

Cariboo-
Chilcotin
Land Use
Plan

CCLUP Northern Caribou Strategy Review: Update #1

Prepared by:

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Strategy
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**Cariboo Regional
Management
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and Natural
Resource
Operations**

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Photo by Pete Nauyokas

Cariboo-Chilcotin Land Use Plan

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Executive Summary³

The CCLUP Northern Caribou Strategy (NCS) was released in 2002 following seven years of research and development of an integrated habitat approach for northern caribou. In 2008, the Cariboo Manager's Committee (CMC) requested the regional Caribou Strategy Committee (CSC) undertake a review of the NCS, focusing primarily on progress towards strategy implementation and whether there is a need to update or change the strategy. This update document reports on the results of the NCS review and provides some key recommendations, however it does not replace the original NCS which is still considered to be an important guidance document.

The update reports out on three main topics: the conservation status of the northern caribou herds in the CCLUP area, the impacts of Mountain Pine Beetle (MPB) on caribou habitat and on the progress since 2002 on implementing the original NCS recommendations. Each of the sections of the update concludes with a discussion of future work and recommendations.

From a conservation perspective, the Itcha-Ilgachuz caribou herd is one of the largest and most dense in the province and therefore of extremely high importance for maintenance and recovery of caribou in the west-central area of BC. In the past, and recently, this herd has been considered a candidate to supply transplant stock to augment other Woodland Caribou sub-populations in danger of extirpation. However recent surveys have yielded results reflecting a declined status for this herd. Therefore, currently the number one concern of the CSC lies with the uncertainty of caribou numbers in the Itcha-Ilgachuz, Rainbow and Charlotte Alplands northern caribou herds. Until the conservation status of these herds is ascertained, the necessary intensity of further conservation measures will be in doubt. A high priority requirement is the completion of population surveys for all three herds and the implementation of a population/habitat monitoring program for the Itcha-Ilgachuz herd.

The three key issues that pose further threats to Northern Caribou herds in this region involve:

- Potential impacts of the MPB epidemic on caribou – lichen abundance, barrier to movement and increased risk of widespread fire
- Increased wolf predation due to elevated populations of alternate prey that are supported by an abundance of early seral forage
- Potential displacement of caribou caused by humans and motorized vehicles

Within the NCS area, including the parks, MPB attained its zenith both in intensity and current attack in 2006. By 2010 over 72% of the Itcha-Ilgachuz caribou habitat area (IICHA) had been

³ Refer to Appendix 1 for a list of Acronyms used throughout this report.

impacted by beetle infestations. Of this infested area, over 60% was classified as very severe attack (greater than 50% stand mortality). Severe and widespread attacks of MPB may decrease caribou habitat suitability and availability by:

- Increasing the risk of widespread fires
- Potentially reducing lichen availability for caribou
- Potentially creating barriers to caribou movement

The extent and severity of MPB attack on the caribou range was examined in more detail using low elevation aerial photography and raster analysis. Results from the raster analysis based on 2008 summer aerial photography done in the IICHA indicate that modified harvest subunits 22, 24, 08 and 28 and the no harvest 01 subunit, located in the north and northeastern portion of the IICHA, will likely be the areas of caribou habitat most adversely effected by MPB as trees fall in the next 10-15 years.

Terrestrial lichen response to tree mortality due to MPB has been monitored on the Itcha Ilgachuz Alternative Silvicultural system trials at Satah Mountain in the Williams Lake TSA and within the modified harvest zone of the Quesnel TSA. Declining trends of terrestrial lichen percent cover have been observed in both study areas. It is important to recognize that although terrestrial lichen abundance is initially decreasing due to MPB caused tree mortality, northern caribou are still utilizing these habitats to graze for terrestrial lichens during winter months.

Despite the level of MPB attack on the caribou winter range, the 'modified harvesting' silvicultural systems have the potential to maintain habitat because the stands, even with mostly dead trees, still provide partial shade for lichens for a period of time. Current research leads to the conclusion that the silvicultural systems and harvesting techniques recommended in the NCS still represent the best approach for maintaining caribou habitat while providing timber to the forest industry as identified in CCLUP.

Substantial work has been undertaken to implement the NCS since 2002, though much of the effort to date has been targeted at maintaining habitat. Although the bulk of government financial investments occurred during the research and strategy development stages (pre-2002), considerable time and funds have also been spent addressing northern caribou management during the last eight years (see Appendix 9). Over the entire IICHA, approximately \$3.13 per hectare has been spent since 1992, with an average of \$260,000 per year. Funding availability for this work has dropped considerably in the last five years. Aside from population surveys, no animal monitoring information has been collected since 2002.

Wildlife Habitat Areas (WHA's) encompassing all of the identified 'no harvest', 'modified harvest' and 'natural disturbance seral distribution' polygons were legally designated under the Forest and Range Practices Act (FRPA) in December 2004, with General Wildlife Measures (GWM's) for these areas being established in July 2005. The GWM's for the 'natural

disturbance seral distribution' WHA were amended in 2007. In 2011 a significant amendment to the WHA Order resulted in the addition of 15,000 ha to the WHA and the creation of 2 new WHA polygons to be managed as a 'caribou enhanced conventional harvest zone'. Together these WHAs represent the largest WHAs by size designated in the province.

Further work on the Northern Caribou herds in this region is recommended and a proposed 5-year plan and summary of costs is located in Appendix 10, which includes the following recommended activities:

- Caribou inventory surveys for all three herds every three years - Itcha-Ilgachuz the foremost priority, followed by the Rainbow and Charlotte Alplands herds
- Continued silvicultural systems research - relating both to success of modified harvest techniques and potential impacts of MPB (including lichen survival, caribou movement barriers and increased fire hazards)
- Inventories of wolf (one survey) and moose (in order of priority: MU 5-12, 5-13C and 5-06)
- Caribou population/habitat monitoring program - GPS and VHF radio-collaring and monitoring to determine caribou responses to habitat changes
- Access management - replacement, maintenance costs and adaptive management (Appendix 6)
- Increasing access control measures by initiating year round motor vehicle closure (Appendix 6 for details)
- Pilot wolf collaring and monitoring program within the habitat range of the Rainbow caribou herd (if warranted by inventories)

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Introduction⁴

In 2002, the Northern Caribou Strategy (NCS) was released by the Cariboo-Chilcotin Land Use Plan (CCLUP) Caribou Strategy Committee (CSC) following seven years of research, inventory and mapping projects to develop an integrated caribou habitat management approach. Work on this project began in 1995 when Geographical Information Systems (GIS) analyses were used to identify initial modified-harvest and no-harvest areas for caribou based on best available information. Extensive consultations with stakeholders, primarily regarding timber harvest areas, but also including access management and park planning were carried out from 1998 until completion of the report in 2002. It was recommended that the NCS be reviewed approximately every five years to ensure that caribou and timber objectives are being met.

In 2008, the Cariboo Manager's Committee requested that the CSC undertake the first review of the NCS. This update report documents the results of this review, conducted from 2008 to 2011, and provides some key recommendations; however it does not replace the original NCS which is still considered to be the foundation guidance document for northern caribou in the Cariboo Region.

The review addresses the following questions:

- What is the current status of the northern caribou (Itcha-Ilgachuz, Rainbow and Charlotte Alplands) population in the CCLUP area?
- What is the extent of the Mountain Pine Beetle attack within the caribou Wildlife Habitat Areas and are the General Wildlife Measures still the best approach for maintaining northern caribou habitat?
- What caribou monitoring and research work has been done since 2002?
- What predator-prey research, monitoring, or management has been conducted since 2002?
- How much timber harvest has occurred and have recommended approaches been followed since 2002?
- What progress has been made in implementing the specific recommendations in the NCS?
- Have any issues emerged since 2002 with respect to implementation of the NCS that require further work and/or changes to the strategy?

Appendix 2 presents an overview summary of progress on implementation of recommendations put forward in the NCS (2002).

⁴ Refer to Appendix 1 for a list of acronyms used in this report

Background: Summary of Government Direction and Planning for Northern Caribou Management

Northern caribou were first blue-listed (provincial status: S3S4) by the Conservation Data Centre (CDC) in 2000 (B.C. Conservation Data Centre 2009). Blue-listed species are considered vulnerable or sensitive (at risk) and in need of special management to ensure their survival. In May 2002, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) confirmed the initial 2000 classification as nationally threatened for all Woodland Caribou within the Southern Mountains National Ecological Area (SMNEA) based on the updated status report (COSEWIC 2002, Thomas and Gray 2002). The NCS addresses three herds in the West Central metapopulation that occur within the SMNEA and the CCLUP planning area: the Itcha-Ilgachuz, Rainbow, and Charlotte Alplands herds (Map 1).

In November 2004 the Province released *A Strategy for the Recovery of Northern Caribou in the Southern Mountains National Ecological Area in BC*. This report was put together by the Northern Caribou Technical Advisory Committee (NCTAC) to identify recovery strategies, based on sound biological principles deemed necessary to protect and recover northern caribou in the SMNEA. Strategies identified use the precautionary approach which states *where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize a threat*. The vision of the Recovery Strategy is:

“The maintenance of caribou and their habitat in perpetuity throughout British Columbia’s Northern Caribou range in the Southern Mountains National Ecological Area.”

The following three recovery goals were outlined to advance the recovery of Northern Caribou in the SMNEA (NTAC 2004):

- (1) *sustainable local populations of northern caribou distributed throughout their current range;*
- (2) *recovery of identified local populations at risk; and,*
- (3) *public support for recovery of northern caribou populations and their habitats*

To facilitate achievement of these goals the West Central Caribou Recovery Implementation Group (RIG) was established to provide further advice on measures required to recover northern caribou from the Charlotte Alplands, Itcha-Ilgachuz, Rainbows, Tweedsmuir-Entiako and Telkwa sub-populations. In October 2004 the Species at Risk Coordination Office (SaRCO) was established and was tasked to develop a comprehensive, credible, and defensible provincial strategy for the conservation and recovery of species at risk in the province. At that time SaRCO requested that RIGs suspend their meetings until a decision framework supported by the provincial government was in place. In 2007 a decision framework supported by the Province was released outlining recovery options (McNay et al. 2008). The Ministry of Environment is presently examining options to reinstate recovery planning and implementation for northern caribou within the SMNEA. Once initiated, this work will address conservation concerns for all

herds and will provide information and recommendations on identification and protection of habitat to address requirements of the federal Species at Risk Act (SARA) for all herds.

Government direction for northern caribou management has to-date been provided through various instruments, some legislated, some non-legislated. The direction provided by the CCLUP Northern Caribou Strategy has recently been legalized for the purposes of forest management under Forest and Range Practices Act (FRPA) by means of designation of Wildlife Habitat Areas and General Wildlife Measures for northern caribou. See the following descriptions for details.

CCLUP Caribou Strategy

The CCLUP as a Higher Level Plan (HLP) contains legal objectives for northern caribou. The CCLUP Northern Caribou Strategy developed from 1998 to 2001, and released in early 2002 by the Inter-Agency Management Committee IAMC, provides non-legislated direction from government on how to best implement the HLP objectives.

Caribou Wildlife Habitat Areas (WHA's)

The 'no harvest', 'modified harvest' and 'natural disturbance seral distribution' areas identified in the CCLUP northern caribou Strategy were legalized for forest management purposes under FRPA in December 2004. Forest Stewardship Plans must respect the legal WHA boundaries. An additional 'caribou enhanced conventional harvest' area was incorporated into the WHAs in April 2011.

General Wildlife Measures (GWM's)

General Wildlife Measures for all the WHA's established for northern caribou were legalized in July 2005. These GWM's are legal practice requirements for forest practitioners or licensees operating within the WHA's. In July 2007 an order amendment was passed to offer more specific direction for harvesting in Area 5-087 (SBPS Natural Disturbance Seral Distribution (NDSD) Zone). The General Wildlife Measure amended in 2007 clarified requirements for age classification of timber attacked by Mountain Pine Beetle within the modified harvest NDSD zone. In April 2011 the GWMs were once again amended to include direction for the new 'caribou enhanced conventional harvest' area. Refer to Appendix 3 for more details.

Land Use Order

Sustainable Resource Management Plans were developed by the Integrated Land Management Bureau to address in more detail how HLP objectives are to be addressed across the different spatial landscapes. The final drafts of these plans were submitted to the Caribou Managers Committee (CMC) in June 2007. The SRMP objectives were accepted by the managers committee as the way the HLP objectives were to be met through time and space across the landscape. At that time however those SRMP's were not legally binding.

Since that time the objectives of the CCLUP which had not been addressed through other methods (e.g. WHA, GWM) have been legalized through the signing of a Ministerial Order under the Land Act. These objectives were established to address the needs of the FRPA and the direction of the CCLUP. The northern caribou objectives contained in the draft SRMP's are not a part of the Land Use Order as this has already been accomplished through designation of WHA's and GWM's.

Part I. Conservation Status for the Northern Caribou in the CCLUP Area

Five northern caribou herds comprise the west-central metapopulation, of which three reside within the CCLUP area: the Itcha-Ilgachuz, Rainbow and Charlotte Alplands herds (Map 1). Conservation values for sustaining metapopulation persistence were assigned to caribou herds based on population viability, habitat and population threats, habitat protection and habitat condition (NCTAC 2004). For caribou herds within the CCLUP area, the highest conservation priorities (indicated by the lowest numeric score) were the Itcha-Ilgachuz and Rainbow herds (Table 1). The Itcha-Ilgachuz herd is one of only two herds within the West Central and North Central metapopulations given highest conservation ranking. As one of the largest and highest density caribou herds in the province, conservation of the Itcha-Ilgachuz herd is vital to the overall recovery of caribou in the SMNEA (NCTAC 2002).

Although the Itcha-Ilgachuz, Rainbow and Charlotte Alplands herds have distinct calving grounds, radio-telemetry information indicates the herds share winter range in some years (Young and Freeman 2001). For the purposes of the NCS review, the range for all three herds will be hereafter referred to as the “Itcha-Ilgachuz Caribou Habitat Area” or IICHA. The IICHA is defined as the outermost boundary of northern caribou radio-telemetry relocations, as outlined by a minimum convex polygon (Map 2).

Table 1. Preliminary conservation risk assessment and priority for northern caribou within the Southern Mountains National Ecological Area (SMNEA)^a

Conservation Category	Itcha-Ilgachuz	Rainbow	Charlotte Alplands
Viability • Population size, trend and connectivity	high	medium	low
Threats • forest harvest, predation, access, unlicensed hunting, forest fire and insect risk	high	High	high
Habitat Protection • percent of habitat protected, inoperable and under special management	medium	medium	medium
Habitat Condition • percent suitable, capable and degree of fragmentation	high	medium	medium
Conservation Priority	1	3	4.5
Conservation Value	high	medium	low

^aFrom “A Strategy for the Recovery of Northern Caribou in the Southern Mountains National Ecological Area in BC – prepared by The Northern Caribou Technical Advisory Committee; Version 1.0 November 2004” (NCTAC, 2004)

Itcha-Ilgachuz Herd

When the Northern Caribou Strategy was released in 2002, the Itcha-Ilgachuz herd appeared to be stable-to-increasing with a population estimate⁵ of 2000 caribou (Young and Freeman 2001). Continued monitoring of the herd suggested a long-term increasing trend with adequate calf recruitment and an increasing bull-to-cow ratio. In 2003, 2861 caribou were observed during the post-calving survey and the population was estimated at 2800 caribou following adjustment for the fall hunting season (Figure 1) (Young and Freeman 2003a). Between 1996 and 2003, neo-natal recruitment for the Itcha-Ilgachuz herd averaged 25.8% calves in June while late winter (annual) recruitment was 17.0%⁶. Annual recruitment was above the 15-16% required to balance natural adult mortality and maintain population stability as suggested by Bergurud (1992). Increases in caribou numbers between 1996 and 2003 were likely due to actual herd increases, as well as better sightability associated with more thorough search effort and a radio-collaring program that involved annual monitoring of the herd during post-calving, rut and late winter.

Limited population monitoring occurred following 2003 partly due to the presumed stable-to-increasing status of the Itcha-Ilgachuz herd and partly due to increased allocation of provincial funding towards Mountain Caribou Recovery efforts. Interest in the Itcha-Ilgachuz caribou as a candidate donor herd for augmentation of declining mountain caribou populations in B.C. prompted re-assessment of the herd status in 2007. In June 2007, a post-calving survey was carried out with the expectation of observing upwards of 3000 caribou (*see* trend 1978-2003, Figure 1); however, only 1784 caribou were observed. Sub-optimal survey conditions were thought to have reduced caribou sightability, thereby contributing to the low count (Roorda and Dielman, 2007). Re-assessment of the herd in 2009 and 2010 resulted in minimum caribou counts of 2093 and 1367, respectively; both surveys were conducted under excellent survey conditions.

Assessment of the 2007 and 2009 survey results suggested cow numbers appeared fairly stable but that calf, bull and yearling counts had declined relative to 2002-03 when survey counts peaked at ~2800 animals. In 2010, low counts were consistent amongst all caribou classification groups.

Recent surveys have not yielded caribou numbers reflective of a stable population, but rather suggest a population decline. There is no clear explanation for the decline in caribou and uncertainty exists on the rate of population decline. Population indices such as neo-natal calf to cow ratios and bull to cow ratio do not appear to indicate a reproduction problem. However, if

⁵ Population estimates reflect post-calving (June) and post-hunter harvest (October) estimates.

⁶ Neo-natal recruitment is a measure of early calf production, calculated as the percent calves of total caribou counted during the June post-calving survey. Annual calf recruitment is a measure of calf over-winter survival, calculated as percent calves of total caribou counted during March late winter survey.

declines in early calf survival are occurring (i.e., increased predation), as potentially observed in 2007 and 2009, declines in overall recruitment and in yearling numbers may be expected in the years following. No annual recruitment data has been collected since 2003. Without the ability to track caribou distribution on the landscape (i.e., no radio or GPS collar tracking has occurred since 2003), it is also impossible to ascertain whether low survey counts can be attributed to modified caribou distribution on the landscape. At higher density, such as observed in 2002-03, caribou may disperse to reduce risk of predation. A change in caribou habitat use and distribution related to the mountain pine beetle (MPB) epidemic that has affected the area since 2000 but may also be occurring. Anecdotal caribou sightings from local residents suggest that during the winter caribou are ranging further than previous years. Local anecdotal reports also suggest that wolf numbers have increased substantially in the area; however no predator surveys have been conducted.

The 2009 population estimate for the Itcha-Ilgachuz herd was 2150 caribou with a population trend that appeared to be *declining* (Freeman 2010). This is a notable contrast to 2003 when the herd was considered to be increasing at 2800 caribou.

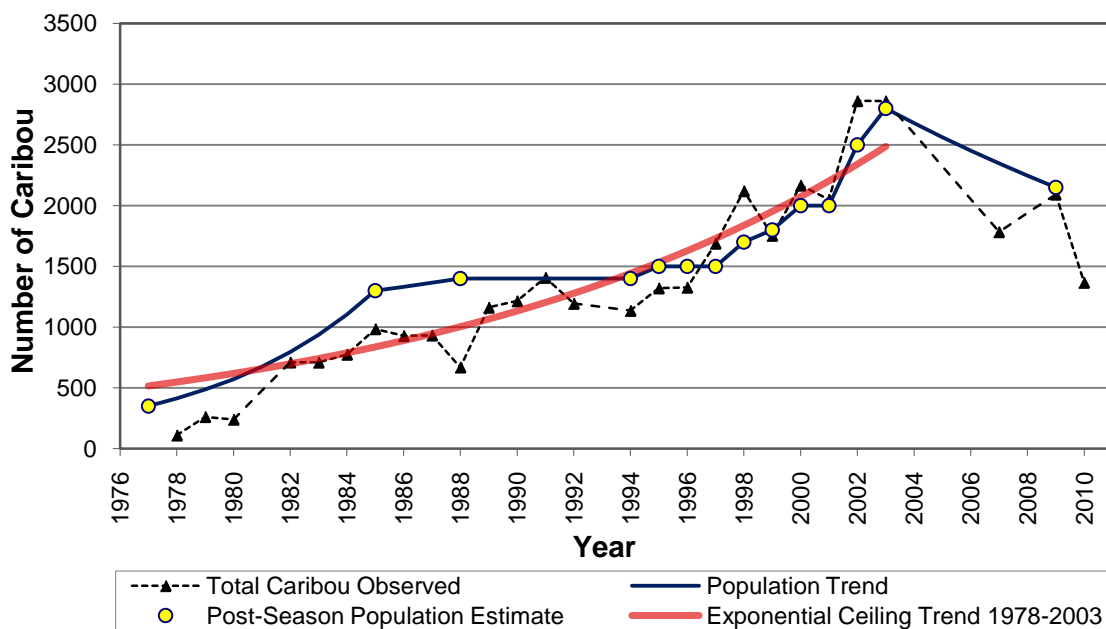


Figure 1. Summary of caribou post calving surveys for the Itcha-Ilgachuz herd, 1978-2010.

Rainbow Mountains Herd

In 2002, the Rainbow Mountains herd was estimated at 125 animals; however from 1996 to 2001 poor calf recruitment and diminishing numbers indicated that the herd was in decline (Young and Freeman 2001). No monitoring of the Rainbow herd occurred from 2002 to 2007. An incomplete reconnaissance survey in October 2007 located only five caribou on the north side of the Rainbow Range (Tsitsutl Peak area); these low numbers were attributed to partial coverage of caribou range (i.e., caribou normally reside on the north-west side of Rainbow Range mountains during rut) and the likelihood of caribou utilizing forested, lower elevation habitats.

In 2008, a rut survey of the Rainbow Mountains was completed and 44 caribou were observed (24 cows, 6 calves and 14 bulls), down from 108 caribou in 2000 (Figure 2). Based on rut surveys between 1995 and 2008, the herd appears to be declining with a λ^7 of 0.91 (Freeman 2009). Similar declines in numbers were observed during the post-calving surveys from 1995 to 2001. Annual late winter surveys conducted between 1996 and 2003 have shown low calf recruitment ranging from 2.8 to 15.0% and averaging 9.4% calves. Recruitment was very low in 2002 and 2003 at 5.4 and 8.7% calves, respectively, suggesting an increase in predator influence. In summary, the Rainbow herd has declined since the mid 1990s and appears to have experienced a rapid decline over the past 8 years with a current population estimate of 50 caribou.

Managers should be extremely concerned with the trend and status of the Rainbow Mountain herd because when caribou herds reach such low numbers (50 or less) their long-term future survival is not certain. Recovery actions for this herd should be developed.

⁷ Lambda refers to the calculated finite rate of increase, where anything less than 1 indicates a declining population.

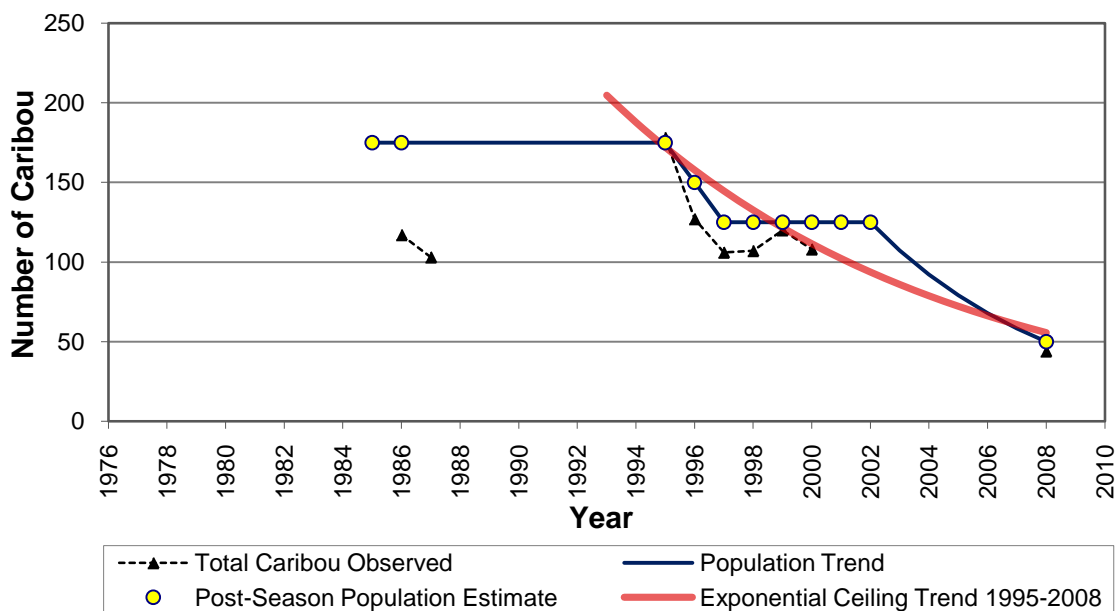


Figure 2. Summary of rut surveys for the Rainbow caribou herd, 1985-2010.

Charlotte Alplands Herd

The Charlotte Alplands herd was established through reintroduction of caribou transplanted from the Itcha-Ilgachuz herd between 1984 and 1991, though caribou were historically known to use this part of the range. By 1993 the Charlotte Alplands herd numbered over 50 caribou; population surveys in the late 1990s observed increasing bull numbers but declining cow numbers and poor calf recruitment (Figure 3). The most recent survey in 2001 observed 23 caribou and a decline in the breeding component, with cow numbers decreasing from 29 cows in 1993 to 12 cows (Young et al. 2001). Reconnaissance surveys coinciding with late winter surveys of the Itcha-Ilgachuz and Rainbow herds between 2002 and 2004, suggest caribou numbers may have further declined. In March 2003, several alpine ridges in the northerly range of the Charlotte Alplands herd were searched for caribou presence, based on observed caribou use in previous years. No caribou or caribou sign was observed, however recreational snowmobile use of alpine areas was noted (Young and Freeman 2003b). It is possible that the herd may have dispersed however without further investigation, the distribution and population status of the Charlotte Alplands herd remains uncertain. Anecdotal sightings from hikers in July 2009 counted a group of 8 caribou and a lone caribou, while hunter sightings in September 2009 counted a lone mature bull and a group of 3 adults and 2 calves; all caribou were observed in the south-easterly range of the herd in the Wilderness Mountain and McClinchy Mountain area.

When the NCS was released in 2002, the Charlotte Alplands herd was estimated at 50 animals and it was uncertain whether caribou numbers had actually declined, remained stable, or increased. Lack of recent survey data makes it difficult to assess the status of the Charlotte

Alplands herd; however, the herd likely numbers fewer than 50 animals. Follow-up work on the status of this herd is highly recommended.

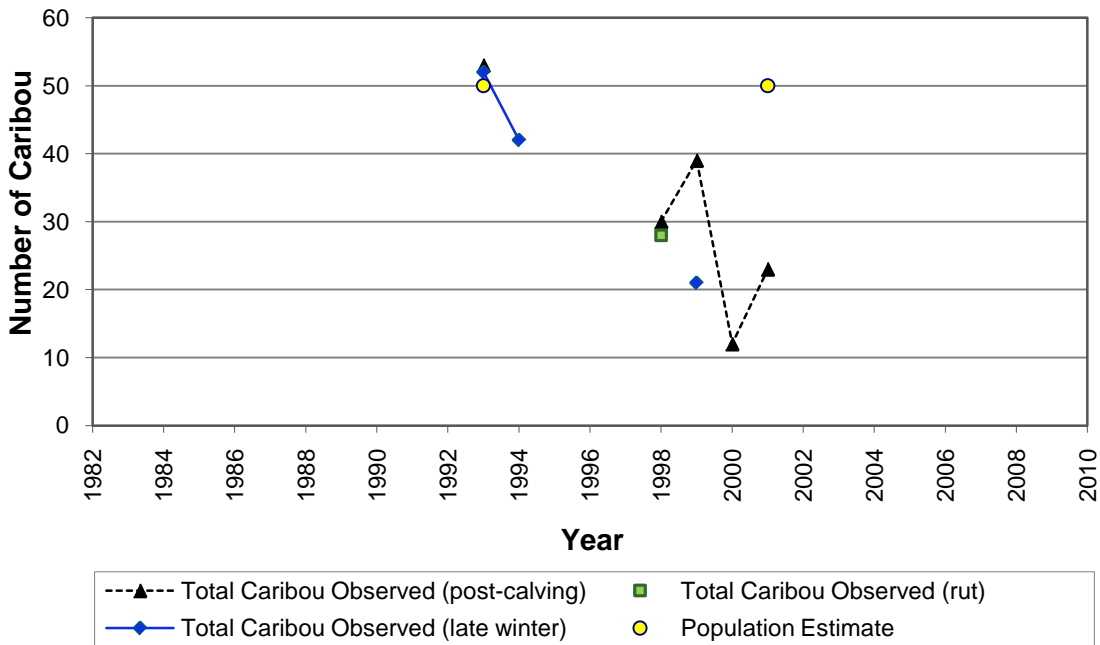


Figure 3. Summary of post-calving, rut and late winter surveys for the Charlotte Alplands caribou herd, 1993-2010.

Future Work and Recommendations – Caribou Population Monitoring

The Caribou Strategy Committee recommends population inventory surveys be conducted every three years for each of the three herds within the IICHA.

The Rainbow Mountains herd population decline is of high management concern. Recovery actions for this herd should be developed.

A monitoring program for caribou that examines the response of caribou to MPB and timber harvest (in the caribou enhanced conventional zone) needs to be initiated. This program should include a GPS and VHF radio-collared sample of caribou to examine caribou responses to habitat changes, improve sightability on population surveys, and increase confidence in population estimates.

Caribou Harvest Management

The Itcha-Ilgachuz herd is one of only two local populations within the SMNEA that maintains a sport hunting season.⁸ The Itcha-Ilgachuz herd is managed with a 5 point bull caribou open season regulation.⁹ Under this regulation, very few caribou less than 4 years of age are harvested. The annual allowable harvest (AAH) is 40 bull caribou for the Itcha-Ilgachuz herd for 2005 through 2010. Caribou harvested by resident and non-resident hunters must be compulsory inspected, however reporting of the First Nation harvest is not mandatory, and the size and composition of the native harvest is unknown. First Nation hunting is not restricted, although most hunting occurs during the winter months. Limited discussions with First Nation bands suggest that 30 caribou per year may be a liberal harvest estimate and that their harvest was likely unselective (i.e. each sex and age class was harvested in proportion to their occurrence in the population) (Hatter and Young, 2004). It is estimated that the Itcha-Ilgachuz population supports an average annual harvest of 50 to 60 animals by First Nations, resident hunters and non-resident hunters.

Since 1974, the annual reported harvest has fluctuated between 9 and 57, with an overall average of 30 caribou a year (Figure 4). Hatter and Young (2004) reported that past harvests have been sustainable since the Itcha-Ilgachuz herd more than doubled in size between 1995 and 2003. Management experience of woodland caribou in North America indicates that a harvest rate of 2 to 3% of adults is within sustainable limits (Yukon Renewable Resources 1996). This suggests recent caribou harvest rates for the Itcha-Ilgachuz herd have been sustainable. If the Itcha-Ilgachuz population continues to decline, further investigation into population trend and harvest rates is recommended.

⁸ Itcha-Ilgachuz herd and Chase herd

⁹ 5 point bull caribou regulation: only caribou that have one antler which bears at least 5 tines (points), including the tip of the main beam, above the rear point are legal. Prior to 2001, bulls with an antler main beam at least 75 cm in length were also legal.

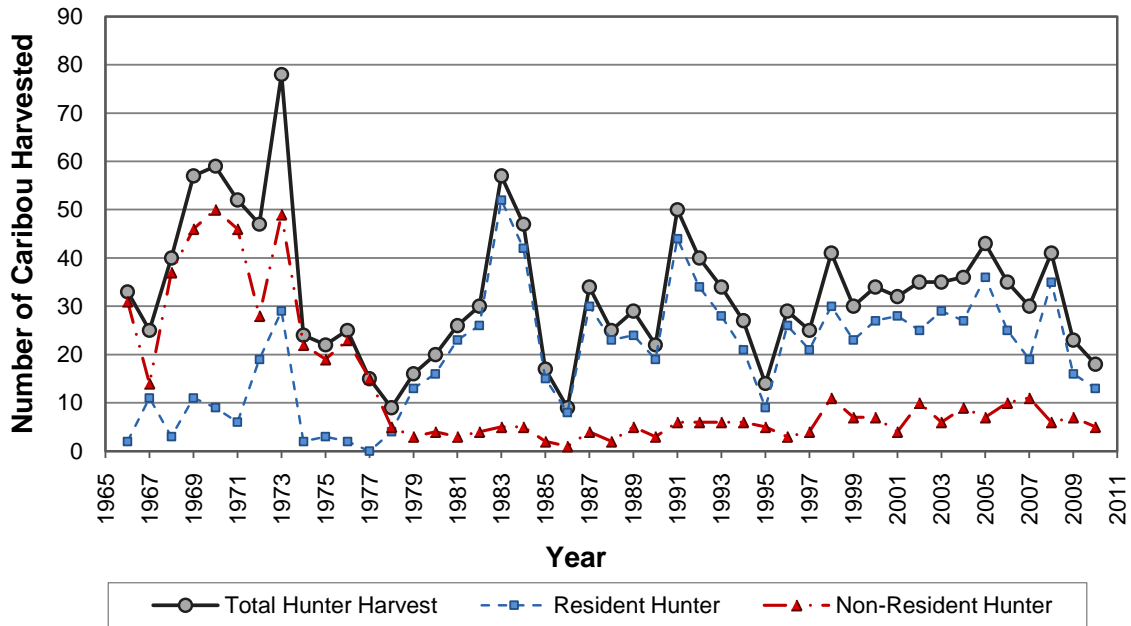


Figure 4. Summary of the annual reported harvest of caribou for the Itcha-Ilgachuz herd within Management Unit 5-12. (Sources for resident harvest: 1966-1977 hunter sample, 1978-1994 and 1997-2010 compulsory inspection, and 1995-1996 compulsory reporting. Source for non-resident harvest: 1966-1977 and 1995-1996 guide returns, and 1978-1994 and 1997-2010 compulsory inspection). * 2009-2010 caribou harvest values are tentative and not finalized.

Part II. Impacts of Mountain Pine Beetle on Caribou Habitat

MPB Risks to Caribou

The mountain pine beetle (*Dendroctonus ponderosae*), is widely considered to be the most damaging of all the insects that attack lodgepole pine in western Canada. It is a small cylindrical-shaped bark beetle that kills mature trees by boring through the bark into the phloem layer, where they feed and lay their eggs. In the early stages of infestation, the beetles target stressed trees however as the beetle populations increase healthy trees are attacked. The three stages of color change advancement within attacked stands include green attack (in the first year), red-attack (the next 1-3 years, retaining dead needles) and grey-attack (subsequently standing dead without needles). Only the green attack trees contain live beetles. The adult beetles emerge and attack new host trees in July and August after the trees begin to die and turn red.

Although a portion of the northern caribou in west-central BC winter in high elevation sub-alpine habitat, the majority spend the winter months in mature low elevation forest stands where they feed on both terrestrial and arboreal lichens. Caribou that select mature stands of lodgepole pine (*Pinus contorta*) forage primarily by cratering in the snow for terrestrial lichens (Cichowski 1993).

Since 1981 the Ministry of Forests and Range has conducted aerial flights over the Cariboo Region to track MPB attack. Within the NCS area, including the parks, the bark beetle attained its zenith both in intensity and current attack in 2006. However the infestation continued to have an increasing impact in cumulative mortality within the strategy area up to the present time (Table 2, Map 3). By 2005 the near maximum susceptible area of lodgepole pine was occupied by varying levels of MPB infestations. After 2005 the level of attack intensified within stands. The amount of trace and light infestations declined gradually as the cumulative levels of severe and very severe increased. By 2010 over 72% of the IICHA had been impacted by beetle infestations. Of this infested area, over 60% was classified as very severe attack (>50% stand mortality). This estimate of cumulative attack is conservative and ground checks indicate stand mortality is more realistically around 65 to 85%. Beetle populations have plummeted as the mountain pine beetle population contracts and collapses due to host shortage. Map 3 illustrates the cumulative infestation levels from the 2002 to 2010 based on aerial pest survey mapping.

Table 2: Cumulative infested area (ha) and intensity of Mountain Pine Beetle attack in the Northern Caribou Strategy Area from 2002 to 2010. [trace = <1%, low = 1% - <10%, moderate = 10% - <30%, severe = 30% - <50%, very severe = ≥ 50%]

Year	No Rating	Trace	Light	Mod	Severe	Very severe	Total Without ("No-Rating" area)	Grand Total
2002	1,451,092	-	62,763	9,023	2,501	29	74,315	1,525,407
2003	868,905	-	519,026	113,631	20,913	2,932	656,502	1,525,407
2004	566,029	109,799	280,062	444,859	71,016	53,644	959,379	1,525,407
2005	497,793	52,752	215,172	444,508	126,597	188,584	1,027,614	1,525,407
2006	479,065	22,290	139,465	275,990	209,075	399,522	1,046,342	1,525,407
2007 ¹⁰	469,653	13,855	89,249	162,609	211,310	578,732	1,055,755	1,525,407
2008	429,858	13,818	92,729	153,599	188,227	647,176	1,095,550	1,525,407
2009	426,454	13,623	88,286	147,098	184,149	665,798	1,098,954	1,525,407
2010	424,711	13,588	88,361	146,128	184,229	668,390	1,100,697	1,525,407

Severe and widespread attacks of Mountain Pine Beetle (*Dendroctonus ponderosae*) that result in high mortality of mature pine trees may decrease habitat suitability and availability by:

- increasing the risk of widespread fires
- potentially reducing lichen availability for caribou
- potentially creating barriers to caribou movement and
- potentially increasing alternate prey densities which support higher predator numbers

Silvicultural systems trials within the IICHA began in the mid 1990's to test group selection and irregular group shelterwoods as 'modified harvesting' options to manage caribou habitat. These research trials have been measured over the course of the MPB infestation. The amount of damage to canopy trees (over 10 cm dbh) steadily increased from 3% in 2003 to 15% in 2004, 47% in 2006, and 61% in 2008, including green attack in the 2004 and 2008 assessments (Waterhouse 2011). The scope of the research also enables measurement of the longer-term impacts of habitat change caused by pine beetle.

The current status of the science on Mountain Pine Beetle and the Itcha-Ilgachuz caribou habitat management options can be found in detail in Armleder and Waterhouse (2008) and Cichowski (2010b). The concerns are the impact of dead trees on the lichen communities and how those trees will block access to lichen forage. Further, there will be increased risk of catastrophic fire, increased barriers to movement (e.g. seasonal migrations and predator avoidance), changing

¹⁰ A small portion of Tweedsmuir Park was excluded from the survey in 2007 and therefore the infested area would be slightly larger than the tabular estimates.

predator prey relationships, and increased access as the salvage logging of beetle killed trees proceeds.

The 'modified harvesting' silvicultural systems have the potential to maintain habitat because the stands, even with mostly dead trees, still provide partial shade for lichens for a period of time. Mobility should not be an issue with 50% of the trees harvested. Even if most of the remaining trees fall, the harvested openings will allow unobstructed travel through the stands. In the areas of modified harvest, the partial cutting should reduce fire hazard by reducing fuel loading, providing fire breaks and breaking the continuity of the overstorey.

Current research leads to the conclusion that the silvicultural systems and harvesting techniques recommended in the 2002 NCS (Youds et al. 2002) still represent the best approach for maintaining caribou habitat while providing timber to the forestry industry as identified in the CCLUP.

Fire Management

Mountain pine beetle (MPB) has been killing lodgepole pine trees within northern caribou habitat in increasing numbers since the late 1990's. Although the potential impacts of MPB on lichen availability and barriers to caribou movement are currently still under investigation, it is clear that the extent of the MPB epidemic has and will continue to greatly increase the risk of severe and widespread fires. A healthy pine stand with 35-45% crown closure may be considered a low fire hazard. As the phases of beetle attack proceeds, fire risk increases in the red attack stage (when it is most at risk for crown fires) and then decreases during the grey phase, until it peaks again approximately 15-25 years after the initial attack. At this time most of the dead trees have fallen (high surface fuel loading), increased light has encouraged sapling growth (fuel continuity between the ground surface and overstorey tree canopies) and the overstorey canopy is composed of surviving trees and standing snags.

Many site characteristics such as soil moisture (Lewis *et al.* 2006, Lewis and Hartley 2005, Hawkes *et al.* 2004), canopy closure (Mitchell and Preisler 1998) and tree diameter (Bull 1983) appear to influence fall rates of MPB killed trees. Observations in the Itcha-Ilgachuz suggest that fall rates are consistent with previous studies that describe similar site characteristics and weather regimes (Hawkes *et al.* 2004, Lewis and Hartley 2005, Cichowski *et al.* 2008).

In response to the heightened fire risk, the Ministry of Environment funded the preparation of a Fire Management Plan for Itcha-Ilgachuz Park and the surrounding WHAs in 2007 (MacKenzie *et al.* 2007). The purpose of that plan was to recommend an approach to manage future high fuel loads within core caribou range in and around Itcha-Ilgachuz Provincial Park. The approach outlined within the plan recommended the creation of fuel breaks at key locations and the zoning of areas where fuel management could occur. Fuel management would involve the use of fire to reduce coarse woody debris loads to a level where caribou movement is not impeded and wildfire risk is reduced (MacKenzie *et al.* 2007, p 56).

The three year proposal involved:

- The development of prescribed burn and monitoring plans with modeled fire effects (Year 1)
- An initial test burn¹¹ and consequent refinement of prescriptions and plan development (Year 2)
- A second test burn and evaluation (Year 3)

Preparation of the 2007 Fire Management Plan was the first step to exploring fire management as a tool in the Itcha-Ilgachuz caribou habitat; however, using prescribed burning, especially in a remote location, is extremely costly. Current funding opportunities are prioritized to target the protection of communities that are at increased fire risk by the MPB. Within northern caribou habitat, many of the MPB attacked trees have already reached the grey stage, reducing the immediate risk of fire for a period of time until more of the trees begin to fall (10+ years). Recent preliminary research and anecdotal observations suggest that when funded, planned and carried out with caution, the success of the management techniques outlined above would likely be high (Lavioe and Taylor 2008, Hawkes 2008); however, these studies did not address the positive and negative impacts of fire on caribou habitat.

If no MPB fire management occurs surrounding Icha-Ilgachuz Park prior to the peak fire risk period (approximately 15-20 years after initial attack), then barriers created by downed trees will likely result in reduced caribou habitat quality and abundance. However, there are numerous unknowns. Any prescribed burning would require road access to be cost effective and address safety. Roads have serious negative impacts on caribou. It is likely best not to do fire management if additional road building is involved. Therefore, this tool, if used at all, is best confined to previously roaded areas.

The range of the northern caribou is within a fire-based ecosystem in the west Chilcotin. Attempting to eliminate all wildfire is neither practical nor desirable in these types of ecosystems. Historically, on average, 1-2 percent of the range burned each year (Mackenzie et al. 2007). Caribou undoubtedly adjusted their habitat use during winter to find areas of sufficient lichen within their extensive range. Unfortunately, their effective range is much smaller than in the past so options of moving to areas free of fire for decades until lichen recovers are more limited.

Any intensity of fire destroys terrestrial lichen. Recovery of lichen to levels useful to caribou is probably in the order of 40 years. Caribou range would significantly suffer if too large a percent of caribou range were to burn over a short period of time.

¹¹ Test burns would be conducted on sites of lower caribou habitat values with woody debris from the 1980s MPB infestation to mimic future stand conditions as closely as possible.

Prescribed burning could be used to create fuel breaks to help prevent very large fires (>10,000 ha). However, this would be costly and logistically challenging in this remote area. Even a large, well funded program would not guarantee that large fires would not occur within the 1.5 million hectare range of these caribou.

Future Work and Recommendations – Fire Management

A recommended approach for fire management with respect to northern caribou is to let wildfire alter the ecosystem as it has historically done. Efforts at controlling wildfire would be limited to situations where the area impacted exceeds a threshold level. This level is difficult to establish because other factors influence range suitability including: the amount, distribution and type of forest harvesting, the predator situation, and the amount, spatial and temporal distribution of motorised activity.

The CSC recommends the following fire management guidelines. Part 1 is general guidance for fire control activity and site rehabilitation relevant to all six of the northern caribou management zones. Part 2 is a table of specific guidance for when wildfire control should be initiated in each of the six zones and specific direction about control and rehabilitation activity. Map 4 outlines these fire management zones and fire history since 1990. Appendix 4 summarizes the area and percentage of each fire management zone burned since 1990 within the IICHA (as of January 2011). Burned areas will need to be digitally updated and re-run annually to provide optimal fire management within the six zones.

Part 1: General Guidance for Fire Control and Site Rehabilitation in All Caribou Zones

1. Encourage high percent retention of unburned areas within fire perimeters. These will serve as refugia for lichen that will be available to provide fragments to inoculate burned areas.
2. Minimize the creation of access especially that which will facilitate access by motorized vehicles after rehabilitation occurs.
3. Use of aerial attack is unrestricted.
4. Do not fell snags as part of the rehabilitation work except as required for worker safety.

Part 2: Plan by Zone

The following provides input to managers making wildfire control decisions. It recognizes the different types of management in each of the six caribou management zones (Table 3).

Table 3. Management Recommendations within IICHA Fire Management Zones

Caribou Management Zones	Threshold for Wildfire Control Action	Specific Guidelines
Parks (Tweedsmuir and Itcha-Ilgachuz)	Only if fire threatens zones (by TSA) outside of park. Refer to Park fire Management Plan.	<ul style="list-style-type: none"> - Do not create access - Avoid the use of heavy equipment - Minimize the alteration of habitat by avoiding the construction of machine guards, helipads, access roads, trails, etc.
No harvest (No Harvest-Quesnel and No Harvest WL)	Only if more than 20% of area burned over last 20 years (by TSA) or if fire threatens areas outside the zone. As of January 2010 1.3% burned in No-Harvest - Quesnel and 2.2% burned in No-Harvest-Williams Lake (Map 4, Appendix 4).	<ul style="list-style-type: none"> - Use of hand-tools for firefighting is acceptable - Rehabilitation efforts should generally not include the use of grass seeding or the introduction of any species not native to the location
Modified Harvest (Modified Harvest-Quesnel and Modified Harvest-WL)	Only if more than 20% of area (by TSA) burned or was harvested over last 20 years or if fire threatens areas outside of zone. As of January 2010 0.1% burned in Modified harvest-Quesnel and 3.1% burned in Modified harvest-WL (Appendix 4, Map 4)	<ul style="list-style-type: none"> - Avoid creating access in areas that do not currently have road access - Rehabilitation efforts should generally not include the use of grass seeding or the introduction of any species not native to the location
Natural Seral Distribution	Only if more than 20% of area (by TSA) burned or was harvested over last 20 years or if fire threatens areas outside of zone.	<ul style="list-style-type: none"> - Avoid creating access in areas that do not currently have road access - Rehabilitation efforts should generally not include the use of grass seeding or the introduction of any species not native to the location
Caribou Enhance Conventional Harvest	Only if more than 20% of area (by TSA) burned or was harvested over last 20 years or if fire threatens areas outside of zone.	<ul style="list-style-type: none"> - Avoid creating access in areas that do not currently have road access
Conventional Harvest	Only if more than 20% of area (by TSA) burned or was harvested over last 20 years or if fire threatens areas outside of zone.	

Lichen Monitoring and Vegetation Dynamics

Terrestrial lichen response to tree mortality due to MPB has been measured on the Itcha-Ilgachuz Alternative Silvicultural system trials at Satah Mountain in the Williams Lake TSA. The last measurement in the replicated trial was made in 2008 (Waterhouse 2011) and can be compared to the five previous assessments (1995 - 2004) (Waterhouse et al. 2011). In the no-harvest controls, terrestrial preferred healthy, lichen declined from an average pre-beetle cover of 11.3% to 9.7%, in 2008 representing a 14% relative drop in cover. This decrease was not significant as there was variability between the blocks with smaller declines in the two MSxv blocks than found in two of the SBPSxc blocks. In the third SBPSxc block with a very open stand condition, lichen cover increased.

The response of lichens in the irregular group shelterwood treatments, where about 50% of the overstory was cut in 1996, was quite different from the controls (Waterhouse 2011). Healthy, preferred lichens have increased from 7.4% to 7.8% on average across all blocks (forest and opening plots combined) between 2004 and 2008. Within the openings the amount of lichen has increased from 7.5 to 9.5% cover. The differential response between the no-harvest controls and these partial cuts (especially the openings) may be due to the lichen already being acclimatized to higher light conditions. The downward trend in lichen abundance in the no-harvest control may be due to the increased light caused by needle loss from the dead overstory trees. Kershaw (1985) describes the morphological differences between lichens growing under different canopy conditions. Lichens that grow under full sunlight have darker pigmentation and a much thicker upper cortex to protect their chlorophyll from oxidation. Dwarf shrub cover increased in all treatments by about 4% in the SBPS from 2004 (15%) to 2008 (19%), and 7% in the MS blocks (13% 2004 to 20% in 2008), mostly likely due to increased light and moisture, but this can't be separated from observer bias. The fact that the lichens did not decline in the partial cuts or block 2 (the very open canopy block) while the dwarf shrubs increased argues that there may not be a direct competitive effect of dwarf shrubs on lichens, at least in the early stages of the post MPB response. If the dwarf shrub community expands further there may be direct competitive effects. Rising soil water content (Waterhouse et al. 2010) and woody litter (needles and small branches) may also be contributing to how lichens are responding.

In 2005, work using the same methodology began in the MS zone of the Quesnel TSA to investigate the impacts of Mountain Pine Beetle on terrestrial lichen survival and abundance within the (MSxv) caribou winter range. Six permanent sample sites (with 50 plots per site) were established in 2005. These six sites were remeasured in 2006 with an additional four sites added to measure lichen values consistently over time. All ten sites contained 50-70% MPB attacked trees and were re-assessed in the summer of 2008. Very little additional MPB attack occurred at the sample plots after 2005/2006 supporting aerial observations that the bark beetle attained its zenith both in intensity and area infested in 2006.

Terrestrial lichens grow slowly, making potential changes in their abundance difficult to measure in the short term. In general within the modified harvest zone of the Quesnel TSA terrestrial lichens were found to decrease as dwarf shrub layers increased. Across the 10 study

sites there was a 1.5% absolute annual loss and a 7.5% relative annual loss of terrestrial caribou forage lichen cover (Cichowski 2009).

A caribou habitat use project was initiated in 2005/2006 in a slightly wetter biogeoclimatic zone/subzone in the Entiako/Tweedsmuir area and results indicate that caribou continue to select and feed within lichen abundant pine habitats despite the grey attack phase of the MPB epidemic (Cichowski 2010). To date, caribou winter habitat use patterns in this study area have been similar to winter habitat use patterns prior to MPB attack in spite of a 10-15% decrease in lichen abundance on sample plots.

Future Work and Recommendations – Lichen Monitoring

It is important to recognize that although terrestrial lichen abundance has initially decreasing due to MPB caused tree mortality, northern caribou are still utilizing these habitats to crater for terrestrial lichens during winter months. The threshold abundance of lichens that makes an area attractive to caribou is unknown at this time. Caribou have been observed cratering in partial cut modified trials where lichen abundance decreased by approximately 50% over a two year period (Armleder, pers. com.) immediately post-harvest. Work on the silvicultural systems trials (replicated and adaptive management) and monitoring project in the Quesnel TSA should be done every four years in order to quantify long term MPB effects on lichen, stand stability, vegetation development and tree regeneration. This is particularly important in the adaptive management blocks where the opening sizes are larger than in the replicated research trial. In addition, a caribou trailing project may be useful to help determine if there is a point where lichen abundance may be too low to deem these habitats suitable for caribou winter foraging.

Mountain Pine Beetle (MPB) Aerial Photography Analysis

The extent and severity of MPB attack levels within the northern caribou WHAs was examined using low elevation aerial photography. Given the knowledge about MPB impacts, the hypothesis is that approximately 15-20 years following attack, old, tall, lodgepole pine stands with high canopy closures and high levels of MPB mortality may:

- Act as a barrier to caribou movement (as the dead trees fall to the ground) and reduce their access to lichen bearing habitat, and
- Be extremely high fire risk areas

In the summer of 2008 an aerial photography contract was awarded to obtain cloudless, high quality, digitally orthorectified mosaic photography of approximately 1,050 linear kilometres of flight line within the northern caribou WHAs (Map 5). Three to four swaths of flight lines averaging a total of 350 m in width were mosaicked together resulting in 294 km² of area photographed (or approximately 6% of the northern caribou WHAs). Two computer based analysis were then conducted on the digital imagery line work, the Linear Transect Analysis and

the Raster Classification. Detailed methodologies for these two analyses can be found in Appendix 5.

Raster Classification

The Raster analysis used to classify aerial photographs can be defined as a maximum likelihood supervised classification. Digital photographs were analysed and, based on a series of training sites, each 10cm raster pixel was classified as:

- Dead - red or grey attack trees
- Live/Green - green trees, meadows, etc.
- Rock/Ground - roads, gravelly areas, bare earth
- Water - rivers, lakes, etc.

In order to best classify tree crowns and cut down on “noise” introduced by the fine 10cm pixels, each raster was resampled and grouped to 1m pixels (using the majority method) in order to detect the percent dead (grey/red) for each stand within the transect lines.

Based on visual review of the raster classified digital photos, four categories were used to define the “Risk Potential” ratings in order to rank stands that may pose a potential barrier to caribou movement within the transects. The four “Risk Potential” categories are as follows:

High	>40% dead
Moderate	=>35-40% dead
Low	=>30-35% dead
Very Low	<30% dead

The raster analysis identifies modified harvest subunits 22, 24, 08 and 28 and no harvest subunit 1 as posing the highest risk potential for caribou movement barriers when MPB attacked trees fall (Table 4). These subunits are located primarily in the northern portions of the IICHA. Transect percentages in the high risk category were less than 9% for the three seral subunits and the remaining five park and no harvest subunits. Details for subunits with analysis that resulted in less than ten percent within the high risk category can be found in Appendix 6.

Table 4. Aerial photography raster classification of High and Moderate potential risk areas within individual subunits for all modified harvest, no harvest/park and seral units with more than 10% in the high category.

Subunit ¹²	Percent of total transect area classified within each rating category		Transect area flown in subunit/total subunit area	% of subunit flown for raster analysis
	High (>40% dead)	Moderate (>=35% to 40% dead)		
modharv_22	99%	1%	509/3553	14.33%
modharv_24	56%	17%	1225/17837	6.87%
modharv_08	40%	11%	1630/20976	7.77%
modharv_28	40%	7%	163/4864	3.35%
modharv_09	36%	2%	524/6884	7.61%
modharv_26	33%	20%	1394/21426	6.51%
modharv_25	30%	13%	1427/25954	5.50%
modharv_13	29%	8%	804/11204	7.17%
modharv_30	27%	5%	869/10825	8.03%
modharv_31	10%	10%	906/16424	5.52%
Noharv_1	52%	16%	4295/58082	7.39%

The percent of each subunit flown for the raster analysis was also reported in order to see the representative sample size obtained for individual subunits (Table 4). An average of 6.75% of each subunit was represented by aerial photography and thus by the raster analysis. Although only a small portion of each subunit was covered by the aerial photography transects, it is believed that the subset of transects flown gives the best available representation of MPB attack on the subunit level.

Two potential problems arose when utilizing the raster analysis for 2008 summer aerial digital photography. These issues involved:

- incorrect classification of tree shadows and
- distinguishing grey attack trees from rock and ground cover

These issues were partially rectified by first resampling and then restricting summaries to the “dead” category (red or grey attacked trees). In addition two days of low level, overcast winter

¹² Moderate and high risk percentages are based on % (ha) of transect flown within the subunit that fell into each category (see Appendix 5)

aerial photography were conducted for comparison with summer photography and future “truthing” of MPB sites. This type of low level, overcast winter photography is currently being used to determine how beetle attacked stands will look in the future (Teti 2007). These results can help interpret aerial photos of caribou habitat and predict potential obstructions as a function of CWD volume. Benefits of this type of aerial photography include:

- higher digital resolution (encompassing a smaller area)
- elimination of shadow effects
- greater ground contrast due to snow coverage and
- revelation of the degree of snow coverage over coarse woody debris (CWD)

A MOF snow research plot was selected on the plateau outside of the IICHA with measured CWD data and both winter and summer aerial photos. It was predicted that the number of pieces of CWD higher than 40cm per unit of transect length could be used as an index of summertime caribou obstructions. The chosen site was in the MS and had approximately 792 cubic meters of CWD on the ground and included 21 pieces per 100m higher than 40cm. When the winter photo of this site was examined with approximately 50cm of snow on the ground, the CWD site characteristics did not appear to exclude winter caribou use.

In March 2009 approximately 2000 photos were taken by Ministry staff over part of the IICHA transects flown in the summer of 2008. In the summer of 2008, one site photographed with a very high CWD load was visited by helicopter. This stand had been heavily attacked by MPB in the 1980’s and approximately 60-70% of the trees within the stand had fallen. Based on the summer and winter photos and winter ground observations with approximately 77cm of snow, this site is also not likely to be an obstacle for caribou movement in the winter.

Linear Transect Analysis

The linear transect analysis was created from VRI polygons in order to determine which segments of the flight lines were at highest risk for severe MPB attack. We concluded that stands at highest “risk” for severe MPB attack would be classified as > 80% lodgepole pine leading stands with the following criteria:

- >45% crown closure
- >12 meters height
- >100 years of age

Utilizing the above criteria, Maps 5(a, b, c and d) were created depicting these high risk segments¹³ using a line intercept method at the mid-point of the aerial transect lines flown in the

¹³ In order to better view the “high risk” areas, the width of the linear transect was increased on the map to appear as a swath similar in width to the aerial photography.

summer of 2008. The VRI database is 20-30 years old across the IICHA, and as such projected age class, crown closure and height data are likely to be less accurate than any classification done by current aerial photography. This exercise was done to depict how these high risk areas may have been selected in the past, and for comparison with the more up to date aerial photography analysis.

Table 5 was compiled totalling the length of “high risk” segments along the line intersect and the percent of “high risk” segments within each subunit along the linear transect. This method provides a much smaller sample of each subunit than in the raster analysis (Appendix 5). Utilizing this methodology, modified harvest subunits 26, 22, 08 and 09, no harvest 1, parkMS 1 and no harvest 2 would be considered most at risk from the effects of severe MPB attack (Map 6).

Table 5. Linear transect analysis results by subunit for the IICHA for subunits with greater than 30% in the “high risk category”.

SubUnit	Transect Length (m) in “high risk” category¹⁴	% of transect length within the “high risk” category
modharv_26	29380	68%
modharv_22	9326	66%
modharv_08	23679	58%
modharv_09	7676	57%
modharv_25	21760	50%
modharv_12	12673	44%
modharv_31	11408	41%
modharv_24	10778	33%
noharv_1	81458	66%
park_MS_1	29006	58%
noharv_2	35014	54%
park_ms_2	11159	46%
seral_1	22546	43%

¹⁴ Transect sections were considered “high risk” if all four CSC defined criteria were met: $\geq 80\%$ pine leading, $>45\%$ crown closure, > 100 years old and $> 12\text{m}$ height.

Future Work and Recommendations – MPB and caribou

Current knowledge still maintains that modified harvest techniques are optimal for the conservation of caribou habitat. However, in the modified harvest zone, the economic situation coupled with severe MPB attacked areas has, and may again result in area trades that are neutral or beneficial for caribou (see Part III Habitat Management Section). Results from the raster analysis based on the 2008 summer aerial photography done in the IICHA indicate that modified harvest subunits 22, 24, 08 and 28 and the no harvest 1 subunit will likely be the areas of caribou habitat most adversely effected by MPB as trees fall in the next 10-15 years.

At this time seasonal photo comparisons and site visits indicate that high CWD stands coupled with heavy snow depths do not pose a winter barrier for caribou in the IICHA. The 2009 low level, winter aerial photographs require geo-referencing and analysis for detailed comparison with the 2008 summer photography. This process requires a significant time investment that government staff is currently unavailable to provide. Results from this type of analysis would help define what poses a barrier to caribou summer and winter movements and assess the accuracy of the percent dead classifications.

Part III. Progress and Review of Strategy Recommendations

The general consensus among caribou scientists today is that fragmentation of their habitat poses the foremost threat to maintaining caribou on the landscape. For this reason, within the IICHA, limiting forest practices that decrease suitability of caribou habitat was the primary focus during the preparation of the 2002 NCS. Other issues such as possible reductions in winter food supply, increased human access and disturbance, and alteration of predator-prey relationships are often associated with habitat fragmentation. Three additional issues have come to light from the current Mountain Pine Beetle epidemic, including impacts of dead trees on lichen communities, barriers to caribou movement and increased risk of widespread fires.

The NCS stressed that the populations of northern caribou within the Cariboo Region could only be maintained over time if the following three strategies were applied together:

- Maintain adequate suitable caribou habitat within existing northern caribou range
- Limit and regulate road access and motorized recreation in caribou habitat
- Manage predation levels on caribou where necessary

The interdependence of these approaches is illustrated by the “caribou three-legged stool”(Figure 5).

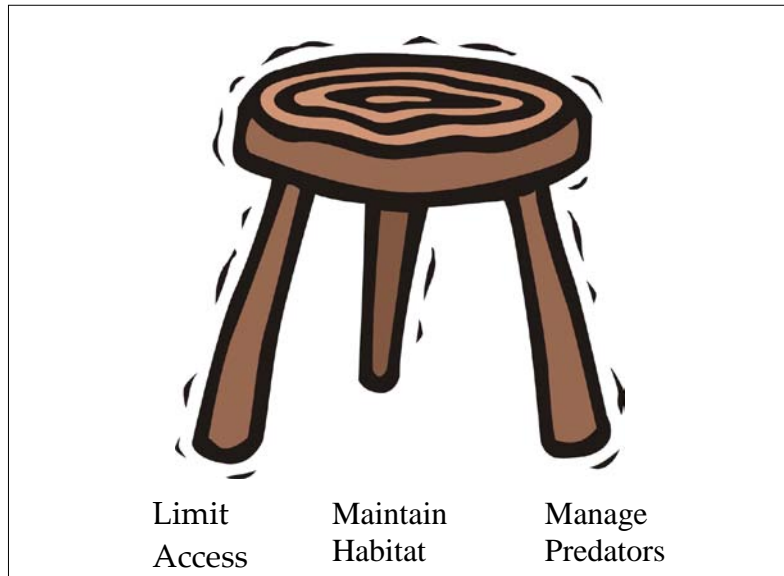


Figure 5. The “caribou 3-legged stool” broadly depicts the interdependence of factors that influence caribou distribution on the landscape.

Substantial work has been undertaken to implement the NCS and these approaches (depicted in Figure 5) since 2002, though much of the effort to date has been targeted at maintaining habitat. Although the bulk of government financial investments occurred during the research and strategy development stages (pre-2002), considerable time and funds have also been spent addressing northern caribou management during the last eight years (see Appendix 9). Over the entire IICHA, approximately \$3.13 per hectare has been spent since 1992, with an average of \$260,000 per year. Funding availability for this work has dropped considerably in the last five years.

Habitat Strategy

In March 2002 the NCS recommended the location of 90,853 ha of ‘no harvest’ (NH), 181,174 ha of ‘modified harvest’ (MH) and 50,252 ha of ‘natural disturbance seral distribution’ (NDS) for protection of caribou habitat. Later in 2002, this recommendation was endorsed by the Cariboo Region IAMC. Wildlife Habitat Areas (WHA’s) encompassing all of the identified ‘no harvest’, ‘modified harvest’ and ‘natural disturbance seral distribution’ polygons were legally designated under the Forest and Range Practices Act (FRPA) in December 2004, with General Wildlife Measures (GWM’s) for these areas being established in July 2005. The GWM’s for the ‘natural disturbance seral distribution’ WHA were amended in 2007.

In 2009, the three major forest licensees in Quesnel presented a proposed area trade to improve the economic access to timber while attempting to minimize the effects of salvage harvesting on the northern caribou population. This initial proposal was modified by the CSC to be neutral to

caribou while still recognizing the main concerns of the forest industry. The modified proposal involved a swap of 15,500 hectares of peripheral, fragmented and heavily hit MPB modified harvest from areas closest to Quesnel with areas (in equal amount) of younger, less heavily MPB attacked forests with caribou habitat suitability and/or capability from areas north of the Ilgachuz Mountains (Map 7).

Rather than becoming part of the conventional harvest zone, the traded area was put into two new WHAs called 'Caribou Enhanced Conventional Harvest' (CECH) zone in order to help mitigate the changes to caribou. A detailed account of the process and associated practices required to make the swap neutral for caribou can be found in Appendix 6. An amended order (Appendix 3) for the GWMs that incorporates these changes into the WHA line work was approved in May 2011.

The amended order can be found online at:

http://www.env.gov.bc.ca/wld/documents/wha/RATA_5-086-873_ord.pdf

Timber Harvest Strategy

Caribou require a continuous supply of large adjoining areas of suitable habitat with little access or disturbance so that they live at relative low densities (50-60 caribou/1000km²) and thus decrease encounter rates with predators (Bergerud 1992, Seip and Chicowski 1996). Prior to timber harvesting and human habitation, it is believed that caribou simply moved from one area to another as fires burned portions of caribou range. With modern harvesting and increased access and development, management of caribou habitat can not be maintained with this natural type of disturbance regime. The IICHA, of approximately 1,500,000 hectares, established from years of caribou radio-telemetry data and multivariate habitat modelling (Apps *et al.* 2001), is managed to include No-harvest, Modified Harvest, Natural Disturbance Seral Distribution, Caribou Enhanced Conventional Harvest and Conventional Harvest zones (Map 7). Park and No-harvest areas provide a core area for caribou to subsist with minimal human disturbance. The modified harvest area within caribou habitat is managed to maintain caribou habitat continuously through time and space and is endowed with firm access restrictions. This approach has been used since 2002 to maintain as much suitable caribou habitat as possible, and to minimize the risk of fragmentation of caribou habitat. One recent study identified a 20 year time lag between extensive logging of caribou habitat and herd fragmentation that resulted from the loss of cow caribou with fidelity to a calving ground (Vors 2007).

The habitat "leg" of the caribou stool has been the one most successfully implemented since release of the NCS in 2002. Table 6 allows a comparison of the amount of productive forest land base (pflb) designated for each harvest type within the caribou area as well as the percentage of caribou range assigned to each of the five harvest approaches (summarized initially in the 2002 NCS).

Table 6. The proportion of productive forest land base and timber harvest strategies within the IICHA¹⁵.

Harvest Strategy	Percent of IICHA (total area)	Total Area within IICHA (ha)	Percent of pflb within IICHA	Hectares of pflb within IICHA (ha)
Conventional Harvest	67.8%	1,034,816	63.0%	571,878
Caribou Enhanced Conventional Harvest	1.1%	16,225	1.7%	15,483
Modified Harvest	13.2%	200,792	20.0%	179,082
Natural Disturbance Seral Distribution	4.2%	63,909	5.5%	49,907
No Harvest and Park	13.7%	472,863	9.8%	88,748
Totals	100%	1,525,407	100%	907,536

Conventional Harvest

Approximately fifty one percent of the caribou area is subject to conventional timber harvest practices. The four designated quadrants for timber harvest that overlap with the IICHA (Quesnel East and West and Williams Lake East and West) contain a total of 905,100 hectares of productive forest land base. Map 8 shows the four quadrants and their relation to management zones and timber harvested within the IICHA. Although significant amounts of timber were harvested prior to 2002, less than 1.7% if the pflb has been harvested with conventional methods since the release of the NCS (Table 7). This is most likely due to the abundance of beetle killed timber found closer to local mills.

Table 7. History of timber harvest outside no-harvest and modified harvest zones, but within IICHA (Conventional Harvest area).

Quadrant	Total area (in ha of pflb)	Timber harvested prior to 2002 (Ha)	Timber harvested 2002-2010 (Ha)
Quesnel East	118,096	9,754	1,761
Quesnel West	105,508	5	707
Williams Lake East	320,692	32,870	4,631
Williams Lake West	360,804	30,182	7,908
Total	905,098	72,811	15,007

¹⁵ The Itcha-Ilgachuz Caribou Habitat Area (IICHA) is defined as the minimum convex polygon including all caribou relocation points from the Itcha-Ilgachuz, Rainbow and Charlotte Alplands herds.

Caribou Enhanced Conventional Harvest

The Caribou Enhance Conventional Harvest (CECH) area will be managed to maintain caribou movement and feeding opportunities within two WHAs severely affected by the MPB. Within each of these WHAs (5-872 and 5-873) 25% (pflb) of the best available caribou habitat must be identified and left unlogged. Harvest blocks must be aggregated into large patches to minimize fragmentation of the remaining 25%. Harvest practices and re-stocking will be carried out in such a way that lichen mortality and the creation of additional access within the zone are minimized. As this zone was newly created in May 2011, monitoring use of this caribou habitat post-harvest will be required to ascertain the effectiveness of these techniques at reducing the negative impacts of MPB on caribou. Prior to creation of the NCS, 2,462 ha were harvested within this zone (Table 8).

Table 8. History of timber harvest within the Caribou Enhanced Conventional Harvest zone.

WHA	Total area (in pflb)	Timber harvested prior to 2002 (Ha)	Timber harvested 2002-2010 (Ha)
Quesnel East	11,841	2,462	0
Quesnel West	1,181	0	0
Total	13,022	2,462	0

Modified Harvest

Modified Harvest areas are managed to maintain caribou habitat continuously through time and space. Forest licensees have been following the modified timber management approach. The accepted harvest technique in this zone allows 13 percent of the Modified Harvest Zone (MHZ) timber volume to be available every 20 years, utilizing large cutblock sizes of up to 1,000 ha. Eighty percent of the modified-harvest area (WHA 5-086) will be managed as terrestrial lichen sites while 20 percent will be managed as arboreal sites within each unit (Map 9). On terrestrial lichen sites an irregular group-shelterwood system harvesting 50 percent of each stand by area (including all skid trails and in-block roads), executed on a snowpack with a 70 year cutting cycle should maintain stands continuously as terrestrial-lichen habitat. On arboreal lichen sites a group-selection silvicultural system with 33 percent removal over a long cutting cycle (80 year) should retain sufficient arboreal lichen for caribou.

A start date of January 1, 2002 was agreed upon for measuring even flow of timber from the modified harvest zone (Youds *et al.* 2002). Thus, from 2002-2022, to meet even flow, 13% of the timber volume within the modified harvest area would be made available for harvesting (as with every 20-year period thereafter).

The overall timber harvest target (hectares of pflb) for each of the four quadrants overlapping the caribou area was compared to the harvest that occurred pre- and post-2002 (Table 9). Timber harvested prior to 2002 was most significant in Williams Lake East, while virtually no harvesting occurred in Quesnel West. Very little harvest has occurred (less than 1% of the area)

within the MHZ since 2002 (Table 10). This is largely due to the extent and location of other areas hit by the MPB, and the increased costs attributed to utilizing modified harvest techniques.

Table 9. Timber harvesting (includes clearcuts (pre-2002) and partial cuts) and overall harvest targets within the modified harvest WHAs by quadrant.

Quadrant	Target (ha of pflb)	Harvest (ha) prior to Jan. 1, 2002	Harvest (ha) (2002 – 2011)
Quesnel East	31,611	629	373
Quesnel West	54,751	0	0
Williams Lake East	59,430	7,010	1,438
Williams Lake West	33,291	1,576	0
Total	179,082	9,215	1,811

Natural Disturbance Seral Distribution

Although the Sub-boreal Pine Spruce (SBPS) BEC zone contains valuable winter caribou habitat, its susceptibility to Dwarf mistletoe means that partial cutting (modified harvest) techniques to maintain habitat are less desirable. For this reason and the expectation in 2002 that MPB attack would be heaviest at lower elevation, the SBPS in the Anahim and Nimpo Lake areas are managed with a seral distribution that mimics natural disturbance levels. SBPS seral distribution targets were derived in the 2002 NCS based on a 100 year stand destroying disturbance return interval¹⁶ (Table 11). Three seral subunits were derived with boundaries based on landscape units in order to better disperse harvesting and provide flexibility to retrieve beetle attacked trees (Map 9). The GWM legalized in 2007 provide targets across the entire NDSD unit and targets are being met in accordance with these GWMs. In the table below, 93.9% of the NDSD landscape falls within the SBPS zone with the remaining 6.1% in the MS BEC zone. The older forest profile present in the MS zone makes natural disturbance targets easier to reach.

¹⁶ From Biodiversity Guidebook (1995) p.92.

Table 10. Seral targets and distribution within Subunits 1,2 and 3 of the Natural Disturbance Seral Distribution zone.

Age (year)	Targets	Seral Subunit			ALL (%) ¹⁷
		1	2	3	
>80	45.0%	63.8%	39.8%	36.5%	48.5%
>100	37.0%	58.4%	29.1%	33.9%	42.1%
>120	30.0%	49.7%	26.7%	27.8%	36.2%
>140	25.0%	38.4%	23.3%	24.3%	29.6%

Within the NDSZ modified-harvest zone (WHA5-087), timber harvest should be planned to maintain a natural seral distribution across the landscape unit and sub-units while retaining large patches of mature and old forest (>250 ha) within large cutblocks of up to 1,000 ha.

Future Work and Recommendations – Timber Harvest and Caribou

Although forest management approaches (and thus GWMs) have been adhered to by licensees to date, newly arisen issues surrounding timber availability, MPB salvage opportunities and economic instability have raised interest levels regarding opportunities within and surrounding the Modified Harvest Zone. At this time the CSC believes, based on best available knowledge, that the GWMs for the specific caribou WHAs are still the best possible approach for management of caribou habitat.

As the MPB epidemic has progressed, the accuracy of projected Vegetation Resource Inventory (VRI) age labels attributed to stands with high beetle mortality has come into question. How long does a 100+ year old lodgepole pine stand with a high level of MPB mortality retain the qualities of an “old” pine stand and thus, the qualities that make it suitable for caribou winter use? Recent research has shown that MPB grey-attack stands continue to provide adequate lichen forage during the winter months and are utilized by northern caribou (Cichowski 2010). In general, MPB attacked trees fall 15-25 years after initial attack. It is at this time that old pine stands with high rates of mortality (>50%) may become substantially less suitable for caribou. In the near future both the Caribou Strategy and Biodiversity Committees must decide how to deal with high mortality stands and determine if these stands can retain their age label indefinitely. The amendment to GWMs addresses this issue within the Caribou MHZ (Appendix 3).

¹⁷ Legally, targets need only be met across the NDSZ zone as a whole (which includes all three seral sub-units).

Silvicultural Systems, Habitat and Biodiversity Research

Northern caribou habitat and population research has been ongoing in the Cariboo region since the first Itcha-Ilgachuz caribou were radio-collared in the 1980's. In the mid 1990's a major project investigating silvicultural systems that could potentially maintain habitat was started in the Itcha-Ilgachuz caribou range (Armleder et al. 1996). The treatments in the replicated research trial included using group selection (GS) (0.02-ha openings) with stem-only harvesting and irregular group shelterwood (IGS) (0.05-ha openings) with both stem-only and whole-tree harvesting. In the late 1990's an adaptive management trial was started with the same area removal targets but with larger opening sizes (0.15 ha). Results from these silvicultural systems trials prior to 2002 resulted in the recommendations for modified harvest techniques outlined in the CCLUP Northern Caribou Strategy (Youds et al. 2002). The following outlines the major activities and research conclusions especially since 2002.

Tree Fall

On the Itcha-Ilgachuz trial, the rate of tree fall was initially measured for 5.3 years post-harvest in the partially cut treatments. There were no significant differences in rates between irregular group shelterwood, group selection and no-harvest treatments for live or dead trees. For live trees, rates were particularly low at 0.04 - 0.18% per ha per year. In contrast, rates were higher for dead trees at 1.4 - 2.3% per ha per year (as a percentage of dead standing). The majority of the mortality resulted from the mountain pine beetle outbreak in the early 1980's. In the second assessment period (2001-2007), for dead and live combined, treefall was not significantly different in the harvesting treatments, and ranged between 0.25 - 0.62 % per ha per year (M. Waterhouse and H. Armleder, 2008, unpubl. file report, Williams Lake, BC). In conclusion, the harvesting systems designed to maintain northern caribou habitat do not aggravate tree fall.

Microclimate

The Chilcotin Plateau has a harsh tree growing environment. On the Itcha-Ilgachuz trial at Satah Mountain, over the 7-year sample period (1997-2003), severity and number of frosts was substantially reduced in the partial cuts compared to clearcuts; however, soil temperature was lower in partial cuts than the nearby clearcuts (Sagar et al. 2005). Mean growing-season soil temperatures were less than 10°C at all locations, with clearcuts being 1.5-1.9°C warmer than nearby partial cuts. Snow-free dates were approximately 1 month later at the highest-elevation site (1620 m) in comparison to the lowest site (1290 m) resulting in lowered soil temperatures and shortened growing seasons at the highest site. Heavier snowpacks virtually eliminated soil freezing at the highest site. The north edge (south aspect) was the most favourable microsite for seedling growth in the partial cuts, with the highest soil temperatures, earlier snow-free dates, and more solar irradiance. Similar to the first measurement period, in the second measurement period (2004-2009), the soil temperatures remained cooler in the partial cuts than the clearcuts, while minimum air temperatures were warmer. The number of frost events in the partial cuts remained substantially lower than in the clearcuts. The volumetric soil water content at the beginning of study was lower in the partial cuts than in the clearcuts as the big trees translocate a lot of water; by 2007 this pattern was reversed, most likely due to mortality of the big trees in the partial cuts and growth of the young forests in the clearcuts (Waterhouse et al. 2010). The

extreme minimum air temperature reached -40°C twice in 2008-09, while only 2 days reached -30°C in 2005-06 and 2007-2008. The second period results are reported by R. Sagar 2010 Unpubl. File Report, Williams Lake, B.C.

Planted Stock

Waterhouse et al. (2010) recently published the ten year results showing that planted lodgepole pine (*Pinus contorta*) showed excellent survival but were smaller in the partial cut openings compared to the clearcuts. Pine grew less in the Sub-Boreal Pine-Spruce biogeoclimatic subzone (SBPSxc) than in the Montane Spruce subzone (MSxv), and trees were smaller in GS versus IGS treatments only within the MSxv subzone. Interior spruce (*Picea glauca* x *engelmannii*) grew best in the MSxv and partial cut treatments, and was significantly impacted by summer frost in the clearcuts. In an operational-scale adaptive management trial, openings were enlarged to 0.15 ha, and both pine and spruce showed excellent survival, minimal frost damage, and 10-year size similar to clearcut conditions. These findings suggest that lodgepole pine and interior spruce can be successfully regenerated in partial cut openings with optimal growth in gaps of 0.15 ha. Earlier results were published by Daintith et al. (2005).

Natural Regeneration

Pine natural regeneration density and height growth were compared among the openings in the harvesting treatments and between biogeoclimatic subzones (Steen et al. 2007). Density of post-logging ingress stems was higher on the SBPSxc blocks than on the higher elevation MSxv blocks. On the SBPSxc blocks, regeneration density was similar to density on adjacent clearcuts in contrast to the MSxv where natural regeneration density was significantly less on the partially harvested blocks than on an adjacent clearcut. These results indicate that small openings in the SBPSxc can be naturally regenerated by lodgepole pine without post-logging site preparation but higher elevation blocks in the MSxv will need to be planted to ensure full stocking by lodgepole pine within seven years. However, a regeneration delay beyond seven years may have little effect on subsequent timber harvests because of the prescribed long period between harvest entries. In the replicated trial, a comparison of data from 2004 and 2008 in the no-harvest controls and partial cuts (forest and openings) (Waterhouse 2011) found the density of natural regeneration stems, over 10 cm tall, increased from 2300 sph to 3200 sph when the treatments were averaged. As of 2008, there was over 6000 sph in each treatment within the SBPS blocks (no-harvest control, partial cut forest and partial cut openings). The distribution of the regeneration was also good as it approached 50% of plots being stocked in the no-harvest controls and forested parts of the partial cuts, and was 63% in the openings. In the no-harvest controls in the MS blocks, densities were lower (2300 sph) than in the partial cuts forest (3200 sph) and openings (3300 sph). The distribution was also poorer in the MS with the percentage of stocked plots at 42% in the openings and 24-25% in the controls and partial cut forest, respectively. The stocking rates have increased in the openings since 2002 (Steen et al 2007), where in the SBPS 51% and in the MS 30% were stocked. Of note, despite the high overstory mortality from MPB, the height growth rates (2008 – 2006) of regeneration in the small openings is still double that of trees growing under a mostly dead forest canopy. Overall as the overstory falls on the study blocks, there will be sufficient regeneration to develop a new forest.

Breeding Birds

Breeding birds were surveyed one year pre-harvest (1995) and for four years post-harvest (1996-2001) to measure the impact of partial cutting in old, lodgepole pine forests on the Chilcotin Plateau of British Columbia. The silvicultural systems recommended to manage northern caribou habitat did not negatively affect the breeding bird community and some species increased in abundance in some years (Waterhouse and Armleder 2007). Data was collected in 2006 and 2007 to monitor the impact of MPB. Bird communities continue to remain stable; however, there was a dramatic increase in black-backed and three-toed woodpeckers due to the availability of MPB forage.

Lichen

Terrestrial and arboreal lichens were measured pre-harvest (1995) and three times post-harvest (1998, 2000, 2004 and 2008). In 1998, edible terrestrial lichen abundance in the partial cuts decreased in proportion to the area cut. By 2004, forage lichen in the group selection treatment recovered to pre-harvest amounts, while lichen in the shelterwood treatments steadily increased from 1998 but not to pre-harvest levels. In contrast, lichens in clearcuts showed large declines after logging and little recovery. While herb response was negligible in the partial cut treatments it was substantial in the clearcuts. These results indicate that lichens seem to be able to recover from partial cutting decades sooner than from clearcutting and create less attractive forage for other ungulates that can attract wolves. An article on the pre-MPB lichen response has been submitted to a scientific journal (Waterhouse et al. 2011). Early post-MPB results are discussed in Part 2 of this report.

Fungi

Pine mushrooms, shingled hedgehog, sheep polypore, black morels, and truffles have been sampled over several post treatment years. Partial cutting positively benefits some species.

Long-term Site Productivity

The objective of this study is to evaluate impacts of woody debris loading levels on sustainability of site productivity. In the first 10 years, planted stock grew best in plots with high levels of woody debris loading. Several hypotheses have been explored including the contribution of woody debris to soil nutrients and provision of a favourable microclimate for seedling growth. An article has been submitted to a scientific journal (Wei et al. 2011).

Future Work and Recommendations – Silvicultural Systems, Habitat and Biodiversity Research

The original plan was to start reducing the frequency of remeasurement at year 15 of the study; however, the mountain pine beetle (MPB) attack has necessitated a change. It is vital to know how the habitat of these caribou will change in response to the massive tree mortality caused by MPB. As a result, remeasurement of the silvicultural systems trials will continue at approximately the current rate of every 4 years for the permanent sample plots (lichen, vegetation, natural regeneration, planted stock, long-term site productivity), and annually for microclimate and treefall studies. This will allow valuable data to be obtained that will inform future management decisions.

Appraisal System and Modified Harvesting

In 2002 forest licensees voiced concerns that the appraisal system hindered implementation of harvesting recommendations found within the NCS. The primary concern was that the appraisal system did not adequately recognize the increased costs required to utilize modified harvest techniques. In general increased costs are associated with the increased complexity of block layouts required for the 'checkerboard' approach within modified harvest areas. Utilizing experienced buncher operators with or without GPS guided machinery may greatly reduce the time required, or eliminate the need for detailed block layouts and manual boundary flagging. Furthermore, harvesting the 'checkerboard' pattern with openings kept to a width that a buncher may reach in one pass up, a series of openings, and one pass down would minimize buncher non-productive time.

Salvage operations related to the MPB epidemic have dominated harvesting activities in both the Quesnel and Williams Lake TSAs, decreasing the attention to the appraisal issue. The appraisal system was also modified to recognize salvage harvesting within parameters allowed by international trade regulations in the conventional harvest areas. The result was increased economic availability of MPB attacked wood in the broader timber harvest land base, resulting in little or no harvest within the modified harvest zone in recent years.

Licensees re-initiated harvest in the modified harvest zone in the winter of 2010/11. The improved harvesting and processing efficiencies developed while operating in MPB impacted stands appear to have improved the economic operability of the modified harvest zone. These efficiencies, coupled with favourable changes to the stumpage status of these stands, appears to have addressed the main appraisal issues noted in 2002 and the appraisal issue has not resurfaced. Licensees are also investigating further options to reduce operating costs within the modified harvest zone to further improve the economic viability of operations.

Future Work and Recommendations – Appraisal System and Modified Harvest

With these issues, and the lumber markets at historic lows, the appraisal issue as outlined in the NCS has presently become silent. Interest in the MHZ is increasing as salvageable timber becomes less available close to mills. Forest Licensees are forwarding the ideas to government to investigate methods to decrease overall operating costs in areas such as the MHZ. These methods could potentially include adjusting silviculture regimes, using cruise based sales, and adjusting the caribou habitat zones to match the reality of the unprecedented volume of beetle killed timber.

Access Management

Current knowledge suggests that long term persistence of northern caribou depends upon the perpetual supply of large contiguous areas of suitable habitat, with little or no vehicle access. The two key management goals linked to access management are maintaining habitat effectiveness throughout the core area being managed for caribou (to ensure they have unimpeded access to the habitat) and to insure that the caribou population remains stable over the long term.

The range of potential negative impacts on caribou from increased access routes and motor vehicle activity was outlined in detail in 2002 Northern Caribou Strategy¹⁸. A growing body of evidence has shown that:

- Caribou tend to utilize habitats close to human activity (including roads and seismic lines) less than expected (Dyer *et al.* 2001, Dyer *et al.* 2002, Cameron *et al.* 1979, Nelleman and Cameron 1998, Weir *et al.* 2007, Courtois *et al.* 2007, Seip *et al.* 2006, , Creel *et al.* 2002, Mahooney *et al.* 2001, Simpson 1987, Simpson and Terry 2000, Cummings & Beange 1993, Dahle *et al.* 2008, Daigle 2010, Farnell 1998, Joly *et al.* 2006, Kinley 2003, Vors *et al.* 2007, Vistnes and Nellemann 2001, James and Stuart-Smith 2000, Oberg 2001, Apps and McLellan 2006, Schindler *et al.* 2006).
- Caribou habitat management practices need to provide a perpetual supply of large, contiguous areas of suitable summer and winter habitat, with little or no vehicle access and disturbance, so that caribou occur at low densities and avoid predators and poachers (Seip and Cichowski 1996)
- As a result of snowmobile activity, caribou can abandon habitat, increase home range size or be under increased levels of stress (Seip *et al.* 2006, Freeman 2008, Creel *et al.* 2002, Mahooney *et al.* 2001, Simpson 1987).
- Increased amounts of linear corridors by motorized vehicles and snowmobiles can provide greater predator access (wolf and human) to caribou habitat and thus higher

¹⁸ Appendix 2 of the 2002 Northern Caribou Strategy

encounter and predation rates (Boutin *et al.* 2004, Bergerud 1992, James & Stuart-Smith 2000, Seip 1991, Wittmer 2004, Seip and Cichowski 1996, Daigle 2010, Kinley 2003).

- Caribou encounters with wolves increase when caribou move near linear features. Wolves tend to select these features, suggesting that the presence of linear features in caribou range will increase wolf-caribou encounter rates and predation risk (Wittington *et al.* 2011)
- Snowmobile disturbance to caribou in winter months when ungulates are in poor physical condition can increase the amount of energy expended in avoidance behaviour and may ultimately threaten winter survival (Geist 1975, Tyler 1991, Simpson 1987, Powell 2004).
- Increased presence of roads and human related disturbance during the calving and post-calving seasons can decrease calf survival and may ultimately reduce herd size (Russel *et al.* 2002, Wolfe *et al.* 2000, Johnson *et al.* 2005, Joly *et al.* 2006).

Access in and adjacent to caribou habitat has in the past generally been initiated as a requirement for forest harvesting. The access recommendations outlined in the 2002 NCS with respect to forest development practices and for motor vehicles (including all terrain vehicles and snowmobiles) were designed to:

1. minimize disturbance to caribou,
2. minimize displacement of caribou, and
3. minimize increased caribou vulnerability to predation

Potential tools available to land managers to regulate access within the core caribou area include:

1. The use of (access restricting) general forest development practices
2. Legal access restrictions enforced by the Wildlife Act or other legislation
3. Physical road closures (including gates and road blocks)
4. Recreational Zoning within Parks that limits certain activities (enforced by Park Act), and
5. Decommissioning roads and road reclamation to block vehicle access

General Forest Development Practices to Minimize Access

Access management concerns are partially mitigated by aggregating no-harvest and modified-harvest in large, contiguous areas. Currently there are very few useable roads into the no-harvest zone. Although very little harvesting has occurred within the modified-harvest zone, the general access recommendations and strategies outlined in the NCS have been adhered to and are as follows:

- Forest harvesting has been aggregated in time and space (Map 8).
- Block sizes within Natural Disturbance Type 3 of about 1000ha have been utilized where practicable for harvest and leave areas.

- Road ploughing has been minimized during winter months.
- The number of main haul roads has been minimized. That is, no new main haul roads have been built within the modified-harvest zone.
- Gated access control points have been utilized (though have not been completely effective due to vandalism issues and need to be re-assessed) (Map 10)
- No new roads or trails for motorized vehicles have been constructed within the no-harvest zone
- Promote non-motorized recreational activities within core caribou habitat

Little deactivation of secondary roads has occurred, since most main roads into the modified and no-harvest areas are controlled by gated access control points. NCS recommends where there are no effective access control points, there should be deactivation of secondary roads.

Motor Vehicle Access –Physical Closures and *Wildlife Act* Closures

A combination of physical access controls and legal regulatory measures have been utilized to minimize the impact of motor vehicle access to caribou habitat (Map 10). Motor vehicle access restrictions enforced under the *Wildlife Act* can be found within the provincial Hunting and Trapping Regulations Synopsis under the Cariboo Region section. Within **MU 5-12** there are currently five main haul roads that are designated as “Motor Vehicles for Hunting Closed Areas” year round:

- Upper Dean River Main Haul Road northerly from 66.5km
- Clusko-Thunder Mountain FSR (Chezacut) and side roads –northwesterly from the junction of this road and Clusko River
- Michelle-Baezaeko (3900) FSR and side roads – westerly from km 66
- P Road and side roads – north from km 57
- BeefTrail Road

Several of the above *Wildlife Act* road closures are additionally enforced by the presence of gates further restricting access. Management Units of 5-12 and 5-13 are closed entirely to ATVs and snowmobiles for hunting purposes from Sept. 1 to Dec. 5. The only legal restriction within MU 5-6 limits the operation of snowmobiles and ATVs for the purposes of hunting from 4am to 10am. Existing *Wildlife Act* closures currently do not limit motor vehicle access for other recreational purposes, including snowmobiles and ATV’s.

Significant effort has been expended to maintain physical barriers in the form of gates on main roads within the modified harvest zone where logging is no longer active (Map 10). These physical barriers are considered valuable, are incremental to legislative closures in an era of limited compliance and enforcement capacity, and should be maintained in effective locations. Given the management issues and effectiveness of these gates, a road access plan must be developed and implemented in conjunction with physical road closures. The access plan will determine which roads can be fully decommissioned and identify effective physical closure points on the main roads.

ATV Access Management within and Surrounding Parks

Wildlife regulations prevent the use of ATVs for hunting purposes from September 1st to December 5th in a large core area surrounding Itcha-Ilgachuz Park, after which time snow conditions generally eliminate ATV use in this area. The 2002 NCS recommended little or no ATV access in the park. Prior to the release of the Itcha-Ilgachuz Park management plan in 2003, ATV use was not authorized in the park; however the approved Itcha-Ilgachuz Park management plan allows 30 ATV permits each year to access Itcha Lake in the month of August from the 3900 Road (MWLAP 2002). There appears to be good compliance and ATV use is confined to the 66 kilometer seismic trail from the park boundary to the Kettle Lake cabin as outlined on the authorization access map (Map 10). The current management plan for Tweedsmuir Park (which includes the Rainbow Mountains) does not permit ATV use within the park (MEP 1988). The Trumpeter Mountain area in the Charlotte Alplands is believed to be a popular summer ATV area for locals and receives moderate use. Within the Wildlife Habitat Area surrounding Itcha Ilgachuz Park, ATV access is currently unrestricted.

Snowmobile Access Management

The NCS recommended that recreational and commercial use of snowmobiles be carefully regulated or excluded from sensitive winter-range areas due to concerns regarding potential caribou disturbance and displacement (Seip 2006, Kinley 2003, Reimers et al. 2003, Simpson and Terry 2000). In addition, packed trails allow wolves' easier access to caribou habitat and can potentially increase encounter and predation rates (James and Stuart-Smith 2000, Oberg 2001).

Rainbow Mountain Herd

Caribou from the Rainbow herd may migrate to the Ilgachuz Mountains, stay in the Rainbow Mountains (Tweedsmuir Park) or migrate to the Anahim Lake area in the winter. Caribou that winter in the Ilgachuz Mountains are believed to be at low risk from snowmobile disturbance as zoning outlined in the 2002 Itcha-Ilgachuz Park management plan limits snowmobile use to approved routes and play areas away from wintering areas (Map 10). Within Tweedsmuir Park (Rainbow Mountains) there has been no new park management plan since the release of the 2002 NCS. The pre-existing (1988) plan was reopened in 1993 to address snowmobile issues. In 1998 snowmobile access within the park was expanded but limited to routes and play areas away from wintering areas as outlined on Map 10. Approved riding areas purposely avoided windswept ridges on the North side of the Rainbow Mountains where there has been extensive winter use by caribou in the past. For this reason, there is a low risk of disturbance to caribou wintering in the Rainbow Mountains.

In years when Rainbow caribou migrate to the Anahim Lake area they are most likely to experience disturbance by snowmobiles. In this area there are multiple road networks for timber harvesting, recreational access and residential and agricultural use dispersed throughout the wintering area. This higher concentration of movement corridors, coupled with a lack of snowmachine zoning increases motorized vehicular traffic as well as improving the wolve's ability to access and prey upon caribou by providing packed trails.

Itcha-Ilgachuz Herd

There are currently no motor vehicle restrictions over much of the winter range used by the Itcha-Ilgachuz herd. Limitations under the Wildlife Act limit the use of snowmobiles and other motorized vehicles for hunting purposes (September 1st – October 15th) in much of the modified harvest area.

The current Itcha-Ilgachuz Park management plan continues to limit snowmobile use to the approved routes shown on Map 10. There appears to be moderate recreational use by snowmobilers, mostly consisting of local members of the Itcha Cabin Society and residents from Quesnel and Prince George. Routes are monitored several times each winter by Parks staff in addition to being “self-enforced” by the Itcha Cabin Society and compliance appears to be high. Operation of snowmobiles on the Corkscrew Road is prohibited year round, except for industrial forestry purposes.

Charlotte Alplands Herd

Charlotte Alplands caribou generally winter either on the windswept alpine ridges in the Trumpeter Mountain area or utilize lower-elevation forests north and east of the Alplands. The NCS recommended closure of snowmobile access to Trumpeter Mountain where there is considerable snowmobile use. To date there has been no zoning of snowmobile use within the Charlotte Alplands and vehicular traffic on roads within low and high elevations alike are not restricted for hunting purposes at any time of the year. Further monitoring of caribou is required before restrictions will be considered.

Future Work and Recommendations – Access Management

The CSC has proposed an area closure under the *Wildlife Act* that would restrict all non-industrial motorized access, year-round within most of the modified and no-harvest area (Map 10). Existing physical road closures will remain in place (or be modified in nature) until an access strategy is developed, and the legal closure area would be expanded to include the core wintering area and a wider range of user groups. Limited ATV and snowmobile use would continue to be permitted on designated travel routes and play areas within the closure area. This new proposal for an expanded area closure under the *Wildlife Act* to protect northern caribou is currently in the consultation stage.

In addition to the *Wildlife Act* Motor Vehicle Closed Area, an access strategy will be developed by March 2012, outlining which roads can be fully decommissioned and identifying effective physical closure points on the main roads. The framework of this access strategy can be found in Appendix 8. Consultation on the access strategy will be led by Ministry of Forests, Lands and Natural Resources Road Engineering staff and Habitat Management staff; funding to complete road decommissioning will be investigated by Road Engineering staff and the road decommissioning work will be led by Road Engineering staff.

In 2009 and 2011, a proposal was put forward by Quesnel Ministry of Forests to extend the 3900 Road (Mitchel-Bazaeko FSR) across the northern portion of the modified harvest zone to join with the Dean River Road, forming a transport loop through caribou habitat. This road would increase timber harvest accessibility within and surrounding the modified harvest zone, increase tourism traffic and provide a secondary fire evacuation route for rural communities. Extension of this road and creation of a travel loop through sensitive habitat would be expected to have serious negative impacts for northern caribou through increased traffic, increased recreation use in core caribou habitat, and predator encounters (Schindler *et al.* 2006, Vistnes and Nelleman 2008, Dyer *et al.* 2001, Dyer *et al.* 2002, James and Stuart-Smith 2000, Oberg 2001, Russel *et al.* 2002, Wolfe *et al.* 2000, Johnson *et al.* 2005, NRC 2003, Kinley 2003, Whittington *et al.* 2011). In light of these negative implications and uncertainty around northern caribou population trends, the CSC strongly recommends against developing any permanent access routes within the IICHA; permanent access development should avoid the caribou WHAs where possible.

There are movement corridors between the Itcha-Ilgachuz, Tweedsmuir-Entiako and Rainbow caribou herds. It is extremely important for long term maintenance of these sub-populations that these connective corridors are protected from major access development.

Predator and Alternate Prey Management

Although wolf predation has been widely accepted as a key cause of caribou mortality within the SMNEA, it is important to recognise that an increase in wolf predation on caribou can sometimes be linked to increases in land clearing and logging brought about by development activities on the landscape (Figure 5). Consequently, predator and alternate prey management may be required to complement habitat protection measures, particularly if extensive early seral habitats are created or road density increases in parts of the IICHA.

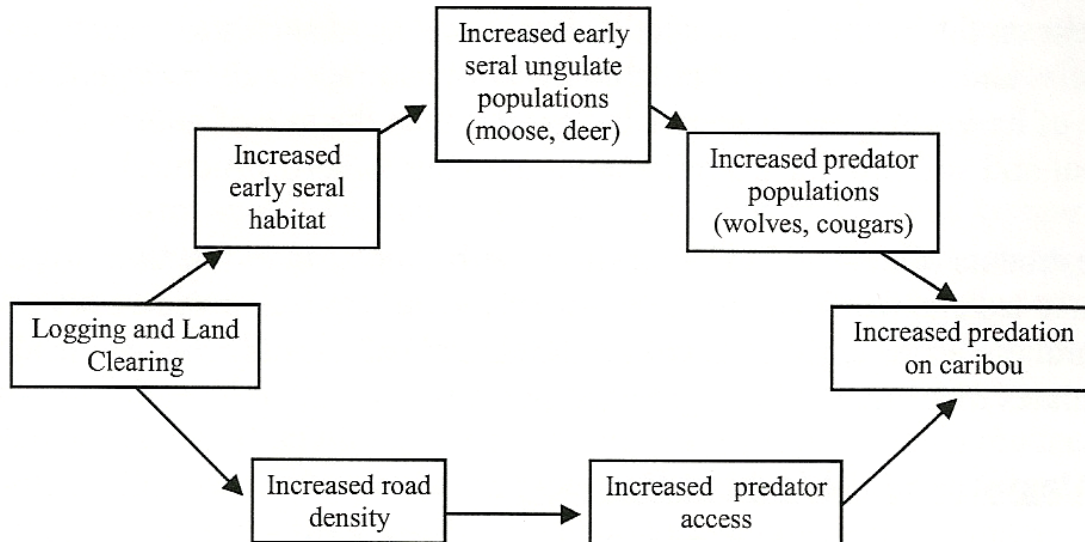


Figure 6. The mechanisms by which timber harvesting and land clearing lead to increased predation on Caribou.

Caribou are extremely vulnerable to predation compared to most other North American ungulates (Seip 1991) because of low densities and a lower reproductive rate. Wolf predation can eliminate caribou from areas where wolves are sustained by other prey species, as there is no negative feedback on the number of wolves as caribou decline (Seip 1991, Bergerud 2006, Wittmer 2004). Based on this knowledge and other research studies relating to caribou population declines resulting from predation, several recommendations and strategies are identified in the NCS to address the potential impact of predation on northern caribou herds situated in the western portion (Wildlife Management Units 5-06, 5-11, 5-12 and 5-13) of the Cariboo Region.

Prior to March 2002, information collected from radio collared caribou indicated wolf predation was the major cause of caribou mortality in the Rainbow Mountains and Charlotte Alplands herds (Young et al. 2001, Young and Freeman 2001). At that time, wolf predation was not considered a major factor for the Itcha-Ilgachuz caribou due to the stable and increasing size of the herd. Anecdotal reports suggested that unsanctioned killing of wolves was contributing to a lower overall wolf density.

Based on the link between caribou population stability and the level of wolf predation, especially in the Rainbow Mountain and Charlotte Alplands herds, the following predator and prey management measures were recommended in the 2002 NCS:

- Develop a moose management strategy that incorporates maximum sustained yield harvesting of moose populations in and adjacent to the caribou range in consultation with First Nations and Stakeholder groups.
- Develop a wolf management program to establish inventory and monitoring of the wolf population within the range of the Itcha-Ilgachuz, Rainbow Mountains and Charlotte Alplands caribou herds.
- Consider wolf sterilization and removal in areas where caribou numbers are declining, with the Rainbow Mountains as the priority.
- Develop a comprehensive access management strategy to minimize permanent road development, restrict motor vehicle activities, and prevent enhancement of wolf travel corridors in caribou habitat.
- Implement forest management practises that limit the establishment or persistence of favourable moose habitat.

A recent statistical modelling study showed that reducing moose and/or wolf densities allows Woodland Caribou populations to stabilize at higher levels (Lessard 2005). This modelling also predicts that caribou recruitment decreases after logging disturbance while moose recruitment increases. Lessard suggests that wildlife managers increase the moose harvest by 10% each year until caribou numbers stabilize and subsequently set quotas to maintain this reduced moose density. Wolf reductions concurrent with moose reductions may be beneficial to prevent wolf populations from “switching” to caribou as a prey source when moose become less abundant. Bergerud (2007) suggests that wolf densities in excess of 6.5 wolves/1000km² will cause caribou populations to decline. Reducing the risk of wolf predation on caribou by decreasing the number of wolves and alternate prey and decreasing wolf encounter rates with caribou is likely the most effective approach to maintain caribou populations (Bergerud 2007).

Other than moose inventories in 5-12 and 5-13C, regular LEH and First Nations sustenance hunting, no alternate prey management has occurred since 2002 within the IICHA. No measures for wolf management have occurred and wolf density within the three northern caribou herd areas is unknown. Resource limitations have constrained the implementation of the predation management leg of the caribou stool.

Predator Management

In 2002, the NCS acknowledged that caribou are extremely vulnerable to predation. At that time, predation did not appear to be a significant issue for the Itcha-Ilgachuz herd; however declines occurring within the Rainbow and Charlotte Alplands herds were thought to be associated with increasing predator populations.

The Rainbow herd was identified as a priority area to initiate a small scale (non-lethal) pilot wolf monitoring program, however due to budget constraints and delivery capacity, no significant progress has been made on this component of the strategy. The SMNEA Northern Caribou Recovery Strategy document (NCTAC 2004) suggested three alternative options to directly reduce local wolf populations without initiating a costly wolf collaring program:

- increase hunting bag limits for wolves;
- extend the wolf trapping season and educating trappers; and,
- extend the general open hunting season for wolves and black bears

There has been an ongoing wolf hunting season with a bag limit of 3 wolves per hunter annually in MUs 5-06 (Charlotte Alplands), 5-12 (Itcha-Ilgachuz) and 5-13 (Itcha-Ilgachuz) (Map 2). Although wolf harvest data is not considered accurate due to the low sample size, the average yearly harvest reported was 18 wolves over the 8 year period from 2002-2009 (Table 12). In February 2011 a wolf No Bag Limit (NBL) was initiated in the western portion of Region 5. This regulation change was as a result of continued concerns expressed by ranchers and First Nations that the wolf density had increased dramatically in the last few years. Based on the area and extent of caribou range in each management unit, recreational hunting is not an effective tool to significantly reduce wolf density. A similar situation exists in the Quesnel Highland Mountain Caribou Recovery area, where a NBL on the harvest of wolves was initiated in 2006 to assist the wolf management program (MU 5-15). Since this NBL was initiated in 5-15, an average of 6 wolves per year has been reported harvested. Trapper training combined with the utilization of bounty incentives for removed wolves was attempted in the Kamloops Region in 2006, but met with limited success.

Table 11. Wolf harvest (estimated resident and reported non-resident) from 2002-2009 in Management Units 5-06, 5-12 and 5-13.

Year	2002	2003	2004	2005	2006	2007	2008	2009	Total
MU 5-06	7	0	0	0	0	0	0	0	7
MU 5-12	0	7	20	10	1	1	0	0	39
MU 5-13	0	13	0	23	9	10	0	41	96
Total	7	20	20	33	10	11	0	41	132

Anecdotal reports indicating wolf numbers have increased during the past few years cannot be substantiated as there is no current wolf inventory or density information available for the IICHA. Aerial inventory of the wolf population within and surrounding the Itcha-Ilgachuz Mountains was attempted in 1999; however, the survey was deemed unsuccessful due to large expanses of heavily forested terrain, limited open waterways in which to track, and poor survey conditions (Roorda and Dielman, 1999). A wolf control program has been successfully utilized to reduce wolf density for Mountain Caribou recovery in the Quesnel Highland Planning Unit (Roorda and Wright 2010). In this ongoing study, helicopter net-gunning has been the most efficient capture technique, but ground trapping with leg-hold traps has also been successful. Surgical sterilization of dominant wolves can be an effective technique to reduce wolf

recruitment while maintaining current stable pack territories (Roorda and Wright 2004, Roorda and Wright 2008, Spence *et al.* 1999).

Although wolves are considered to pose the greatest predation threat to the three northern caribou herds, grizzly bears are also present. Grizzly bears have been shown to reduce caribou calf recruitment and contribute to adult caribou mortality (Whittmer *et al.* 2005, Adams *et al.* 1995, Mahoney and Virgl 2003). Grizzly bear population estimates and densities have been generated for the three Grizzly bear population units that overlap the range of the three caribou herds (Table 13) (Hamilton *et al.* 2004, Hamilton 2008). Incidental observations of grizzly bears during caribou post-calving surveys also suggest that more grizzly bears may occur in the Rainbow and Charlotte Alpland areas than in the Itcha-Ilgachuz survey area. This is likely due to bear movement from the salmon-bearing Dean River and Atnarko River into the Charlotte Alplands and Rainbow Mountains.

Table 12. Grizzly bear population and density estimates for the Blackwater-West Chilcotin, Tweedsmuir and Klinaklini-Homathko Grizzly Bear Population units (Hamilton *et al.* 2004 and Hamilton 2008).

Grizzly bear survey Unit	Corresponding Caribou herd	Grizzly Density
Blackwater West Chilcotin	Itcha-Ilgachuz and Rainbows	9/1000 km ²
Tweedsmuir	Rainbow and Charlotte Alplands	15/1000 km ²
Klinaklini-Homathko	Charlotte Alplands	8/1000 km ²

Alternate Prey

Within the NCS area there are 5 prey species potentially contributing to increased predator densities. Moose, mule deer, mountain goats, caribou and feral horses constitute the large prey species available to predators. Moose are the main prey species of wolves; however caribou may also be a significant prey species, especially in the Itcha-Ilgachuz where caribou are at highest density. Based on the variety and numbers of prey species available to wolves and favourable habitat for prey species, an increase in wolf density is expected.

There are currently general open and LEH seasons for moose, mule deer, caribou and mountain goat in the SMNEA. All four prey species are also utilized by First Nations for sustenance purposes. Other than recreational hunting, sustenance use and population inventories no specific alternate prey management has occurred since the release of the NCS in 2002. In order to better understand the relationship between prey species and relative changes to wolf numbers, information regarding wolf density and number of packs needs to be collected.

Moose

The AAH for moose is adjusted following periodic reviews of local moose populations. No additional LEH authorizations have been distributed for the purpose of reducing the wolve’s primary prey within caribou habitat since release of the NCS in 2002. The AAH for bull moose within the IICHA has increased slightly since 2002 and is typically utilized in it’s entirety (Table 14). From 2002 to 2009 average annual harvests by residents and non-resident hunters combined were 16, 140 and 156 moose respectively in MUs 5-06, 5-12 and 5-13C.

Table 13. Bull moose non-resident harvest and limited entry resident harvest and from 2002-2009 in MU 5-06, 5-12 and 5-13C.

Management Unit	Year	Annual Allowable Harvest ¹⁹	Authorizations Available ²⁰	Resident Harvest	Non-resident Harvest ²¹
5-06	2002	14	40	15	7
	2003	14	40	11	2
	2004	13	46	11	5
	2005	13	47	8	4
	2006	13	51	13	2
	2007	13	47	15	-
	2008	13	64	12	-
	2009	15	54	12	-
	Annual Average		14	49	12
5-12	2002	90	329	71	66
	2003	90	341	93	65
	2004	90	354	62	75
	2005	90	384	88	68
	2006	90	373	70	69
	2007	69	476	69	53
	2008	90	535	77	-
	2009	106	430	65	-
	Annual Average		89	403	74
5-13C	2002	94	309	141	38
	2003	94	246	139	44
	2004	94	224	114	40
	2005	94	194	68	45
	2006	94	268	104	35
	2007	94	253	63	-
	2008	94	322	112	-
	2009	83	191	191	-
	Annual Average		93	251	116

Moose Management Zone 5-12 lies entirely within the IICHA. The most recent inventory of moose in MU 5-12 occurred in 2002 and both bull and calf ratios were found to be higher than the provincial minimum recommendations (Table 15). These ratios suggested a stable to increasing moose population within the management unit (Stalberg 2002). The 2002 population estimate of 1550 animals was arrived at from surveying a representative portion of the management unit (due to its large size). When compared to survey results obtained within the

¹⁹ The AAH represents the number of animals that can be harvested.

²⁰ The number of authorizations available is generated based on the AAH and hunter success rate.

²¹ Non-resident harvest data was incomplete for 2007-2009. Annual average was based on years with complete data.

management unit in 1997 it was found that the population was growing with a finite rate of increase of 16.3% per year (Stalberg et al 1997a, Stalberg et al 1997b, Stalberg 2002). This MU needs to be re-surveyed to ascertain current moose population status and possible effects of the MPB epidemic.

Moose management unit 5-13C borders 5-12 and contains some overlap with the IICHA. A stratified random block moose survey was conducted in February 2008 and the population was estimated at 2,270 animals with a healthy bull ratio and a calf ratio slightly lower than the provincial target (Lirette 2008). Changes in population estimates from 1997 to 2008 were tested statistically and the population was found to be stable. Of the three MUs that overlap the IICHA, 5-13C sustains the highest moose harvest. No moose surveys have been conducted in 5-06 since 2002.

Table 14. Moose inventory results for MU 5-12 (2002) and 5-13C (2008).

Management Unit/Zone	Population Estimate	Bulls/100 Cows	Calves/100 Cows	Density (moose/km ²)
5-12	1550	44	48	0.58
5-13C	2270	35	30	0.49
Provincial Targets		30	40	

Mule Deer

Mule deer are likely preyed upon by wolves to a lesser degree than moose within the IICHA. High snowpacks and availability of forage during the winter months limit local mule deer populations. Although aerial surveys are not conducted, mule deer population estimates have been established and are based on estimated amounts of available winter habitat (Table 16). Resident and non-resident mule deer harvest in 5-06 and 5-12 has remained low since 2002 (Table 17). Level of First Nations harvest of Mule deer is undetermined.

Table 15. Mule deer population estimates in Management Units 5-06, 5-12 and 5-13.

Management Unit	Mule deer population estimate
5-06	150
5-12	250
5-13	2200

Table 16. Mule deer resident and non-resident harvest from 2002-2009 for Management Units 5-06, 5-12 and 5-13.

Year	MU 5-06	MU 5-12	MU 5-13
2002	16	120	456
2003	9	85	576
2004	15	56	432
2005	9	56	444
2006	5	53	447
2007	16	36	555
2008	0	66	348
2009	10	19	167

Goats

Mountain goats most often utilize steep, rocky terrain that makes them less accessible to wolves. Incidental observations indicate wolves sometimes prey upon goats, however they are not considered a significant prey species. Therefore, additional information on goat populations is not included in this review.

Wild/Feral Horses

An increase in the feral horse population is adding a new dynamic to the predator-prey system by potentially providing an alternate food source for wolves. Discussion with local professional wolf trappers suggests wolves will not normally pursue and kill horses. However, based on wolf trapping experience in the Quesnel Highland Mountain Caribou Recovery project, it was found that horse carcasses are a highly favoured food source for wolves. Further investigation is required on the predation of horses by wolves.

The Chilcotin feral horse population has been increasing since 1991. Observers on winter (fixed wing) census flights in 2009 recorded 415 feral horses in the South Chilcotin and 370 in the North Chilcotin (Hamilton 2010). Horses were sighted most often in wetland/meadow complexes. The predatory-prey system has become more complex as a result of the increasing horse population within the IICHA and it is important that they be included as part of the overall alternate prey strategy. Focusing solely on moose may only solve part of the problem.

Future Work and Recommendations – Predators and Alternate Prey

Wolf and moose management strategies need to be better linked to the caribou management efforts in the IICHA.

A wolf inventory of the IICHA should be conducted to provide important information for managers to determine whether a control program is necessary. If wolf densities are found to be higher than Bergerud's (2007) threshold of 6.5 wolves/1000 km², and caribou populations are continuing to decline, then predator control (or alternatives) will need to be considered. Costs associated with a wolf project involving the capture, radio-collaring (GPS and VHF) and reductions of wolf packs are outlined in Appendix 10.

To establish a moose population target that may assist in the recovery and maintenance of caribou populations, a stratified random block survey for moose needs to be completed in MU 5-12. Once determined, the moose population estimate could potentially be used to develop a moose harvest management strategy that results in increased harvesting of moose populations in and adjacent to caribou range and consequently, lowered densities of moose in these areas.

It is essential to link moose and wolf management efforts to achieve the optimum result for caribou population maintenance.

Continued efforts should be made to encourage forest management practises that limit the establishment of favourable moose habitat following timber harvest in the modified, enhanced conventional and conventional harvest zones.

Range Management

As stated in the 2002 NCS, there is anecdotal evidence from other jurisdictions that fencing can be a hazard to caribou by blocking the movement of animals (O'Donoghue, 1996). Historically some First Nations people employed the use of fences (both log and rock) to direct caribou into locations where they could be killed for sustenance. The following recommendations were made in the NCS:

- Drift fencing should avoid areas of no-harvest and modified harvest for northern caribou.
- In the upper Dean River valley, drift fences should not be built perpendicular (i.e. north-south) to caribou migration routes (see Map 11).
- Where drift fences are required in the range of caribou in the upper Dean valley, the fencing should be designed to be wildlife safe.

Since release of the 2002 NCS, extensive sections of previously built fences have either deteriorated and/or will need to be rebuilt/repared due to current and expected windthrow effects of MPB.

Future Work and Recommendations - Range

Observing the reality that existing fence infrastructure could be rebuilt due to MPB impacts of windthrow and in consideration of the age of existing fences, the following additional recommendations need to be passed onto government Agriculture and Range departments:

- Rebuilt fences should take into account caribou movement patterns through the strategic placement of gates or barways at existing trails or known travel routes. These openings should be at regular intervals along the fenceline, in some cases 500m to 750m apart.
- Barways and gates located within the NSD zone and Dean River Migration Corridor can be closed prior to cattle turnout in the spring, but must be opened as the cattle are gathered at the end of the grazing season.
- Range readiness criteria, stubble heights, and grazing patterns outlined in Tenure Holders Range Use Plans should be determined in conjunction with the season and duration of caribou use and migration.
- Temporary intra-pasture fences may be used in areas during times of caribou absence; however these fences must be removed prior to the season of caribou use.
- Little is known about the carrying capacity of grazing areas within Itcha-Ilgachuz Provincial Park. These limited higher elevation grasslands and sedge meadows are important summer forage habitats for caribou, and are high in demand for range tenure holders, horseback riders and First Nations. Further study of the carrying capacity of these areas and their importance to caribou is needed to ensure habitat values are maintained.

Conservation Risk Assessment

One of the recommendations of the regional NCS was to have a detailed conservation risk assessment completed that identified critical risks and assessed how well the NCS reduced those risks. Although this task has not been specifically completed for the herds in the Cariboo Region, work undertaken by the NCTAC to identify recovery strategies has improved our understanding of the relative magnitude of stressors to caribou and the long term viability of northern caribou herds across BC. Completion of a specific conservation risk assessment is no longer considered to be a high priority activity because the detailed monitoring and analysis work that is already underway should be more valuable for assessing risk.

Part IV. Conclusions and Future Review

Conclusions Related to Key Questions

This review of the Northern Caribou Strategy (NCS) was requested by the Cariboo Managers Committee in 2008. Several key questions were identified at the outset to be addressed by the review:

What is the current status of the northern caribou (Itcha-Ilgachuz, Rainbow and Charlotte Alplands) population in the CCLUP area?

The population status of all three herds is declining or uncertain. This should be of high management concern.

What is the extent of the Mountain Pine Beetle attack within the caribou Wildlife Habitat Areas and are the General Wildlife Measures still the best approach for maintaining northern caribou habitat?

Extensive, severe MPB attack has occurred within much of the caribou WHAs, however the review has concluded that the overall habitat strategy, and particularly the modified harvest technique recommended for the MH zone in 2002, is still the optimal approach for the conservation of caribou habitat.

What caribou monitoring and research work has been done since 2002?

No caribou animal monitoring or research has been done since 2002. Research has been conducted at trial sites on silvicultural systems, habitat, lichens and biodiversity on a 4 year cycle, most recently in 2008. Because of the changes in caribou habitat due to MPB, coupled with the declining trends in the herds, it is of high importance to initiate a caribou animal monitoring program and to continue to monitor the silvicultural systems research installations.

What predator-prey research, monitoring, or management has been conducted since 2002?

Very little work has been conducted on predators or alternate prey in the IICHA since 2002. Wolf inventory is a very important activity to initiate in the area to determine the magnitude of the concern.

How much timber harvest has occurred and have recommended approaches been followed since 2002?

Only a relatively small amount of timber harvest has occurred in the MH zone since 2002, all of it following the recommended approaches. Recent interest in the area by licensees, coupled with the creation of the caribou enhanced conventional zone, suggest that timber harvest activities will soon increase in the area.

What progress has been made in implementing the specific recommendations in the NCS?

Appendix 2 presents an overview summary of progress on implementation of recommendations put forward in the NCS (2002). The habitat and timber harvest recommendations have been the most successfully implemented. Progress on access management recommendations is partially implemented and significant work is planned for 2011 and 2012. The least progress has been made on predator-alternate prey management recommendations. Capacity and too few resources to undertake this work are a significant factor.

Have any issues emerged since 2002 with respect to implementation of the NCS that require further work and/or changes to the strategy?

The MPB epidemic that occurred throughout the area is the largest issue that has emerged. This review has concluded that, despite the changes that MPB has caused, the original NCS recommendations are still the optimal approach for caribou conservation. An amended Order was approved in May 2011 to partially address severe MPB impacts in the northeastern corner of the WHA through the creation of a caribou enhanced conventional harvest zone and the addition of 15,000 hectares of new WHA on the northern boundary. Initiation of a caribou monitoring program is of very high importance to determine how the caribou are responding to the habitat changes that will continue to occur over the coming decades.

Key Recommendations and Future Work

The following is a summary of the key recommendations and future work identified in this report:

- Caribou population inventory surveys should be conducted every three years for each of the three herds within the IICHA.
- A caribou animal monitoring program, which includes radio-collaring a sample of caribou, should be initiated to gather habitat and population management information related to how the herds are responding to MPB and timber harvest
- The CSC recommends a set of fire management guidelines that should be implemented for the IICHA (Refer to p. 29).
- Work on the silvicultural systems trials (replicated and adaptive management) and monitoring project in the Quesnel TSA should be done every four years in order to quantify long term MPB effects on lichen, stand stability, vegetation development and tree regeneration.
- The CSC has proposed an area closure under the Wildlife Act that would restrict all non-industrial motorized access, year-round within most of the modified and no-harvest area.
- In addition to the *Wildlife Act* Motor Vehicle Closed Area, an access strategy will be developed by March 2012, outlining which roads can be fully decommissioned and identifying effective physical closure points on the main roads.

- A wolf inventory of the IICHA should be conducted to provide important information for managers to determine whether a control program is necessary.
- To establish a moose population target that may assist in the recovery and maintenance of caribou populations, a stratified random block survey for moose needs to be completed in MU 5-12.
- Rebuilt fences should take into account caribou movement patterns through the strategic placement of gates or barways at existing trails or known travel routes.
- Little is known about the carrying capacity of grazing areas within Itcha-Ilgachuz Provincial Park. Further study of the carrying capacity of these areas and their importance to caribou is needed to ensure habitat values are maintained.

Future Review

It is recommended that the Northern Caribou Strategy be reviewed again in another five years, in 2016.

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Appendix 1. List of Acronyms

AAH	Annual Allowable Harvest (hunting)
ATV	All Terrain Vehicle
CCLUP	Caribou Chilcotin Land Use Plan
CDC	Conservation Data Centre
CECH	Caribou Enhanced Conventional Harvest
CMC	Caribou Managers Committee
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSC	Caribou Strategy Committee
FLNRO	Forests, Lands and Natural Resource Operations
FRPA	Forest and Range Practices Act
FSR	Forest Service Road
GAR	Government Actions Regulation
GIS	Geographical Information Systems
GPS	Global Positioning System
GS	Group Selection
GWM	General Wildlife Measures
HLP	Higher Level Plan
IAMC	Inter-Agency Management Committee
IGS	Irregular Group Shelterwood
II	Itcha-Ilgachuz
IICHA	Itcha-Ilgachuz Caribou Habitat Area
LEH	Limited Entry Hunting
MH	Modified Harvest
MOE	Ministry of Environment
MPB	Mountain Pine Beetle
MS	Montane Spruce biogeoclimatic zone
MU	Management Unit
MU	Management Unit
NBL	No Bag Limit
NCTAC	Northern Caribou Technical Advisory Committee
NDSD	Natural Disturbance Seral Distribution
NH	No Harvest
NCS	Northern Caribou Strategy
PFLB	Productive Forest Land Base
RIG	Recovery Implementation Group
SARA	Species at Risk Association
SaRCO	Species at Risk Coordination Office
SBPS	Sub-Boreal Pine-Spruce biogeoclimatic zone
SMNEA	Southern Mountains National Ecological Area
SRMP	Sustainable Resource Management Plans
TSA	Timber Sales Area
VRI	Vegetation Resource Inventory
WHA	Wildlife Habitat Area

Appendix 2. Summary table of progress on implementation of CCLUP Northern Caribou Strategy.

	Strategy Recommendation	Progress to Date	Work Underway OR Gaps/Issues	Next Steps	Implementation Progress Rating
1	Habitat Strategy - location of 'no harvest', 'modified harvest' ('NSDS' is defined as a second type of modified harvest)	No harvest' and 'modified harvest' areas legally designated as Wildlife Habitat Areas (2004) with legal General Wildlife Measures (2005)	OGMAs can be moved if MPB impacts deem it necessary in some areas		Completed
2	Timber harvest strategy recommended for 'modified harvest' areas	Recommended timber management approaches for modified harvest (terrestrial and arboreal lichen sites) and natural disturbance seral distribution were incorporated into the legal GWMs for the WHA's. GWMs amended in 2007 to deal with issues that arose in the NDSD zone. WHA's and GWMs again amended in 2011 to deal with MPB impacts.	Long term lichen monitoring continues to assess survival following harvesting and/or MPB attack Possible effects of high volume MPB downed trees as a barrier is under investigation.	Continue silvicultural systems research and lichen monitoring	Ongoing
3	Resolution of the appraisal allowance issue	No progress		Explore options to reduce stumpage payable under modified harvest	Currently less of an issue
4a	An access-management strategy that addresses: a) general access recommendations for forest development practices, and motorized vehicles and	Several gates to block access for vehicles, lack of ploughing to limit snowmobile use in winter, access routes vehicle restricted for hunting purposes	<i>Wildlife Act</i> area road closure under review.	Consultation with First Nations and user groups regarding area road closure to all motorized access. Additional road deactivation.	Partially addressed , but ongoing major deficiency until access management work is completed
4b	b) ATV and snowmobile access in the IICHA	II and Tweedsmuir Park Plans take measures to limit and minimize disturbance to caribou by ATVs and Snowmachines.	Dean corridor disturbance/access for wolves may be an issue for Rainbow caribou in the winter.	Consultation with First Nations and user groups regarding area road closure to all motorized access.	Completed

	Strategy Recommendation	Progress to Date	Work Underway OR Gaps/Issues	Next Steps	Implementation Progress Rating
5	A predator management strategy should address development of a moose management strategy and a wolf management program in the northern caribou range	Moose harvest management has continued, though Moose LEH permits have not been increased since 1999. No direct wolf management has been conducted (other than regular hunting and trapping). Wolf NBL in western portion of region initiated in February 2011.	No funding/staff - Regional funding/staff utilized for predator management within Mountain Caribou habitat instead (Quesnel Highland)	Develop an alternative prey management strategy. More aggressive methods may be necessary to stabilize or reduce the overlapping moose population.	Major Deficiency
6	Ongoing monitoring of caribou populations is recommended	Two of three caribou sub-populations surveyed in 2003. II in 2007, 2009 and 2010. Rainbows in 2007 and 2008.	Obtaining funds to do the work, and unfavourable weather conditions, have been problems.	Continued caribou monitoring (all 3 herds) every 3 years. Need to improve sightability information for population surveys.	Minor Deficiency
6a	Ongoing monitoring of moose and wolf populations is recommended	Monitoring of moose (2002) in MU 5-12 and (2008) 5-13C. Wolf population monitoring was not been done since 1999.	Obtaining funds to do the work has been a problem	Wolf inventory and 5-12 moose inventory required immediately.	Major Deficiency
7	A detailed conservation risk assessment should be completed that identifies critical risks and assesses how well the NCS reduces these risks	Some assessment work has been done by the Northern Caribou Advisory Committee	Completion of this assessment is no longer considered a high priority	Continue with more detailed monitoring work and assessment of MPB impacts	Minor Deficiency but not considered significant
8	The NCS should be reviewed in detail every 5 years in order to determine if refinements are necessary	First review completed September 2011	Postponed due to MPB research and need for current caribou numbers.	Next review recommended to be completed by 2016.	Completed

Appendix 3. Approved Order for Wildlife Habitat Areas and General Wildlife Measures for Northern Caribou



AMENDED ORDER – General Wildlife Measures: Wildlife Habitat Areas #5-086, 5-087, 5-118, 5-872 and 5-873

This order is given under the authority of Section 9(2) and 10(1) of the *Government Actions Regulation* (BC Reg. 582/2004).

1. The Deputy Minister of Forests, Lands and Natural Resource Operations, being satisfied that

- i. the following area contains habitat that is necessary to meet the habitat requirements for Northern Caribou (*Rangifer tarandus caribou*);

orders that:

- a) the areas shown in the map set out in the attached Schedule A (5-086 AMENDED, 5-872 and 5-873) and contained in the wildlife habitat area (WHA) spatial layer stored in the Geographic Warehouse (WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY) are established as wildlife habitat areas 5-086, 5-872 and 5-873 for Northern Caribou. The centre point of the line on the attached Schedule A is what establishes the WHA boundary;
- b) the boundary for 5-086, as shown in the attached Schedule A (5-086 AMENDED, 5-872 and 5-873) replaces the boundary for WHA 5-086 established on December 13, 2004;
- c) the areas established for WHAs 5-087 and 5-118 on December 13, 2004 and contained in the wildlife habitat area (WHA) spatial layer stored in the Geographic Warehouse (WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY) remain; and
- d) if there is a discrepancy between the areas shown in the map set out in the attached Schedule As and the WHA spatial layer stored in the Geographic Warehouse (WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY), the areas as detailed in the WHA spatial layer will take precedent.

2. The Deputy Minister of Forests Lands and Natural Resource Operations, being satisfied that

- i. the general wildlife measures (GWMs) described below are necessary to protect and conserve habitat of Northern Caribou; and
- ii. GAR or another enactment does not otherwise provide for that protection or conservation;

orders that:

- a) this order cancels and replaces the order established on June 4, 2007, entitled "AMENDED ORDER – General Wildlife Measures: Wildlife Habitat Areas # 5-086, 5-087, 5-118";
- b) the GWMs outlined in Schedule 1 are established for WHAs 5-086, 5-087, 5-118, 5-872 and 5-873; and

- c) the general wildlife measures outlined in Schedule 1 do not apply for the purposes of exploration, development and production activities when these activities have been authorized for the purpose of subsurface resource exploration, development or production by the *Mineral Tenure Act*, the *Coal Act*, or the *Geothermal Resources Act*.

Schedule 1

Caribou No-Harvest – Wildlife Habitat Area 5-118

1. With the exception of cutblocks and the associated roads authorized at the time of the establishment of the Wildlife Habitat Areas, all forest cover within WHA 5-118 will be retained.
2. Primary forest activities designed to address forest health activities will not result in the construction of permanent access structures within WHA 5-118.

Caribou Modified Harvest – Wildlife Habitat Area 5-087 (SBPS) Natural Disturbance Seral Distribution Zone)

3. Primary forest activities within WHA 5-087 will result in retention of forest cover such that:
 - (i) Forest cover of the age set out in Column 1 of Table 1, is represented within the entire area of WHA 5-087 at no less than the proportion of the area set out in Column 2.
 - (ii) Forest cover within Old Growth Management Areas (OGMAs) will be considered to meet the old requirement (>140 years) regardless of actual age or level of attack by Mountain Pine Beetle (MPB).
 - (iii) If areas of living forest (<50% dead) outside of OGMAs are not available to meet the additional forest cover age requirement of (i), then and only then, forests outside of OGMAs that have higher mortality because of MPB (>50%) but are not harvested or salvaged can continue to contribute to the forest cover age requirement of (i) using the stand age at time of death (of >50% of the stand) for the following 10 years.

Table 1. Proportions of WHA 5-087 to be retained by age class

Column 1	Column 2
Age (year)	Landscape Proportion (%)
>80	45
>100	37
>120	30
>140	25

4. Primary forest activities within WHA 5-087 will result in more than 50% of the area required for retention of mature and old forest (>100 years) occurring in patches that are greater than 250 hectares with as much interior forest condition as possible.
5. Timber harvesting within WHA 5-087 will be concentrated by using large cutblocks and/or aggregating with existing cutblocks (those <20 years old) or young natural forest (those <20 years old).
6. To meet the proportions identified in the above Table 1, forest development will result in the recruitment of mature and old forest patches to replace areas harvested.
7. Primary forest activities within WHA 5-087 will result in retention of Wildlife Tree Patches in the areas of highest lichen abundance.

Caribou Modified Harvest – Wildlife Habitat Area 5-086

8. In WHA 5-086, 80% of the area of each Landscape Unit will be managed as terrestrial lichen sites, and 20% as arboreal lichen sites.

Definitions:

1. The 20% best arboreal lichen bearing areas are arboreal lichen sites.
 2. Higher elevation sites of the MSxv are more commonly arboreal lichen sites.
 3. The best arboreal sites are often adjacent to wetlands, creeks and other sources of humidity.
 4. Sites in the SBPS are commonly terrestrial lichen sites.
9. Within WHA 5-086, on **terrestrial** lichen sites, timber harvesting will occur by way of irregular group shelterwood harvesting 50% of each stand by area (including all skid trails and in-block roads) on a 70 year cutting cycle, and, timber harvesting within WHA 5-086, on **terrestrial** lichen sites, will:
 - (i) Result in openings that are not more than 2 tree lengths wide by 3 to 4 tree lengths in length.

- (ii) Occur on a snowpack of at least 30 centimetres to avoid physical damage to terrestrial lichens.
- (iii) Result in piling of slash along the edges of the openings to minimize the slash contact with terrestrial lichens.
- (iv) Result in no damage or minimal damage to live residual trees. Minimal is defined as a maximum of 5% of post-harvest stems. Damage refers to both crown and 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 residual stand (and boundary) that can be considered windfirm.

10. Timber harvesting in WHA 5-086, on **arboreal** lichen sites, will occur by way of group selection harvesting of 33% of each standby area (including all skid trails, and in-block roads) on an 80 year cutting cycle, and timber harvesting in WHA 5-086, on **arboreal** lichen sites, will

- (i) Result in openings that are not more than 2 to 3 tree lengths wide by 3 to 4 tree lengths in length.
- (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 live residual trees. Minimal is defined as a maximum of 5% of post-harvest stems. Damage refers to both crown and 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) Where significant terrestrial lichens are present, timber harvesting will result in opening sizes that are not more than 2 tree lengths wide by 3 to 4 tree lengths in length and will occur on a snowpack of at least 30 centimetres to avoid physical damage to terrestrial lichens.

11. Primary forest activities designed to address Mountain Pine Beetle infestations within WHA 5-086 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.

12. Silvicultural practices within WHA 5-086 will result in:

- (i) no use of mechanical site preparation techniques, except on subhygric or wetter ecosystems
- (ii) minimal use of grass seeding so to avoid displacement of lichens. Grass seeding on disturbed areas of road prisms is allowed but only as a site specific requirement.
- (iii) Use stocking standards consistent with Table 2 to achieve habitat objectives (for lower than typical stocking levels) while maintaining volume expectations.

Table 2. Stocking standards to be applied to WHAs 5-086, 5-872 and 5-873.

Zone/RSZ	Series	Conifer		Target	MIN ps (well-spaced/ha)	MIN p	Species	Ht (m)	Post max density	
		Preferred (p)	Acceptable (a)						min	max
MSkv	01	PI Sx ^{1,2}	B ^{3,4}	1000	800	600	PI	1.0	1000	
							Others	0.8		
	02	PI ¹		1000	550	400	PI	0.8	1000	
	03	PI		1000	500	400	PI	0.8	1000	
	04	PI Sx ⁴	B ^{3,4}	1000	800	600	PI	1.0	1000	
							Others	0.8		
	05	PI Sx ⁴	BI ⁴	1200	700	600	PI	1.0	1200	
							Others	0.8		
	06	PI Sx ⁴	B ^{3,4}	1200	700	600	PI	1.0	1200	
						Others	0.8			
07	PI Sx ⁴	B ^{3,4}	1000	500	400	PI	0.8	1000		
						Others	0.6			
08	Sx ^{1,4}	PI BI ^{1,2,4}	1000	500	400	PI	0.8	1000		
						Others	0.6			
09	Sx ^{1,4}	BI ^{1,4} PI ¹	400	200	200	PI	0.8	400		
						Others	0.6			

¹ elevated microsites are preferred

² restricted to southern portion of biogeoclimatic unit in region

³ limited by moisture deficit

⁴ limited by growing-season frosts

(iv) A Minimum Inter-tree Distance of:

- a. 1.5 metres for site series 01, 02, 03 and 04.
- b. 2.0 metres for all other site series, except 1.6 metres where mechanical site preparation is employed on subhygric or wetter ecosystems.

13. Dwarf mistletoe management is not required in WHA 5-086.

14. Access management within WHA 5-086 will result in:

- (i) primary access roads (and main spur roads on large blocks) being located in a manner that facilitates access control structures and reduces line of sight.
- (ii) deactivation of main spur roads as soon as silviculture activities are complete.
- (iii) use of winter or temporary access structures where practicable, to minimize or avoid the construction of in-block access

- (iv) spur and single block access being constructed in winter conditions, with minimal use of fill and cut of soils, using snow as fill material to the extent practicable.
- (v) Identification of key points at which the primary access corridors can be controlled to limit non-industrial traffic.

Caribou Enhanced Conventional Harvest (CECH Zone) – Wildlife Habitat Area 5-872 and 5-873

15. Primary forest activities within WHA 5-872 and 5-873 will result in retention of forest cover such that:

- (i) 25% of the total productive forest area is left unlogged in each WHA.
- (ii) Of the 25% to be left unlogged, over half is identified and mapped at the landscape level (see Retention Maps and shapefiles (<http://www.env.gov.bc.ca/esd/distdata/ecosystems/fipa/wha/r5/>)).
- (iii) The remaining amount, up to the 25% level, will be identified and mapped to include the best available caribou habitat at the stand level. This will be done by the forest licensee(s).
- (iv) The best available caribou habitat will usually be mature or older forest (>100 years) with the highest levels of lichen (terrestrial or arboreal) in the area.
- (v) Retention areas can be any size greater than 2 hectares but should be distributed in ways to facilitate movement of caribou and build on the existing retention.
- (vi) Small changes to mapped retention areas will be allowed to effectively translate mapped lines to ground features. These changes will be limited to moving the line a maximum of 30m and will not change the net area left unlogged. Any changes must be located by GPS, documented on maps and supplied to the Ministry of Forests Lands and Natural Resource Operations, Ecosystems Biologist.

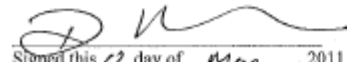
16. Primary forest activities within WHA 5-872 and 5-873 will be concentrated by using large cutblocks and/or aggregating with existing cutblocks (those <20 years old) or young natural forest (those < 20 years old) so that the majority (>50%) of the cutblocks or aggregate patches will be over 250 hectares in size.

17. Timber harvesting within WHA 5-872 and 5-873 will occur on a snowpack of at least 30 cm to minimize site disturbance and avoid physical disturbance of terrestrial lichens.

18. Silvicultural practices within WHA 5-872 and 5-873 will result in:

- (i) no use of mechanical site preparation techniques, except on subhygric or wetter ecosystems.

- (ii) minimal use of grass seeding so to avoid displacement of lichens. Grass seeding on disturbed areas of road prisms is allowed but only as a site specific requirement.
 - (iii) Stocking standards within WHA 5-872 and 5-873 will be consistent with Table 2.
 - (iv) A Minimum Inter-tree Distance of:
 - a. 1.5 metres for site series 01, 02, 03 and 04.
 - b. 2.0 metres for all other site series, except 1.6 metres where mechanical site preparation is employed on subhygric or wetter ecosystems.
 - (v) Stump heights not more than 40 cm being left to create micro-site planting areas for reducing summer frost damage and improve planted seedling growth.
19. Access management for and within WHA 5-872 and 5-873 will result in:
- (i) primary access roads (and main spur roads on large blocks) being located in a manner that facilitates access control structures and reduces line of sight.
 - (ii) deactivation of main spur roads as soon as silviculture activities are complete.
 - (iii) use of winter or temporary access structures where practicable, to minimize or avoid the construction of in-block access
 - (iv) spur and single block access being constructed in winter conditions, with minimal use of fill and cut of soils, using snow as fill material to the extent practicable.
 - (v) Identification of key points at which the primary access corridors can be controlled to limit non-industrial traffic.



Signed this 12 day of May, 2011

Doug Konkin, Deputy Minister

Ministry of Forest, Lands and Natural Resource Operations

Appendix 1

1. Further guidance on management practices in Northern Caribou habitat can be obtained from the *Northern Caribou Strategy* dated March 2002 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 the modified harvest, no harvest and enhanced conventional areas.

An exemption application should be submitted to the Minister's delegate 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 Regional Management Team (RMT) of the Ministry of Forest, Lands and Natural Resource Operations.

In reference to GWM 12 and 18, any use of grass seeding should have a documented justification by a RPF.

Appendix 4. Area and percentage of forested land burned (1990-2010) within fire management zones within the Itcha-Ilgachuz Caribou Habitat Area (IICHA).

Fire Management Zone (FMZ)	Area (ha) of FMZ Burned (1990 - 2010)	% of FMZ Burned (1990 - 2010)	Area (ha) of FMZ Not Burned (1990 - 2010)	% of FMZ Not Burned (1990 - 2010)	FMZ Total Area
Conventional Harvest - Quesnel TSA	3,602	4.6%	73,961	95.4%	77,563
Conventional Harvest - WL TSA	19,156	3.1%	592,582	96.9%	611,737
Enhanced Conventional Harvest - Quesnel TSA	178	1.1%	16,035	98.9%	16,213
Modified Harvest - Quesnel TSA	89	0.1%	99,363	99.9%	99,452
Modified Harvest - WL TSA	3,018	3.1%	95,798	96.9%	98,817
No Harvest - Quesnel TSA	755	1.3%	56,016	98.7%	56,771
No Harvest - WL TSA	879	2.2%	39,865	97.8%	40,744
Seral - WL TSA	86	0.1%	61,105	99.9%	61,191
Tweedsmuir Park	15,683	8.4%	170,239	91.6%	185,922
Icha-Ilgachuz Park	8,605	10.5%	72,984	89.5%	81,589
Narcosli Lake Ecological Reserve		0.0%	739	100.0%	739
Totals	52,051	3.9%	1,278,686	96.1%	1,330,738

Note: Area burned is based on fire perimeters collected and loaded to the provincial data warehouse. There may be gaps in this coverage. Small portions of the Mid Coast & Kingcome TSAs were lumped in with the Williams Lake TSA for analysis purposes. Areas for FMZs and fires do NOT include non-burnable areas (lakes, large rivers, rock, ice & glaciers, gravel pits, extraction sites, etc.).

Appendix 5. Methodology for linear transect analysis and raster classification analysis for the Northern Caribou Strategy review.

Two different types of analyses were performed – the first was a Linear Transect Analysis based on Vegetation Resource Inventory (VRI) polygons, and the second was a Maximum Likelihood Supervised Classification of 10 cm resolution ortho-rectified air photos captured during the summer of 2008.

Linear Transect Analysis:

Based on the flightlines of the Summer 2008 airphoto flight, routes were created.

These routes were intersected with a series of polygon datasets to help give an indicator as to the makeup of the forest stands. ArcMap's Linear Referencing tools were used throughout.

1. Routes were created from flightlines
2. Features from the following datasets were then located spatially along the route:

Layer Name	Source
FTEN Cut Blocks	WHSE_FOREST_TENURE.FTEN_CUT_BLOCK_POLY_SVW
FTEN Roads – 10 m buffer applied	WHSE_FOREST_TENURE.FTEN_ROAD_LINES
RESULTS Openings	WHSE_FOREST_VEGETATION.RSLT_OPENING_POLY_SVW
TRIM Roads – 10 m buffer applied	WHSE_BASEMAPPING.TRIM_TRANSPORTATION_LINES
TRIM Waterbodies	WHSE_BASEMAPPING.TRIM_EBM_WATERBODIES
TRIM Watercourses	WHSE_BASEMAPPING.TRIM_EBM_WATERCOURSES
TRIM Wetlands	WHSE_BASEMAPPING.TRIM_EBM_WETLANDS
Fire Events	Local data supplied by Ministry of Forests
Vegetation Resource Inventory	WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY
Biogeoclimatic Zones	WHSE_FOREST_VEGETATION.BEC_BIOGEOCLIMATIC_POLY
Northern Caribou Strategy Sub-Units	Local data from the 2002 Northern Caribou Strategy project
Timber Supply Areas	WHSE_ADMIN_BOUNDARIES.FADM_TSA

3. The resulting line segments were classified into 4 groups:
 - o >= 80% Pine Leading segments
 - o < 80% Pine Leading segments

- Other Forested Stands – any forested, non-pine leading segments
 - Non-Forested Stands – any segment that was any of the first eight datasets above, or any segment that was considered non-productive or NSR in the VRI.
4. Additionally, segments classified as $\geq 80\%$ pine leading were broken down by:
- Crown closure – less than/greater than 45%
 - Height – less than/greater than 12 m
 - Age – less than/greater than 100 years

Raster Classification

Note: Approximately 6% of the total Northern Caribou Strategy area was analysed (modified harvest, no harvest, park, and natural seral distribution areas only – 294 km² of 4,709 km² total area).

Maximum Likelihood Supervised Classification:

- Based on a series of training sites, each 10cm raster pixel was classified into one of a set number of predefined classes (in this case, four classes). Each class received equal weighting (i.e. a pixel had just as much of a chance as being classified as “Dead” as it did “Water”).
1. Training Site Collection:
 - A series of training sites were defined for individual raster transects due to differences in colour balancing, shadows, and land cover variation. Each training site was given a value from 1 to 4:
 - 1 = Dead (red or grey attack trees)
 - 2 = Live/Green (green trees, meadows, etc.)
 - 3 = Rock/Ground (roads, gravely areas, bare earth)
 - 4 = Water (rivers, lakes, etc.)
 2. Raster Preparation:
 - Each raster transect was clipped to a smaller, uniformly rectangular area to eliminate “NODATA” areas on the edges of the airphoto transects.
 3. Maximum Likelihood Classification:
 - Signature files were built for each raster transect
 - Each raster transect was sliced into 60 smaller, uniform pieces. The classification was performed on each of the smaller pieces, rather than the entire raster transect, to speed up processing time. Once complete, every pixel in the raster transect was assigned a value from 1 to 4 as listed above.
 4. Raster Resampling and Mosaic:

- Each smaller raster slice was resampled to 1 meter pixels using the “Majority” method – if the majority of pixels within a 10 pixel x 10 pixel area were classified as “Dead” (1), the 1 meter pixel is assigned a value of “Dead” (1)
 - Once resampling was complete, the smaller raster slices were mosaiced back into their original raster transects
5. Raster Addition:
- The supporting datasets used in the linear transect analysis above were all converted to raster, then summed with the classified raster
6. End Result:
- A table associated with each raster that summarizes each cover type (Dead, Green/Live, Rock/Ground, Water) by the VRI stand and SubUnit, then gives the number of pixels (square meters) it covers.

Appendix 6. Results by subunit for MPB raster and linear analyses.

Area of Risk Potential Rating (Hectares) From Ortho Photo Classification								Potential for Issues			
SubUnit (SubUnit Area)	Transect	N/A	Very Low	Low	Moderate	High	Total Transect Area within Subunit (ha)	From linear transect analysis of VRI polygons along flightlines. If "Yes", stands meet all 4 flagged criteria ($\geq 80\%$ pine leading, $> 45\%$ cc, > 100 years old, & $> 12\text{m}$ height)			
		non forested stands	$< 30\%$ Dead	$\geq 30\%$ to $< 35\%$ Dead	$\geq 35\%$ to $< 40\%$ Dead	$> 40\%$ Dead		No length of transect in meters	% NO	Yes length of transect in meters	% Yes
modharv_08	Total	20	515	258	185	652	1630	17498	42%	23679	58%
(20,976 ha)	% of total transect area classified within subunit in each rating category	1%	32%	16%	11%	40%	7.77%				
modharv_09	Total	0	322	6	8	187	524	5861	43%	7676	57%
(6,884 ha)	% of total transect area classified within subunit in each rating category	0%	62%	1%	2%	36%	7.61%				
modharv_12	Total	59	899	35	44	9	1046	16182	56%	12673	44%
(14,394 ha)	% of total transect area classified within subunit in each rating category	6%	55%	2%	3%	1%	7.27%				
modharv_13	Total	26	471	9	65	234	804	18275	89%	2340	11%
(11,204 ha)	% of total transect area classified within subunit in each rating category	3%	59%	1%	8%	29%	7.17%				
modharv_14	Total	98	1276	88	53	89	1604	26445	75%	8954	25%

(15,957 ha)	% of total transect area classified within subunit in each rating category	6%	80%	5%	3%	6%	10.05%					
modharv_22	Total	0	0	2	5	501	509		4870	34%	9326	66%
(3,553 ha)	% of total transect area classified within subunit in each rating category	0%	0%	0%	1%	99%	14.33%					
modharv_23	Total	3	269	9	7	6	294		10012	71%	4140	29%
(5,969 ha)	% of total transect area classified within subunit in each rating category	1%	92%	3%	3%	2%	4.92%					
modharv_24	Total	25	226	87	203	685	1225		22360	67%	10778	33%
(17,837 ha)	% of total transect area classified within subunit in each rating category	2%	18%	7%	17%	56%	6.87%					
modharv_25	Total	81	614	121	188	423	1427		21821	50%	21760	50%
(25,954 ha)	% of total transect area classified within subunit in each rating category	6%	43%	8%	13%	30%	5.50%					
modharv_26	Total	19	409	230	273	465	1394		13758	32%	29380	68%
(21,426 ha)	% of total transect area classified within subunit in each rating category	1%	29%	16%	20%	33%	6.51%					
modharv_27	Total	4	832	67	53	25	981		19646	71%	8221	29%
(12,858 ha)	% of total transect area classified within subunit in each rating category	0%	85%	7%	5%	3%	7.63%					
modharv_28	Total	4	41	41	11	65	163		8094	90%	904	10%
(4,864 ha)	% of total transect area classified within subunit in each rating category	2%	25%	25%	7%	40%	3.35%					
modharv_29	Total	47	583	29	65	5	728		14567	94%	915	6%

(8,329 ha)	% of total transect area classified within subunit in each rating category	6%	80%	4%	9%	1%	8.75%					
modharv_30	Total	108	440	49	42	231	869		17355	84%	3339	16%
(10,825 ha)	% of total transect area classified within subunit in each rating category	12%	51%	6%	5%	27%	8.03%					
modharv_31	Total	174	502	51	88	91	906		16128	59%	11408	41%
(16,424 ha)	% of total transect area classified within subunit in each rating category	19%	55%	6%	10%	10%	5.52%					
noharv_1	Total	143	953	304	670	2224	4295		41394	34%	81458	66%
(58,082 ha)	% of total transect area classified within subunit in each rating category	3%	22%	7%	16%	52%	7.39%					
noharv_2	Total	175	1532	172	137	56	2072		30424	46%	35014	54%
(40,298 ha)	% of total transect area classified within subunit in each rating category	8%	74%	8%	7%	3%	5.14%					
park_ESSF_1	Total	68	805	236	50	56	1216		65072	79%	16928	21%
(43,317 ha)	% of total transect area classified within subunit in each rating category	6%	66%	19%	4%	5%	2.81%					
park_ESSF_2	Total	142	88	43	3	12	288		101751	86%	16409	14%
(29,385 ha)	% of total transect area classified within subunit in each rating category	49%	31%	15%	1%	4%	0.98%					
park_MS_1	Total	113	1133	163	118	141	1668		21344	42%	29006	58%
(27,526 ha)	% of total transect area classified within subunit in each rating category	7%	68%	10%	7%	8%	6.06%					
park_MS_2	Total	160	291	5	3	15	475		13001	54%	11159	46%

(10,968 ha)	% of total transect area classified within subunit in each rating category	34%	61%	1%	1%	3%	4.33%					
seral_1	Total	398	1453	162	110	4	2127		29955	57%	22546	43%
(25,543 ha)	% of total transect area classified within subunit in each rating category	19%	68%	8%	5%	0%	8.33%					
seral_2	Total	295	1055	129	42	62	1583		36744	88%	5018	12%
(20,729 ha)	% of total transect area classified within subunit in each rating category	19%	67%	8%	3%	4%	7.64%					
seral_3	Total	257	1090	81	7	0	1435		28657	79%	7656	21%
(17,629 ha)	% of total transect area classified within subunit in each rating category	18%	76%	6%	0%	0%	8.14%					

Appendix 7. Detailed background and modified Proposal for Mountain Pine Beetle area swap within the Itcha-Ilgachuz Caribou Habita Area (IICHA).

Three major licensee proponents, West Fraser Mills Ltd, Tolko Industries Ltd, Canadian Forest Products Ltd. in conjunction with BCTS supplied government with a proposal that would improve the economic access to timber while hopefully minimizing the effects of salvage harvesting on the caribou population.

This is the Caribou Strategy Committee's response to that proposal. The original proposal, as submitted, was not considered neutral or beneficial to caribou by the committee, therefore we have modified the proposal to be neutral to caribou while still recognizing the main concerns of the forest industry.

This proposal contains several elements that are deemed necessary to be implemented in combination so that the overall proposal is neutral to caribou. Each of these elements will be described in more detail in this document but in general include: a spatial relocation of modified harvest areas, and implementation of access management, monitoring and special stand level practices in a new enhanced conventional harvest zone to help protect caribou habitat.

Although there is some uncertainty, we think this modified proposal will:

- Potentially improve long term habitat for caribou.
- Prescribe management regimes that will assist to mitigate short-term and mid-term habitat conditions for Northern Caribou.
- Maintain or enhance timber supply by identifying opportunities for cost effective harvesting and silviculture strategies.
- Develop access management strategies and implementation requirements to minimize the effects of human interaction on Caribou.

Spatial Relocation of Modified Harvest Areas and Creation of a Caribou Enhanced Conventional Harvest Zone

The proposal moves 15,500 hectares of modified harvest from areas closest to Quesnel to areas north of the Ilgachuz Mountains (see attached map). These changes represent only about 1/3rd of the area that was proposed by the industry but it is the maximum area available for changes that maintain caribou habitat. There are no additional identified areas of suitable caribou habitat available to trade in the Quesnel TSA.

This proposal addresses the industry concern of having more conventional harvest area with the shortest haul distance to Quesnel, albeit with less area being moved. However, rather than moving the traded area back to conventional harvest we propose the creation of a new zone called

'Caribou Enhanced Conventional Harvest'. This zone would help, at least in a small way, to mitigate the changes to caribou. At the same time, the practices proposed for this zone are not expected to impact wood supply or logging and silvicultural costs.

Rationale for Relocation

The Caribou Committee has evaluated the industry proposal based on an analysis of existing caribou habitat use data, lichen habitat mapping, and other ecological mapping and considerations. The spatial relocation of modified harvest area can be rationalized as neutral to caribou based on the following findings:

The area proposed to be established as a Caribou Enhanced Conventional Harvesting Zone has the following attributes:

- It contains peripheral and/or partially fragmented caribou habitat.
- It has heavier Mountain Pine Beetle attack and mortality in older stands which may pose an elevated risk to future caribou mobility and use due to coarse woody debris levels as stands deteriorate and fall down.
- It has higher surface fuel loadings than most other areas of the larger caribou Wildlife Habitat Area (based on the fire management plan for the area by MacKenzie et al. (2007)) and therefore it is at higher risk for future wildfires.

The area proposed to be compensatory replacement modified harvest has the following attributes:

- It contains younger aged stands that are less impacted by the present Mountain Pine Beetle epidemic.
- The southern portion of this area has current suitability as caribou habitat, while the larger northern portion has expected future caribou habitat suitability, though mostly for arboreal lichen sites.
- The identification and management of this area as modified harvest may help facilitate inter-population movement of caribou between the Itcha-Ilgachuz population and the Tweedsmuir-Entiako population.

In order for this relocation to be neutral for caribou, the committee feels that it is also necessary to manage the proposed Caribou Enhanced Conventional Harvesting Zone in a way that protects caribou habitat values better than on the conventional harvest landbase. The proposed ways that this could be accomplished are described in the sections that follow.

Forest Management Practices in the Caribou Enhanced Conventional Harvesting Zone

Landscape Level Retention and Pattern

The chief forester's guidance for MPB enhancement with large openings recommended 25% retention. The Caribou Strategy Committee will delineate about 13% retention to include the best caribou habitat. These typically are more open, lower volume stands that have more terrestrial lichen and are also less desirable sites for timber production. The remaining 12% retention can be delineated by industry recognizing that

capturing the remaining best lichen habitat would be beneficial for caribou. This would include focusing retention on those ecosystem site series where there are the greatest amounts of terrestrial lichen both at the landscape and stand levels.

Stand Level Retention and Pattern

The concepts of the Chief Forester Guidance on Stand Level Retention during Large Scale Salvage and the Quesnel Forest District Enhanced Retention Strategy should be used to identify stand level retention at the harvest block level. As with landscape level retention, the focus should be to retain areas that have the best terrestrial or arboreal lichens. Stand level retention could be linked to other ecological anchors, such as riparian zones and non-pine stand structures. Also, stand level retention, as much as possible, should reduce line of sight into harvested areas.

Harvesting Practices

- Locate primary access roads to facilitate access management control structures and reduce line of sight. Main spur roads on large blocks that are necessary to provide access for silviculture activities are considered to be primary access roads. Main spur roads of this nature should be deactivated as soon as silviculture activities are complete.
- Limit or avoid the construction of in block access by conducting winter or temporary access structures. Spur and single block access roads should be constructed in winter conditions, using minimal cut and fill of soils, and snow should be used as fill material as much as possible. This will allow lichen to re-establish post harvest.
- Minimize site disturbance and protect terrestrial lichen by harvesting on a minimum 30 cm snow pack.
- Retain dead trees within the allowances of Worksafe BC regulations and identify opportunities to create 5m stub trees.
- Dwarf mistletoe obligations will be waived where retention of secondary structure is prescribed to protect terrestrial lichen.

Silvicultural Practices

- Do not use mechanical site preparation techniques. Raw planting or natural regeneration supported with fill planting is recommended.
- Mechanical site preparation is only permitted on subhygric or wetter ecosystems.
- Minimize grass seeding as it has the potential to displace lichen. Grass seeding on disturbed areas of road prisms only as required to decrease risk of invasive plant vectoring and mitigate lichen displacement.
- Review opportunities to improve conditions for terrestrial lichens. Stocking densities at the low end of what is acceptable for timber production are better for caribou.
 - Identify stocking standards for the area that will eliminate the need for site preparation while managing risk for both the crown and the licensees operating in the area
 - Utilize TASS (Tree and Stand Simulator growth and yield model) runs to check the estimated timber volumes from a number of scenarios with varying minimum inter tree distances and minimum stocking levels to allow for a tighter spacing of trees while still realizing the timber volumes expected from the previous modified harvest strategy.

Access Management

- Identify and plan the long term main access corridors for the 3900 and 4000 roads in coordination with the Caribou Strategy Committee.
- Identify key points at which access can be controlled in the most effective manner and ensure secondary road structures are planned to limit access.
- Investigate opportunities for seasonal access restrictions.

Monitoring

There is an ongoing need to monitor the status of the Northern Caribou Strategy. This becomes even more important with the developing impact of the MPB epidemic and the changes to the strategy. At the same time, we acknowledge that monitoring has limited value in getting at specific questions regarding the impact of each change to the strategy. To do this would require a major research effort that we feel is not the best use of limited resources. However, this does not diminish the need to monitor the overall implementation of the strategy and the status of the caribou. To accomplish this, the following is recommended:

- Develop a plan, in consultation with industry, which includes both implementation monitoring and an assessment of caribou habitat use and caribou population status.
- Analyze and present the results in Caribou Strategy updates.

Appendix 8. Motor Vehicle Access Strategy; 2011 to 2016

- Implement a year round motor vehicle closure under the *Wildlife Act* over the area identified on Map 10. Consultation will be lead by Habitat Management staff.
- Develop an access strategy by March 2012 for the following roads and their side roads, where those roads intersect the proposed Motor Vehicle Closed Area under the *Wildlife Act*:
 - The 3900 Road, 6800 Road, 6500 Road and 4200 Road within the Quesnel TSA
 - The Clusko-Thunder Mountain (Chezacut) Roads and the P-Road within the Williams Lake TSA
 - The Quesnel Road, Rodeo Road, Corkscrew Roads and Holtry Forest Service Road within the Anahim Lake Round Table Area
 - Any new road that is developed in the proposed Motor Vehicle Closed area
- The access strategy will begin with the Clusko-Thunder Mountain Road and the P-Road, and continue on the remaining roads; these first two roads have the highest number of concerns and gate management has only been moderately effective.
- Existing closures will remain in place until suitable and effective alternate physical closures and locations have been identified and recommended.
- The strategy will highlight roads that can be decommissioned to effectively block vehicle access (including ATV's) in the following order: roads that are no longer required, short term harvesting roads, main haul roads. Where it is not possible to decommission a short term harvesting or main haul road, the Motor Vehicle Closed Area will be supported by physical controls.
- Consultation will be led by Ministry of Forests, Lands and Natural Resource Operations Road Engineering and Habitat Management staff, funding to complete road decommissioning will be investigated by Road Engineering staff and the road decommissioning work will be lead by Road Engineering staff.

Appendix 9. Approximate budget history for Northern Caribou work conducted in the CCLUP area (includes salary and non-salary dollars).²²

	Expenditures 1992 to 2002	Expenditures 2002 to 2010	Total Expended 1992-2010
Northern Caribou Work - Non-Salary Expenses			
Population Surveys, caribou and moose	\$698,000	\$297,000	\$995,000
Caribou monitoring and habitat studies	\$600,000	\$0	\$600,000
Silvicultural systems research ²³	\$590,000	\$522,000	\$1,112,000
Predator management	\$15,000	\$0	\$15,000
Strategy implementation and monitoring	MOE/MOFstaff only	\$120,000	\$120,000
Access management and monitoring	\$10,000	MOE/MOFstaff only	\$10,000
Sub-Total	\$1,913,000	\$939,000	\$2,837,000
Northern Caribou Work - Staffing Expenses			
Ministry of Environment	\$200,000	\$200,000	\$ 400,000
Ministry of Forests	\$1,125,000	\$509,000	\$1,616,400
Sub-Total	\$1,325,000	\$709,000	\$2,016,400
Totals	\$3,238,000	\$1,648,000	\$4,853,400

²² Years indicated are in government fiscal terms, April 1995-March 2002 and April 2002-March 2010.

Appendix 10. Projected expense summary to implement recommendations from the Northern Caribou Strategy Review Update #1 over the next 5 years, 2011-12 through 2015-16.

Strategy Component	Description	Year 1 (2011/2012)	Year2 (2012/2013)	Year3 (2013/2014)	Year 4 (2014/2015)	Year 5 (2015/2016)	Total
Caribou Inventory	II - \$25k/yr, R- \$10K/yr and CA - \$10/yr All 3 sub-populations every 3 years		\$45,000			\$45,000	\$90,000
Wolf Inventory	2 days helicopter (II and R)	\$15,000					\$15,000
Moose Inventory	MU 5-12, 5-6 and 5-13C respectively	\$130,000	\$60,000		\$80,000		\$270,000
Caribou Habitat and Population Monitoring Program ²⁴	Radio-collaring with GPS collars, aerial monitoring, population inventory in year 2, habitat analysis	\$152,109	\$124,779	\$103,229	\$46,375		\$426,492
Wolf Management Project ²⁵	Wolf capture, GPS radio-collaring and removal (in conjunction with caribou monitoring)	\$150,000	\$90,000	\$90,000	\$60,000	\$50,000	\$440,000
Lichen Monitoring	Continue to monitor permanent lichen plots in the Quesnel Dist. Mod-harvest, every 3 years			\$40,000			\$40,000
Silvicultural Systems research ²⁶	Long-term measurements of lichen, vegetation, microclimate, tree regeneration, site productivity, and biodiversity.	\$92,000	\$112,000	\$63,000	\$54,000	\$29,000	\$350,000
Strategy Implementation and Monitoring	Staff time for implementation and oversight of strategy; sometimes includes contractor costs to support committee on analyses	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$50,000
Access Management	Road deactivation, signage and gate management	\$10,000	\$40,000	\$50,000	\$50,000	\$50,000	\$200,000
Totals		\$606,452	\$425,000	\$263,300	\$231,100	\$129,000	\$1,881,492

²⁴ Estimated cost per year with partial funding confirmed for Year 1 as of April 2011.

²⁵ Estimated cost of implementing a wolf removal program within the habitat range of the Rainbow herd, if warranted by inventories

²⁶ Estimated cost per year with no funding confirmed as of April 2011.