly throughout this management unit during the past decade. This has also allowed for an increase in predator numbers such as wolf, black and grizzly bear.

Moose and mule deer inventory information is limited throughout most of the management unit. This shortage of information is primarily related to the high costs of conducting inventories and the general lack of inventory funds. The dense forest also makes it difficult to observe mule deer and therefore no mule deer population surveys have been undertaken. There has been only one complete moose population survey (stratified random block design) conducted in Management Unit 5-15. A stratified random block survey covers the entire zone, and in addition to sex and calf ratios being obtained, a moose population estimate is derived.

The survey occurred in Zone D in 2004. The wintering moose density was estimated at 0.13 moose/km2, the adult sex ratio was 52 bulls/100 cows and the calf ratio was 27.2 calves/100 cows (Stalberg 2004). The wintering moose density was well below average in comparison to

other areas surveyed in the region; however because this is a mountainous area, many of the moose that occupy the area during summer/fall migrate to adjacent, lower elevation zones to winter.

For the remaining zones in MU 5-15 (A, B and C), several reconnaissance flights have been conducted over the past 5 years. During a reconnaissance survey only moderate and high density moose areas are sampled and only adult sex ratios and calf ratios are obtained. Based on available inventory information, the moose population within Management Unit 5-15 is considered to be stable; however low calf numbers, especially in zone B, suggest a significant level of predation by wolves. If low recruitment continues in the future, then a declining population trend would be the expected outcome.

Moose are the primary prey of wolves in the Quesnel Highland and Cariboo Mountains of Region 5. As the number of moose has increased since the 1900s (Spalding 1990), dependant predator populations such as wolves have also increased. Results from one study suggest that the decline of Woodland Caribou is due to competition over range with moose where caribou may become secondary prey resulting in caribou population declines (Wittmer et al 2005). The anti-predator strategy used by caribou – to space themselves from con-specifics such as moose – becomes less effective when wolf densities are high and moose are spending time at higher elevations utilizing early seral stage forage.

In an attempt to reduce the moose population within MU 5-15, additional LEH authorizations have been added annually (Table 1) since 2001. Over the long term, it is anticipated a reduction in moose availability will result in a decline of wolf density. Additional moose inventories are required in all four sub-zones to accurately assess moose densities and population dynamics within Mountain Caribou range. Once these inventories are completed, a modified moose management strategy that incorporates higher levels of harvest rates for moose populations within caribou range could be incorporated to help maintain lower wolf numbers and thus aid in caribou recovery. Moose numbers within mountain caribou and matrix habitats (as defined by the Hart and Cariboo RIG) should be gradually reduced to levels that would be supported by a natural seral distribution.

Table 1. Number of Bull and Cow Moose Limited Entry Authorizations Allocated in MU 5-15 for the Period of 1999-2006.

MU 5-15	Total Number of Authorizations[1]	Bulls	Cows
1999	263	263	0
2000	267	267	0
2001	387	387	0
2002	387	387	0
2003	379	379	0
2004	447	407	40
2005	435	395	40
2006	512	445	67

[1] The number of moose authorizations is reassessed yearly based on reported success rates. For this reason LEH numbers fluctuate in order to stay within the annual allowable harvest (AAH).

Predator Management

In 2001 the Quesnel Highland Wolf Project was initiated to determine which wolf packs frequented caribou habitat and had a high probability of impacting the stability of the Mountain Caribou population. The sterilization of dominant wolf pack members and removal of sub-dominant wolves was also conducted to reduce the wolf density throughout caribou range and thus, the amount of wolf predation on caribou. During the project (2001-2004) a total of 27 wolves were radio collared; of which 9 males and 7 females were sterilized. These twenty-seven wolves were members of 11 different packs. Nine (82%) of the known wolf packs in the study area appear to pose a moderate to high threat to caribou. Thirty six wolves were removed from the study area[2]. Weekly, bi-weekly or monthly aerial telemetry flights were conducted to determine pack composition, location and territory size. The number of wolves in the 11 collared packs was reduced from 82 to 46 wolves over four years (Roorda and Wright 2004). Funding was not available after March 2004, resulting in no new information being collected on wolf pack dynamics within the project area. Until November 2005, wolf sterilization and removal also ceased.

Previous studies have shown that reduced wolf numbers can result in a reduced predation rate on caribou (Farnell and McDonald 1988, Boertje et al. 1996, Bergerud and Elliot 1985). Based on aerial and ground observations during the first year of the project, the wolf density was estimated at 7.2 to 9.8 wolves per thousand square kilometres (Roorda and Wright 2004). As of March 31, 2004, wolf density was estimated between 5.4 and 6.7 wolves per thousand square kilometres (Roorda and Wright 2004). There is a high confidence level with the 2004 population and density estimates, as radio collared animals allowed for frequent radio telemetry locations and observations of individual animals in each pack.

It is difficult to determine the overall success of the Quesnel Highland Wolf Project (July 2001-March 2004). The lack of funding did not allow for an accurate assessment to occur. Since the project began in 2001 calf recruitment within the Wells Gray North sub-population has remained above the stabilizing recruitment of 15%. The number of caribou observed from the Wells Gray North sub-population during late winter inventory flights has also increased yearly since 2001. These increases suggest that this caribou sub-population is at least stable and possibly increasing, which may be due in part to increased predation management.

Funding was obtained through the Forest Investment Account (through West Fraser Timber Company Ltd. Williams Lake) to re-initiate the Quesnel Highland Wolf Project in November 2005. From December 2005 to October 2006 this funding was used to monitor the remaining collared wolves, locate wolf dens (Roorda and Wright 2006b), obtain a density estimate and collar four additional wolves within the study area. Two collared wolves were re-captured and three wolves were removed during this study period[3]. Preliminary analysis suggests that pack dynamics, wolf numbers and pack territories have changed dramatically over the period since the project lapsed in March 2004. Wolf density is estimated to have recovered to near pre-project levels, 7.4 - 9.6 wolves per thousand square kilometres (Roorda and Wright 2006). This increase to near pre-project levels may be due to numerous reasons including; the cessation of the project

[2] Removed wolves include project related removals, mortalities from hunting and trapping in addition to natural wolf mortality and dispersal from the study area.
[3] Removal was not funded by Forest Investment Account.

in March 2004, less accurate (ground based) methods utilized in 2006 to obtain wolf population estimates, high collared/sterilized wolf mortality (estimated at an average of more than 18% for collared wolves) and dispersal rates within the study area[4].

Costs associated with ground trapping wolves is high, resulting from the remoteness of the study area, large pack home ranges (and inaccessibility of some packs), and the wolf's wariness to human activities at bait and scent stations. A significant amount of time and effort is required to be successful at ground trapping. From July 2001 to March 2006 approximately $402,000 were spent for the Quesnel Highland wolf project (Appendix 5). Most of the funding was provided by FIA. Contributions by the Ministry of Environment were substantial but not included in the detailed cost breakdown. Some of these costs included the salary of the project coordinator, the use of motor vehicles (4x4 trucks and ATV's, snowmobiles), costs of fuel, motor vehicle repairs and immobilization equipment.

Practices to Limit Moose Habitat

Forest licensees are following the harvesting recommendations outlined in the Mountain Caribou Strategy for harvesting in the modified harvest area. Maintaining an average opening size of 0.5 hectares within the 0.1 to 1.0 hectare range should contribute to the control of moose habitat by limiting the growth of plant species favoured by moose. The vegetation response in the ESSF, where the vast majority of 'modified harvest' area is located, is not expected to be significant for moose forage species. It should be noted that relatively little harvesting has occurred in the Mountain Caribou modified harvest zone to date, and what timber has been harvested is within the adaptive management trial on Mt. Tom.

Regulatory requirements and public opposition have complicated or reduced the opportunity to use silvicultural tools that shift vegetation complexes and reduce the production of winter ungulate browse species. Prescribed burning and herbicides tend to shift the vegetation complex away from shrubs that are a primary food source during the winter. Smoke and particulate management requirements have reduced burning windows, and regulatory requirements for the approval to use herbicides has shifted silviculture strategies away from chemical control towards prompt reforestation with the use of more aggressive site preparation and stock type selection to control or deal with competing vegetation. The efficacy of these vegetation management tools is somewhat limited as moose will shift to some conifer species (e.g., subalpine fir) in the absence of more favoured browse species. Public perception of prescribed burning has changed since the dramatic interface fires of 2003; the use of fire for habitat and fuel management is gaining more public acceptance with the threat of increased fire hazard associated with the Mountain Pine Beetle outbreak.

Some licensees have increased establishment densities for timber management objectives. Combined with natural ingress, this may have the benefit of reaching a closed canopy state earlier and reducing the period that browse species are available in significant supply. However, any benefit will likely be overshadowed by the anticipated increase in early seral resulting from the accelerated salvage of Mountain Pine Beetle infested timber.

[4] High mortality and dispersal rates for collared and/or sterilized wolves resulted in an increased number of fertile packs and loss of contact with some packs (and therefore a less accurate estimate of wolf numbers within these un-collared wolf packs).

Access Management

The 2000 CCLUP Mountain Caribou Strategy recommended snowmobile avoidance or heavily regulated snowmobile use in highly sensitive caribou areas. However, these recommendations were not completely implemented. Following meetings between government groups and local snowmobile clubs, a less restrictive set of voluntary closure and caution zones was established in 2001. Snowmobile use and their interactions with Mountain Caribou have been monitored from 2002 to 2006 in the snowmobile zones developed through agreement between the local snowmobile groups (represented by the Quesnel Highland Management Society), ILMB and MOE.

The first three years (2003-2005) of this monitoring program focused on the compliance of back country recreationists within the voluntary closure zones (Price 2003, Price 2004 and Price 2005). The fourth and final year (2006) of the program was directed towards monitoring use of both Mountain Caribou and snow machines in and around caution zones throughout the study area (Roorda 2006).

During the course of the four year project a total of 708 snow machines and 241 caribou were observed. Compliance of recreationists within voluntary closure zones varied from 98.2% to 78.3%, with a four year average of 92.5%. In 2006 an analysis involving probability and intensity of snow machine use within caution zones was conducted. Probability of snow machine use in caution zones on a given weekend day was 80% or greater for the Bald Mountain, Yanks Peak, Roundtop Mountain, Eureka Ridge and Mica Mountain areas. Average intensity of snow machine use of greater than 10 snow machines per survey day were recorded for Bald Mountain, Yanks Peak, and Mica Mountain caution zones. Several of these designated snowmobile caution zones with high probability of snowmobile use and high snowmobile intensities were defined as highly sensitive caribou areas to be avoided in the 2000 CCLUP Mountain Caribou Strategy.

A recent study done on Mountain Caribou in the Yukon showed that maternal groups (those including cows, calves and yearlings) were twice as likely to run as male groups when disturbed by snow machines (Powell 2004). A single response to disturbance by female caribou increased daily energy expenditure by 1.2%, and caused increased vigilance and movement following the disturbance. Size, speed, direction of approach and cessation of movement of snow machines did not affect caribou reaction (Powell 2004). On twenty-one occasions within the Quesnel Highland study area caribou activity and snow machine activity were recorded within 500m of each other. The majority of these potential caribou-snow machine interactions occurred in zone C, on Cameron Ridge and in the Grain Creek drainage (10 instances). Interactions were recorded on six occasions in Zone D (Barkerville census block) and 5 times in Zone A (Horsefly census block).

The primary recommendation of the final report was the closure of the Grain Creek caution zone to snowmobile activity. The small Grain Creek caution zone provides access to vast amounts of critical winter Mountain Caribou habitat. The consistent and combined number of caribou (particularly large maternal groups) observed during snow mobile flights, caribou surveys and telemetry flights indicate plainly that this area is one of the most critical areas of caribou winter habitat for the Wells Gray North sub-population. Maintenance of appropriate signage and keeping the lines of communication open with snowmobile clubs will be necessary components

to maintain voluntary closure and caution zone compliance within Mountain Caribou habitats. It is important to note that the existing voluntary snowmobile closures are significantly less than that recommended in the Hart and Cariboo Mountains Recovery Implementation Plan.

Funding for this four year monitoring project was provided by the Habitat Conservation Trust Fund (HCTF) and the Ministry of Environment. Total costs associated with the four years of snowmobile monitoring amounted to just over $47,000 (Appendix 5).

Helicopter skiing also has the potential to displace and disturb Mountain Caribou on their winter ranges (Wilson and Hamilton 2003). In 2001 Canadian Mountain Helicopters (CMH) was granted a ten year tenure within the CCLUP area. Use of best management practices for sustainability may help to minimize possible disturbance to caribou (BCHSSOA 2003, CMH 2005). Collared caribou locations that government biologists shared with the heli-skiing tenure holder in addition to company observations resulted in temporary closure of ski runs in close proximity to these sightings until the animals appear to leave the area (Willy Trinker 2006, Personal communication.). However, there is uncertainty about long term caribou displacement impacts from heli-ski activities in this area and detailed analysis of ski run use in relation to caribou use has not been undertaken. The 2005 RIG document recommends restricting helicopters and skiers from about one quarter of the operators existing more than 200 runs due to intensive and frequent caribou use.

Roads that improve human and predator access within caribou habitats can increase winter recreational opportunities and predator success. Little progress has been made concerning the rehabilitation and reforestation of existing roads to prevent human activity and reduce predator access within core caribou habitats.

Conservation Risk Assessment

One of the recommendations of the regional Mountain Caribou Strategy was to have a detailed conservation risk assessment completed that identified critical risks and assessed how well the Mountain Caribou Strategy reduced those risks. Although this task has not been specifically completed for the herds within the Cariboo Region, work undertaken by the overlapping Recovery Implementation Group and the SaRCO is improving our understanding of the relative magnitude of various stressors to caribou and the long term viability of Mountain Caribou herds across BC. For example, the SaRCO Science Team is developing habitat-based models to identify the efficiency of using various management tools to recover caribou. In addition, an expert opinion survey and the use of a Structured Decision Making Approach to caribou recovery will help clarify our understanding of the consequences of various management actions to caribou recovery. Once these projects are completed the need for further risk assessment of caribou recovery should be reviewed based on our improved understanding of outstanding issues.

Two overview flights were conducted to assess fire, beetle and development impacts within the mountain caribou WHAs in October of 2006. Spruce Beetle infestations mapped by forestry staff were investigated (Appendix 2). Fires that occurred within the last five years were outlined and any forestry and/or road activity into the areas was noted.

Appraisal Issue

Forest licensees expressed concerns that the current appraisal system impeded implementation of the harvesting recommendations outlined in the Mountain Caribou Strategy. The primary concern was that the appraisal system does not fully recognize the additional costs associated with implementing the small opening harvest system recommended in the strategy. Forest licensees state that the administration, development, harvest and silviculture costs associated with high elevation, small opening harvesting are significantly higher than conventional high elevation harvesting. The lack of recognition of these costs is considered an impediment to successful implementation. The Mountain Caribou Strategy recommended that government and forest licensees work towards resolution of these concerns.

To date, little progress has happened to address these concerns. It appears that the primary reason for a lack of action is a shift in harvest focus to Mountain Pine Beetle salvage, which occurs outside the Mountain Caribou modified harvest zone. The lack of harvest applications in the modified harvest zone reduced the immediate need to address the appraisal issues related to implementation of the harvesting recommendations.

Forest Health

Mountain Pine Beetle management continues to dominate the provincial forest health program. Accelerated salvage harvesting to capture the maximum value from the infested timber is expected to have an impact on Mountain Caribou management through the increase in early seral habitat, resulting in increased populations of early seral ungulates and their predators. Ungulate and predator population management will increase in prominence

Although overshadowed by Mountain Pine Beetle, other forest health agents are also increasing. Spruce Bark Beetle populations are on the rise and have the potential to directly impact core caribou habitat. Overview flights indicate the Spruce Bark Beetle infestation levels are not a high concern in the core caribou habitat; there is sufficient surviving spruce, mixed with sub-alpine fir, to maintain viable lichen populations. Therefore, Spruce Beetle mortality in mixed subalpine fir/spruce stands does not constitute a problem for caribou habitat. Continued monitoring of this pest is warranted to determine if lichen populations are being negatively impacted. A future concern is the impact on caribou mobility in the impacted stands as the dead trees deteriorate and fall.

Spruce Bark Beetle Management is active outside the core caribou habitat. Sanitation and salvage harvesting is active in the larger infestation areas and licensees are engaged in an extensive trap tree program to limit the expansion of this pest. The committee supports aggressive management of Spruce Bark Beetle, through trap tree programs outside of core caribou habitat, to limit the impact on caribou habitat and the additional contribution to early seral habitat. If additional trap tree sites are required in the modified harvest area to control the spread of Spruce Beetle then licensees or the Ministry of Forests should address these issues as exemptions under the General Wildlife Measures.

Other Related Issues

Forest Licensees were contacted to solicit issues and concerns related to the implementation of the strategy. The committee received suggested changes to the regeneration requirements, such as longer free growing periods, short height requirements and lower stocking levels. It is unclear at this time how these suggested changes would influence the creation of moose habitat or enhance the management of Mountain Caribou habitat. Research results indicate that current free growing requirements can be met when trees are planted; relying on natural regeneration may require a longer interval to reach free growing status. Monitoring of silvicultural research trials will continue to verify timber production expectations.

There is a general belief that the Mountain Caribou Strategy has not been in use long enough or to the extent needed to determine either the successes or failures of the recommendations. A more thorough review of this issue should be done in the future.

Part III. Government Direction and Planning for Mountain Caribou Management

Government direction for mountain caribou management has to-date been provided through various instruments, some legislated, some non-legislated. The direction provided by the CCLUP Mountain Caribou Strategy has recently been legalized for the purposes of forest management under FRPA by means of the designation of Wildlife Habitat Areas and General Wildlife Measures for Mountain Caribou. See the descriptions that follow for details.

CCLUP Caribou Strategy

The CCLUP as a Higher Level Plan contains legal objectives for Mountain Caribou. The CCLUP Mountain Caribou Strategy developed from 1995 to 2000, and endorsed in early 2001 by the IAMC, provides non-legislated direction from government on how to best implement the HLP objectives.

Caribou Wildlife Habitat Areas (WHA's)

The 'no harvest' and 'modified harvest' areas identified in the CCLUP Mountain Caribou Strategy were legalized for forest management purposes under FRPA in December 2004. Forest Stewardship Plans must respect the legal WHA boundaries.

General Wildlife Measures (GWM's)

General Wildlife Measures for all those WHA's established for Mountain Caribou were legalized in August 2005. These GWM's are legal practice requirements for forest practitioners or licensees operating within the WHA's. Please refer to Appendix 2 for details.

Sustainable Resource Management Plans (SRMP's)

Sustainable Resource Management Plans are being developed by the Integrated Land Management Bureau to address in more detail how HLP objectives are to be addressed across the different landscapes. SRMP objectives are at present unlegislated, however the intent is that once finalized a suite of these objectives would be legalized under the appropriate legislation. With respect to Mountain Caribou objectives, the objectives contained in the draft SRMP's would not likely be required to be legalized, as this has already been accomplished through designation of WHA's and GWM's.

The Recovery Implementation Plan for the Hart and Cariboo Mountains Recovery Area

A Strategy for the Recovery of Mountain Caribou in British Columbia was released in September 2002. The provincial Mountain Caribou recovery strategy recommended that the Mountain Caribou range be further sub-divided to allow the development of more locally appropriate Recovery Implementation Plans.

The Recovery Implementation Group for Northern populations of Mountain Caribou (which includes the CCLUP area) met several times between January 2003 and June of 2005. Members of the group came from a variety of government ministries, industries, and public groups but did not represent or act as advocates for their organisation. All members had expertise in caribou ecology or aspects of land use that were relevant to caribou recovery. Decisions by the group were based on consensus whenever possible. Consensus was defined as all individuals believing that a decision was technically sound and supported by the best available information. When consensus could not be reached, majority views were recorded and dissenting opinions were acknowledged and documented. The group used the precautionary principle to err on the side of caribou recovery in decisions where technical data were equivocal. The group did not thoroughly examine socio-economic trade-offs but considered allowance of some activities that did/would not unduly compromise caribou recovery.

The Northern recovery group (RIG) produced a set of key recommended recovery actions in August 2005. SaRCO has received these recommendations but to-date has taken no action to approve or recommend these for implementation. Therefore, the RIG recommendations presently have no status in terms of government direction.

The Species at Risk Coordination Office and Mountain Caribou Recovery Planning

In October of 2004 the Species at Risk Coordination Office (SaRCO) initiated a process to accelerate decisions and action regarding the recovery of Mountain Caribou in British Columbia. A SaRCO option for each of the mountain caribou planning units was released in late 2006 for comment and input. Government is expected to make a decision on Mountain Caribou recovery options in 2007.

Part IV. Strategy Assessment

The 2000 Mountain Caribou Strategy states that the regional mountain caribou habitat and population can only be maintained if all of the following issues are addressed together:

- Maintaining suitable caribou habitat within existing mountain caribou range
- Limiting and regulating road access and motorized recreation in caribou habitat
- Managing predation levels on caribou

Considerable time and funds have been spent dealing with these critical issues during the last five years (Table 2).

Table 2. Budget history for Mountain Caribou work conducted in the CCLUP area and forecast requirements (in thousands of dollars) for the next 5 years to continue implementation of strategy (includes salary and non-salary dollars).

Mountain Caribou Work Non-salary dollars	**Expenditures 1990 to 2000**	**Expenditures 2001 to 2006**	**Total Expended To-date**	**Funding Requirements, next 5 years**
Population surveys	$250	$225	$475	$230
Animal monitoring and habitat studies	$500	$200	$700	$400
Silviculture research	MOF staffing expense only	MOF staffing expense only		$328
Predator management	$45	$403	$448	$496
Strategy implementation and monitoring	MOE staffing expense only	MOE staffing expense only		MOE staffing expense only
Access management and monitoring	MOE staffing expense only	$47	$47	$83
Mountain Caribou Work Staffing expense				
Ministry of Environment	$800	$400	$1200	$1020
Ministry of Forests and Range	$1000	$500 – $750	1500-1750	$900

Maintaining Suitable Caribou Habitat

Mountain Caribou exist at low densities, employing an anti-predator strategy in which they space themselves from con-specifics and predators over a very large area. For this reason, caribou need a continual supply of large connected areas of suitable summer and winter habitats that are largely undisturbed. With this target in mind, Wildlife Habitat Areas (WHAs), encompassing 86,836 ha of "no-harvest" and 53,509 ha of "modified-harvest" for caribou habitat, were legally established under FRPA in December 2004. General wildlife measures for these areas were established in July 2005 to minimize the potential negative impacts on caribou (Appendix 3).

Forest licensees are following modified harvest recommendations with the intent to maintain caribou habitat continuously through time and space and to limit the early seral forage favoured by moose. The accepted modified harvest technique applies 30% volume removal group selection with an 80 year cutting cycle. Harvest openings range from 0.1 to 1.0 ha in size with a mean of 0.5 ha or smaller. Considerable silvicultural research has been conducted within the Cariboo Region since 2000 and modified-harvest research trials to date indicate: arboreal lichen biomass is retained on the residual stand, the prescription is wind firm and the harvesting approach is viable. The adaptive management trial at Mount Tom, designed in part to address caribou response to partial cutting at a landscape scale, is a long term project that should be completely logged in 2008; then caribou response will be measured for ten years.

Road Access and Motorized Vehicles

Snowmobiling is considered to be a major conservation concern due to the potential for displacement of caribou from critical winter habitats. The Mountain Caribou Strategy recommended snowmobile avoidance or heavily regulated snowmobile use in highly sensitive caribou areas. These recommendations have been partially implemented with the negotiated voluntary agreement entered into between the local snowmobile clubs (the Quesnel Highland Management Society) and government agencies. Certain areas of critical caribou winter habitat were voluntarily closed to snowmobiles and caution zones were created indicating sensitive caribou habitats where snowmobiles were permitted but instructed to minimize direct and indirect disturbance to caribou whenever caribou or caribou sign was observed. An education program including pamphlets and signage for these zones was put in place and maintained by the Quesnel Highlands Management Society. The 2005 RIG document recommends some additional restrictions on snowmobile use in core caribou habitat.

From December 2002 to April 2006 fixed wing flights were conducted to collect baseline data on snowmobile compliance within voluntary closure areas and location of caribou in relation to caution and closure zones. Compliance within voluntary closure zones varied from 98.2% to 78.3%, with a four year average of 92.5%. On twenty-one occasions caribou activity and snow machine activity were recorded within 500m of each other. The majority of these potential caribou-snow machine interactions occurred in zone C, on Cameron Ridge and in the Grain Creek drainage (10 instances). In 2006 an analysis involving probability and intensity of snow machine use within caution zones was conducted. Probability of snow machine use on a given weekend day was 80% or greater for the Bald Mountain, Yanks Peak, Roundtop Mountain, Eureka Ridge and Mica Mountain caution zones. Snow machine intensities of greater than 10

snow machines per survey day were recorded for Bald Mountain, Yanks Peak, and Mica Mountain caution zones. This 4-year monitoring project reached completion in April 2006.

Tenure was granted to Canadian Mountain Helicopters (CMH) within the CCLUP area in 2001. Wildlife managers met with CMH operators and efforts were made to limit the number of heli-ski runs within critical Mountain Caribou winter habitats. Operational management practices, such as closing ski runs when caribou are in the area, have been used to minimize possible disturbance to caribou created by the skiers and helicopters. The 2005 RIG document recommends further restricting helicopters and skiers from areas of frequent, intensive caribou use.

The General Wildlife Measures, legalised for mountain caribou in July 2005, state that forestry practices occurring in Wildlife Habitat Areas must "result in the maintenance of caribou habitat by limiting access and human disturbance to the lowest levels possible, for example through road deactivation and reducing active road density." In the last five years, little has been done to enforce or ensure existing road closures and deactivations within caribou winter range. Without some active intervention, natural regeneration of disused road is slow. It is fortunate that very little new harvesting has been carried out in these core habitats, primarily due to the Mountain Pine Beetle epidemic and continuing issues with stumpage.

Managing Predation Levels on Caribou

Although it is widely accepted that predation by wolves is the primary cause of Mountain Caribou mortality in the CCLUP area, it is important to recognise that this increase in wolf predation on caribou almost certainly stems from increases in human activities such as land clearing and logging. The flowchart below (from the Recovery Implementation Plan) depicts how logging and land clearing leads to increased predation on caribou.

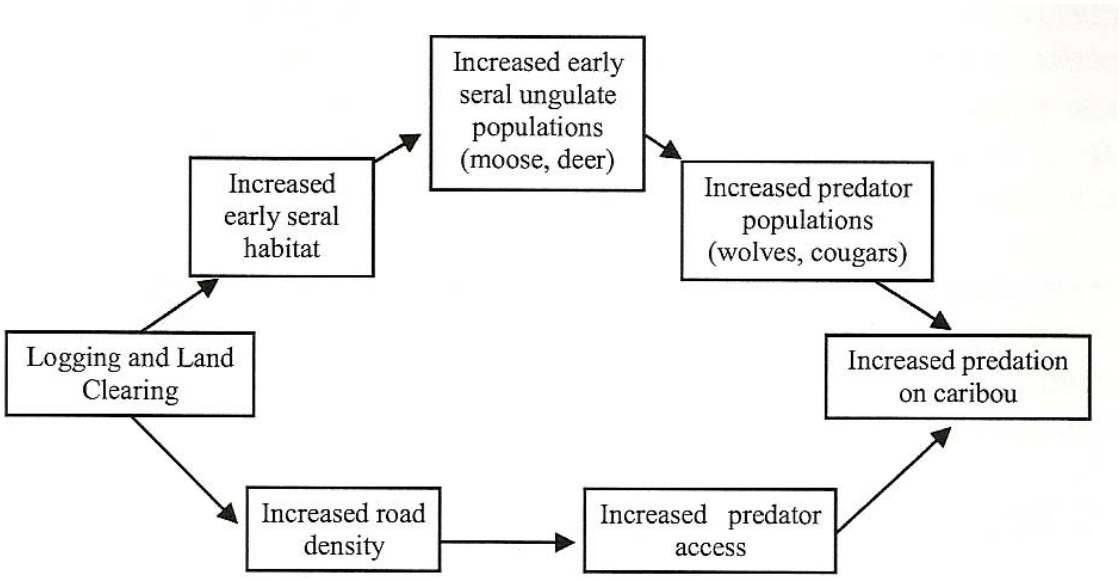


Figure 3. The mechanisms by which logging and land clearing lead to increased predation on Mountain Caribou (RIG 2005).

To address the issue of high wolf predation rates on Mountain Caribou the Quesnel Highland wolf project was initiated in July 2001. The objectives of the project were: 1) to locate and establish home ranges for wolf packs within the study area and 2) to reduce wolf density and recruitment. The second objective was accomplished (from July 2001-March 2004) through a combination of lethal control and sterilization of dominant wolf pairs.

During this time period wolf density within the 9,540km^2 study area went from between 7.2 and 9.8 wolves/km^2 in March 2001 to between 5.4 and 6.7 wolves/km^2 in March 2004. Nine males and seven females were sterilized and 30 wolves were removed[5] from the study area during this time period. Funding for the project ceased in March 2004 and little monitoring was done until some funding was again obtained in November 2005.

During the project lapse, high mortality of collared/sterilized wolves (averaging 18.5% per year) and changes in pack dynamics resulted in recovery of the wolf population to near pre-project levels by March 2006**.** This demonstrates the necessity of consistent long term management funding. Caribou populations are unlikely to recover within the CCLUP area unless there is long term predator management and concomitant efforts to reduce the incursion and prevalence of early seral ungulates.

[5] Wolf "removal" from the study area was defined as any confirmed wolf mortality, regardless of cause.

Part V. Future Work

In order for recovery of the CCLUP Mountain Caribou population to occur, a natural forest age-class distribution to sustain natural levels of early seral ungulates must be achieved or predators and their primary prey must be managed in perpetuity. If the decision is to manage the early seral habitat this long term process must also include short to medium term reductions of moose, deer and wolf numbers until the habitat has recovered. Potential stress to and displacement of mountain caribou caused by human recreational activities must also be minimized within core caribou habitats. Estimated costs to implement these steps (beyond government staffing) for the next five years are broken down in Tables 3 through 6.

Seral Stage/Early Seral Stage Ungulate and Predator Management

Early seral stage mapping and generation of moose, deer and wolf reduction targets

In order to estimate the number of early seral ungulates that would likely occur under natural forest conditions, a predictive habitat supply mapping exercise must be completed. Once mapped, the current amount and the location of early seral forage can be used to estimate the number of moose and deer present in caribou and matrix habitats. These early seral ungulate estimates will be used to set moose, deer and wolf reduction goals, based on the numbers of moose and deer (and therefore wolves) that would potentially be supported under natural forest conditions (Figure 4). This mapping exercise will likely be carried out by government GIS staff and therefore additional non-staffing costs are not anticipated.

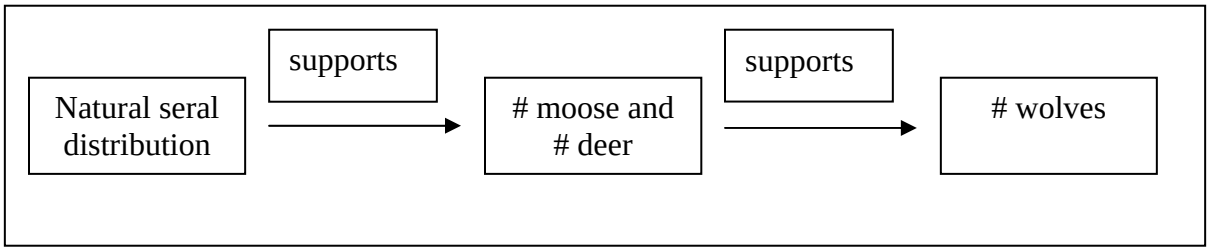


Figure 4. Depiction of how a natural early seral distribution supports early seral ungulates and their predators.

Moose and Deer Management

Once targets are established for reduced moose and possibly deer numbers in core caribou and matrix habitats, a management plan must be initiated. Lack of hunter access into more remote

areas surrounding core caribou habitats will restrict efforts to reduce early seral ungulates through increased harvest opportunities. Options to decrease moose density within the CCLUP area may include; introduction of open seasons for moose bulls and possibly cows, an increase of LEH authorizations and/or increasing guide quotas for moose. Costs for this portion of the recovery plan will likely only involve government staff time.

Wolf Management

Options to reduce wolf numbers through hunter and trapper harvest are limited due to the elusive, shy nature of wolves. Introduction of no bag limits have been ineffective to increase the number of harvested wolves since they are extremely difficult to locate and shoot. Similarly, attempts to contract wolf trappers and offer wolf bounties have been largely unsuccessful within British Columbia. For these reasons the government led Quesnel Highland wolf project was initiated with the goal of reducing wolf numbers through a combination of lethal control (accomplished through ground trapping) and the sterilization of dominant wolf pairs. The intent of this program was to reduce wolves over a period of five to ten years to allow the Mountain Caribou population to increase to more self-sustaining numbers. Although these methods are costly, when consistently funded and long term in nature there is the potential to effectively maintain reduced wolf densities within the target area (Table 3). If radio-collaring efforts are successful, helicopter wolf surveys should not be necessary to obtain an accurate wolf population estimate.

Table 3. Costs associated with wolf control and sterilization program for the Quesnel Highland area (5 year plan).

Description	Year 1	Year 2-5	5 Year Total
Helicopter/bait stations (winter)	$25,000	$40,000	$65,000
Aerial capture (helicopter)	$15,000	$10,000	$25,000
Professional wolf trapper services	$30,000	$40,000	$70,000
Contractor assistance	$35,000	$140,000	$175,000
Telemetry (1/month)	$20,000	$80,000	$100,000
Radio-collars (VHF)	$10,000		$10,000
Sterilizations	$20,000	$16,000	$36,000
Equipment and repairs	$3,000	$12,000	$15,000
Yearly Total	**$158,000**	**$84,500 / year**	**$496,000**

Moose and Caribou Management Monitoring

It will be important to monitor the success of implemented moose and wolf management programs. Although there is no initial cost associated with implementing an increased moose harvest system, aerial random stratified block surveys should be conducted on each of the four zones within MU 5-15 once the first year of the new management system is complete. One zone could be surveyed each year for the four years following implementation of the management

prescription. These yearly moose inventories should give an indication of the success of the new moose management strategy and adjustments to the rate of harvest can be made based on survey findings.

It is likely that adequate habitat use studies have been completed for the mountain caribou, making frequent, precise telemetry relocations unnecessary. However, maintaining radio-contact with representative caribou will help correct for sightability during March inventory flights and will help provide calf recruitment estimates. In addition, collared animals in the vicinity of intense recreational use area may be useful in conjunction with access monitoring and management. Costs associated with moose and caribou monitoring are outlined in Table 4.

Table 4. Moose and caribou monitoring costs for the Quesnel Highland area (5 year plan).

Description	Quantity over 5 years	Five Year Total
Moose inventory (A,B,C,D)	4 (1/year)	$200,000
Caribou inventory (every 2 years)	2	$80,000
Caribou radio-collars (VHF)	20	$8,000
Caribou collaring (net-gunning)	20	$24,000
Caribou telemetry (1/month, 6 hours each)	60	$126,000
Retrieval of collars (dead animals)	30 (6 hours/year)	$27,000
Total Five Year Cost		**$465,000**

Access Management

The current restrictions on snowmobile activities in Mountain Caribou habitat are a good start but may need further refinement to ensure caribou conservation. The recommendations of the Hart and Cariboo Mountains RIG delineate what is needed to recover caribou. Efforts must continue to minimize the risk of displacing caribou from core winter range by human activities. A recent study in central British Columbia concluded that intensive snowmobiling resulted in displacement of mountain caribou from suitable habitat (Seip et al., in press.). Government staff should continue to work with local snowmobile groups and heli-skiing operators to ensure recreationists are educated regarding potential mountain caribou displacement. This may be accomplished through meetings, information sharing and maintaining adequate signage at access points. To reflect best efforts at caribou conservation, government representatives should work with the local snowmobile clubs to convert the Grain Creek snowmobile caution zone to a voluntary closure zone. If funding can be obtained, periodic monitoring of snowmobile closure and caution zones would be beneficial. Future plans to discuss road deactivation and decrease active road density in core caribou habitats need to be discussed with licensees. Costs associated with maintaining an active access management plan are outlined in Table 5.

Table 5. Access management costs for the next five years in the Quesnel Highland area.

Description	Quantity over 5 years[6]	Five Year Total
Snowmobile access signs	10	$7,500
Informational brochures	500	$500
Snowmobile monitoring (fixed wing 2/month)	5	$75,000
Total Five Year Cost		**$83,000**

Continued Research

The silviculture systems research in this region is the longest continuous replicated research on this topic. The value of continuing to monitor existing research trials was highlighted with the latest lichen re-measurements that revealed for the first time that lichen biomass actually increased after partial cutting (on a per tree basis) and that the lichens shifted slightly to the genera most preferred by caribou. The plans are to continue the monitoring to determine how these and other key relationships develop though time.

The Mount Tom project is an adaptive management trial in the ESSF that is of a scale to address caribou response to operational application of the modified harvesting treatments. It includes about 1200 ha of harvesting (to be completed in 2008) and a 2000 ha uncut control area. This trial also addresses operational refinements to the partial cutting prescriptions as well as outstanding questions about the response of forage lichens, planted stock, windfirmness and hydrology.

The Isaiah Creek adaptive management trial explores partial cutting in the ICH part of caribou habitat. This trial was harvested in the summer and fall of 2006. Monitoring will include lichens, planted seedlings, natural regeneration, windfirmness, stand structure, coarse woody debris, vegetation and micro-climate.

One area of research that is not being addressed is studies on techniques to reduce the value of matrix habitat to early seral ungulates. This could include an evaluation of techniques to speed the development of forests through the stage that is attractive to early seral ungulates. Currently, no people or resources are available within government to conduct this research. Costs associated with the next five years of silviculture research and monitoring are outlined in Table 6.

[6] No funding was available to complete fixed wing monitoring for the winter of 2006/2007, though projected cost was included in this table.

Table 6. Continued silviculture systems research costs for the next 5 years in the Quesnel Highland area.

Description	06/07 (Yr 1)	07/08	08/09	09/10	10/11	Total
FIA/FSP	$92,000	$63,000	$87,000	$88,000	$60,000	$390,000
Mount Tom	$50,000	$50,000	$50,000	$50,000	$50,000	$250,000
Isaiah Creek	$70,000	$81,000	$36,000	$26,000	$53,000	$266,000
Totals	**$212,000**	**$194,000**	**$173,000**	**$164,000**	**$163,000**	**$906,000**

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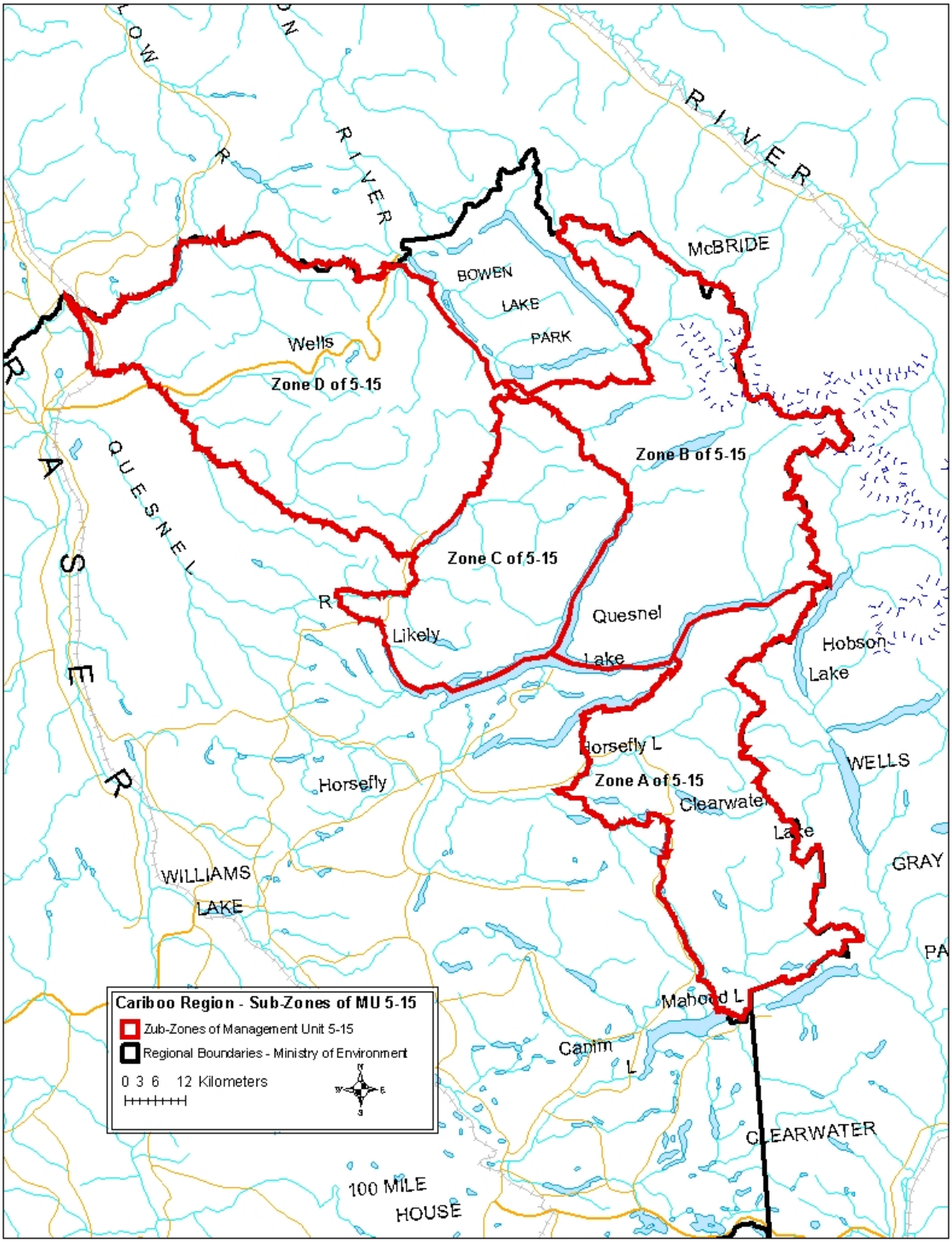
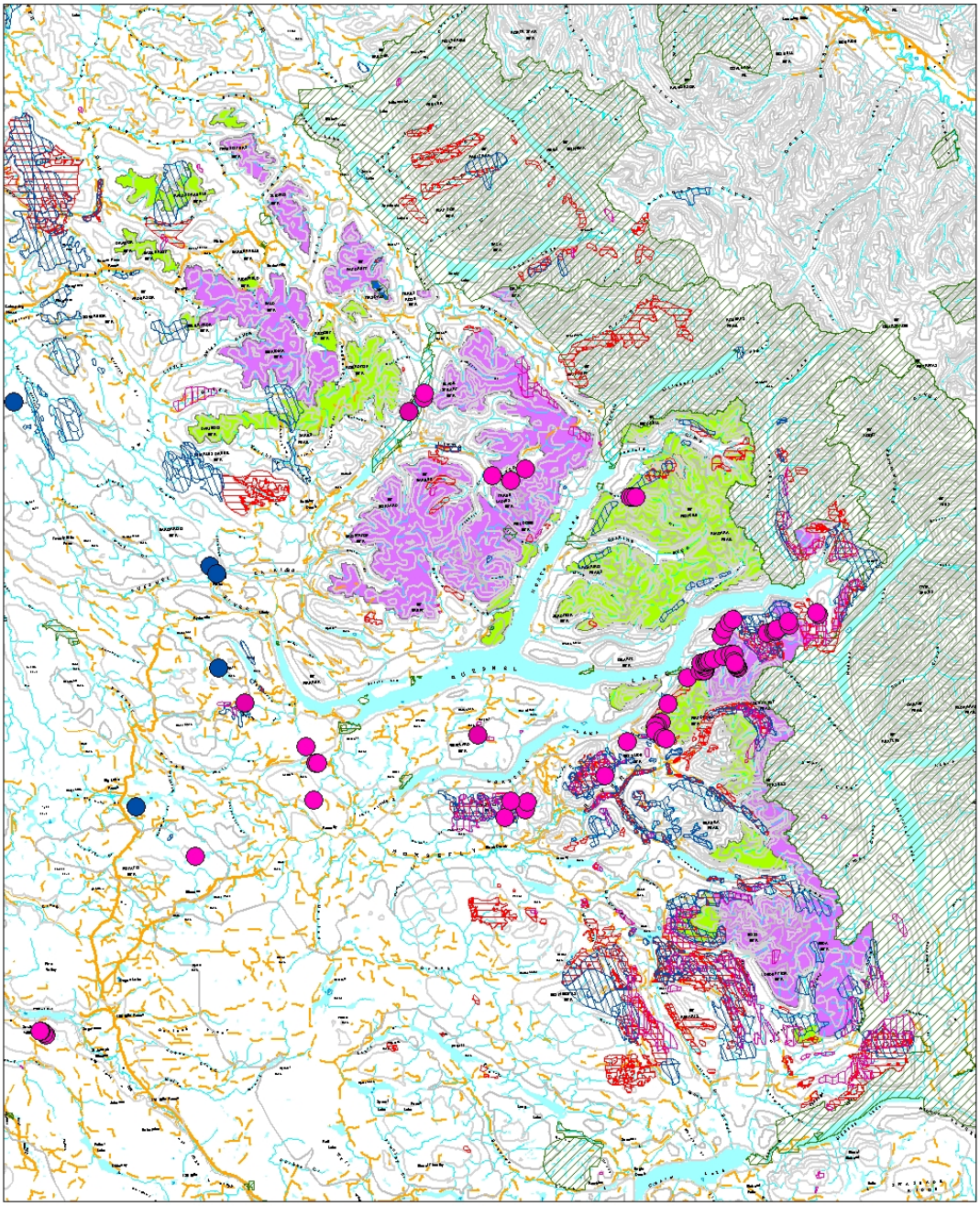
Appendix 1. CCLUP Moose Management Unit 5-15, zones A, B, C and D.



Appendix 2. Mountain Caribou Wildlife Habitat Areas (WHAs) and Spruce Beetle Infestation (2004-2006).



Appendix 3. Approved General Wildlife Measures

BRITISH COLUMBIA

ORDER – General Wildlife Measures:
Wildlife Habitat Areas #5-088 to 5-117

This order is given under the authority of Section 9(2) of the *Government Actions Regulation* (B.C. Reg. 582/2004).

The Deputy Minister of the Ministry of Environment orders that:

1. The general wildlife measures outlined in Schedule 1 are established for wildlife habitat areas 5-088 to 5-117 and apply to the areas shown in the maps set out in Schedule A (5-088 to 5-117) approved December 13, 2004 and the boundaries contained in the GIS file *nwlu_bc*.

Schedule 1

The purpose of these General Wildlife Measures is to maintain caribou habitat values within the polygons specified in the Order consistent with the Cariboo-Chilcotin Land Use Plan.

These General Wildlife Measures do not apply for the purposes of exploration, development and production activities when these activities have been authorized for the purposes of subsurface resource exploration, development or production by the *Mineral Tenure Act*, the *Coal Act*, the *Mines Act*, the *Petroleum and Natural Gas Act*, the *Pipeline Act* or the *Geothermal Resources Act*. Caribou concerns will be addressed through these other Acts.

Caribou No-Harvest – Wildlife Habitat Areas # 5-096 to 5-101, 5-106 to 5-108, 5-110 and 5-117

1. With the exception of cut blocks and the associated roads authorized at the time of the establishment of the Wildlife Habitat Areas, all forest cover within WHA 5-096 to 5-101, 5-106 to 5-108, 5-110 and 5-117 will be retained.

2. Forestry practices designed to address forest health activities will not result in the construction or maintenance of permanent access structures within WHA 5-096 to 5-101, 5-106 to 5-108, 5-110, and 5-117.

NOTE: Forest health issues can be dealt with under an exemption as per Appendix 1.

Caribou Modified Harvest – Wildlife Habitat Areas 5-088 to 5-095, 5-102 to 5-105, 5-109, 5-111 to 5-116

1. Forestry practices within Wildlife Habitat Areas 5-088 to 5-095, 5-102 to 5-105, 5-109, 5-111 to 5-116 will occur by way of group selection harvesting of 33% of each stand by area (including all skid trails and in-block roads) on an 80 year cutting cycle and will:

ORDER – General Wildlife Measures:
Wildlife Habitat Areas #5-088 to 5-117

(ii) result in distribution of the openings throughout the block so that subsequent entries can be well distributed.
(iii) result in a residual stand (and boundary) that can be considered windfirm.
(iv) result in no damage or minimal damage to residual trees. Minimal is defined as a maximum of 5% of post-harvest stems. Damage refers to both crown or bole damage and is defined as: 1) loss of ¼ or more of the crown, or 2) loss of bark (to or beyond the cambium) amounting to either 1000 cm2 or from 1/3 or more of the circumference of the tree.
(v) result in a variation of opening shapes to incorporate natural clumps of trees within the stand.
(vi) result in a distribution of openings throughout the block and keeping openings at least 2 tree lengths apart.
(vii) result in regenerating with the pre-harvest proportion of *Abies* versus spruce and a clumpy distribution of stems. Meeting these proportions at the time of planting will be considered adequate. Lodgepole pine must not be planted in mountain caribou habitat.
(viii) result in the maintenance of caribou habitat by limiting access and human disturbance to the lowest levels possible, for example through road deactivation and reducing active road density.

2. Forestry practices designed to address forest health activities within WHA 5-088 to 5-095, 5-102 to 5-105, 5-109, 5-111 to 5-116 will be limited to timber harvesting and road construction as required for forest health sanitation activities. Sanitation is defined as harvest of trees with live brood only.

Signed this 2nd day of May, 2005
Chris Trumpy, Deputy Minister
Ministry of Environment

ORDER – General Wildlife Measures:
Wildlife Habitat Areas #5-088 to 5-117

Appendix 1

1. Further guidance on management practices in Mountain Caribou habitat can be obtained from the *Mountain Caribou Strategy* dated October 2000 prepared under the Cariboo-Chilcotin Land Use Plan, and approved by the Inter-Agency Management Committee and Regional Resource Committee.

2. Authority to consider an exemption from these general wildlife measures is provided in Section 92(1) of the *Forest Planning and Practices Regulation*. In instances where it is not practicable to comply with these measures, a person proposing to conduct forestry activities should consider seeking an exemption from the requirement to comply with the applicable General Wildlife Measures – this applies to both the modified harvest and no harvest areas.

   An exemption application should be submitted to the Minister's delegate (Regional Manager – Ministry of Water, Land and Air Protection) with a rationale describing the nature of the problem and options to integrate caribou habitat conservation with proposed forestry practices. This submission will assist in timely consideration of the matter, and will inform the conditions, if any, of the exemption that may be granted prior to commencement of activities.

   Salvage of dead timber (non-infectious) resulting from severe natural disturbance may be proposed as an exemption if the proposal is a net benefit to caribou as opposed to taking no action.

   When the Minister's delegate considers an exemption, they will respect that caribou habitat conservation is the overriding priority for these Wildlife Habitat Areas. Where an exemption is granted, then notification of the exemption and the conditions will be provided to the IAMC (Cariboo Managers Committee) and the Regional Resource Committee (RRC).

Appendix 4. Summary Table of Progress on Implementation of CCLUP Mountain Caribou Strategy

	Strategy Recommendation	*Progress to Date*	*Work Underway OR Gaps/Problems*	*Next Steps*	*Implementation Progress Rating*
1	Habitat Strategy - location of 'no harvest' and 'modified harvest'	No harvest' and 'modified harvest' areas legally designated as Wildlife Habitat Areas (2004) with legal General Wildlife Measures (2005)	RIG made recommendations that differed from the MCS Habitat Strategy - SARCO currently assessing next steps in terms of recovery.		Completed
2	Timber management approach recommended for 'modified harvest' areas	The recommended timber management approach was incorporated into the legal General Wildlife Measures for the WHA's	The IAMC has requested that the Caribou Committee review the recommended approach with respect to Spruce Bark Beetle suppression.		Completed
3	Resolution of the appraisal allowance issue	No progress			Deficiency
4	An overall road access management plan be developed within caribou winter range	No progress to date			Significant Deficiency
5	Non-commercial and commercial recreational uses of snowmobiles, ATVs and helicopters should be carefully regulated or excluded from caribou winter range areas	A modified version of the Caribou Strategy was negotiated to develop snowmobile zoning for caribou winter range. Heli-skiing operators in caribou areas have incorporated caribou avoidance strategy as part of their management plan.	Monitoring of the conformance levels with the voluntary snowmobile closure areas completed (02/03-04/05); monitoring of snowmobile use in caution zones completed in 05/06.	Continue monitoring and sign/education maintenance. Implement RIG 2005 recommendations for heli-skiing and snowmobiles.	Partially addressed with some deficiency
6	Ongoing monitoring of caribou, moose and wolf populations is recommended	Caribou population monitoring has continued on an annual basis, though caribou population distribution and habitat use monitoring has only been continued on a minimal basis. Moose population monitoring is on a periodic basis, not annually - last years of survey were 2003 and 2004. Wolf population monitoring was done 2001 to 2004 - funding is being sought to continue this program.	Commitment to funding has been a problem.	Continued caribou monitoring at least every 2 years, moose inventories need to be done and wolf population monitoring to determine success of management programs.	Partially Completed

	Strategy Recommendation	*Progress to Date*	*Work Underway OR Gaps/Problems*	*Next Steps*	*Implementation Progress Rating*
7	Implementation of forest management practices that limit the establishment of favourable habitat for moose within or adjacent to the caribou range	No progress - modified harvest techniques do limit early seral forage to some degree.			Deficiency – particularly of concern adjacent to core caribou habitat
8	A wolf management program should be developed that specifically targets individual wolves or packs that are preying on caribou	Wolf management program developed and implemented from 2001 to 2004 – partial funding continued Nov. 05 - present	Wolf program work re-initiated - funding has continued to be a problem.		Partially Completed
9	Develop a modified moose management strategy that incorporates higher harvest rates for moose populations within and adjacent to caribou range	Higher rates of harvest for moose, including cow LEH permits, have been developed for moose in MU 5-15.	Analysis of early seral habitat to establish moose and wolf targets is just underway.	More aggressive methods may be necessary to decrease moose population.	Partially Completed
10	Motorized recreational access be carefully regulated or excluded from the 'modified harvest' located between Cariboo Mountains Park and Quesnel Lake	Snowmobile use has been zoned out of much of the area. A heli-ski tenure was issued in the area in 2001.		Road deactivation needs to be looked into. Follow RIG recommendations regarding heli-skiing and snowmobile closures	Partially Completed
11	A detailed conservation risk assessment should be completed that identifies critical risks and assesses how well the MCS reduces these risks	This assessment work is being done through the Caribou RIG work and the follow-up by SARCO.			Partially Completed
12	The MCS should be reviewed in detail every 5 years in order to determine if refinements are necessary	Review to be done by January 2007			Completed

Appendix 5. More detailed history of associated costs of caribou recovery/monitoring.

Quesnel Highland Wolf Project Costs (July 2001 to March 2006).

Description	Jul-01 to Mar-03	Apr-03 to Mar-04	Dec-05 to Mar 06	Total
Contract Services (Biologist)	$64,206	$59,709	$13,513	$137,428
Radio Collars	$14,662	---	---	$14,662
Aircraft Charter	$142,203	$52,135	$7,735	$202,073
Training/Workshops	$1,550	$1,500	---	$3,050
Wolf Sterilization and Veterinary Services	$9,256	$8,000	$222	$17,478
Professional Trapper			$15,292	$15,292
Trapping Supplies	$9,845	$1,567	---	$11,412
Equipment Repairs	$1,138	---	---	$1,138
Total	**$242,860**	**$122,911**	**$36,762**	**$402,533**

Cost summary for four years of snowmobile/caribou monitoring within the Quesnel Highland study area (2002-2006).

Year	No. of Flights	Flight Hours	Total cost
2003	21	53.1	$14,400
2004	25	56.9	$16,310
2005	6	19.0	$5,703
2006	9	35.1	$11,001
Total	**61**	**164.1**	**$47,413.83**