Cariboo-Chilcotin Land Use Plan

Northern Caribou Strategy

Photo by Dale Seip

Prepared by:

CCLUP Caribou Strategy Committee

Prepared for:

Cariboo-Mid-Coast Interagency Management Committee

March 2002

Cariboo-Chilcotin Land Use Plan

Northern Caribou Strategy

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March 2002

Summary and Key Recommendations

The Cariboo Chilcotin Land Use Plan (CCLUP) recognizes that northern caribou are of provincial significance in the western portion of the Cariboo Region. Maintaining habitat values for northern caribou was identified as an 'overriding objective' in the CCLUP.

Northern caribou are currently blue-listed by the Conservation Data Centre (CDC). Blue-listed species are considered vulnerable or sensitive (at risk) and in need of special management to ensure their survival. In 2000, northern caribou in the Southern Mountain National Ecological Area (SMNEA) were nationally designated as a threatened species.

This report addresses the three northern caribou herds (Itcha-Ilgachuz, Rainbow and Charlotte Alplands) that live in the CCLUP planning area. From a conservation perspective, the Itcha-Ilgachuz herd is very significant because it is currently one of the largest and highest density caribou herds in the province. The conservation of the Itcha-Ilgachuz herd will be vital to the overall recovery of caribou in the SMNEA.

This report presents the maps and background information for the Northern Caribou Strategy, explaining CCLUP targets for northern caribou and presenting the rationale for any significant changes from the interim 1996 and 1998 Caribou Strategy Reports. This report also provides updated information on the definition of modified harvest for northern caribou, the recommended timber harvest management approaches and access, and predator management recommendations.

In the strategy the modified-harvest and no-harvest areas were selected to best maintain caribou values while taking into account stakeholder values and making the best use of overlap opportunities. A large part of this task was a map-based exercise drawn at 1:20,000 scale showing proposed no-harvest and modified-harvest locations for the northern caribou.

CCLUP targets for northern caribou were clarified based on thorough review of boundaries, calculation of the productive forest land using geographic information systems (GIS) and direction received from the Cariboo-Mid-Coast Interagency Management Committee (IAMC). CCLUP targets for modified-harvest and no-harvest were utilized in determining an updated strategy that would help to maintain caribou and caribou habitat while following higher level plan and IAMC direction. At the landscape level, the identification of modified-harvest and no-harvest areas for northern caribou used similar criteria as outlined in the 1996 caribou strategy report. Additional radio-telemetry information was available for determining areas of high caribou use. A habitat suitability model derived from the radio-telemetry data was used to update modified-harvest and no-harvest areas.

Stakeholder representatives from the Major Licensees and Conservation Council participated in the strategy update review process.

The following is a list of key findings and recommendations that are detailed in the report:

- Based on current scientific knowledge, caribou habitat and populations can only be maintained if all three of the following issues are addressed together:
  - maintaining suitable caribou habitat within existing caribou range
  - limiting and regulating road access and motorized recreation in caribou habitat
  - managing predation levels on caribou
- The location of modified-harvest and no-harvest areas and the natural-disturbance-seral-distribution polygon depicted in Map 9 form the basis of the northern caribou habitat strategy. The sum of no-harvest, modified-harvest and natural-disturbance-seral-distribution areas identified meets the overall area-based target for northern caribou identified in the CCLUP but not specific subunit targets.
- Forest stands in the Dean River Migration Corridor should be managed to provide open stands that do not impede travel and provide adequate sight distance to detect predators.
- A timber harvest strategy should be followed that includes:
  - general forest development recommendations within the modified-harvest zone
  - general forest development recommendations within the SBPS natural-disturbance-seral-distribution zone
  - an operational procedure for adjustment of harvesting boundaries with respect to modified-harvest and no-harvest zones
  - modified-harvest approaches for terrestrial lichen and arboreal lichen sites
  - a mountain pine beetle (MPB) strategy for northern caribou range
  - post-harvesting recommendations related to dwarf mistletoe, species selection for regeneration, site preparation, stocking levels and roadside seeding and planting
- An access-management strategy that addresses general access recommendations for forest development practices, and motorized vehicle, ATV and snowmobile access in the northern caribou range.
- A predator management strategy should address development of a moose management strategy and a wolf management program in the northern caribou range.
- The Northern Caribou Strategy should be reviewed in detail every five years to ensure that caribou and timber objectives are being met.

Acknowledgements

The work to develop this strategy began in 1995, following the development of the Cariboo-Chilcotin Land Use Plan. More than six years later, following extensive research, planning and consultation, this report was produced with the help of a multitude of people who shared a common interest – the conservation of northern caribou in this region. Sincere thanks are extended to all those who have contributed to the development of this strategy and also to those that had the foresight to recognize the need for this work during the land use planning process.

The CCLUP Caribou Strategy Committee, whose members included Harold Armleder, Chris Bauditz, Mike Folkema, Robin Hoffos, Mike Lloyd, Mike Pelchat, John Youds (chair) and Jim Young, prepared this report. Ordell Steen, Simon Crawley and Leo Rankin contributed to writing some sections of the report. Invaluable GIS analysis and support was provided by Jennifer Ballentine, Mark McGirr and Lynn Rankin. Simon Crawley contributed significant analysis work, supporting development of the strategy. The research of Nola Daintith, Ordell Steen and Micheala Waterhouse provided essential support for the silvicultural recommendations. Nicola Freeman, Stefan Himmer and Kerra Shaw contributed immensely in helping to conduct the caribou research. Diane Mousseau and Stella Ramsay provided support with editing and production of the document.

Since 1995, funding to undertake radio-telemetry, population surveys and silvicultural systems research in the regional range of northern caribou was provided by Forest Renewal British Columbia (FRBC), Ministry of Environment, Lands and Parks and Ministry of Forests. Local forest companies have supported the northern caribou inventory initiative by providing FRBC funding through their multi-year agreements. Companies supporting this work include Riverside Forest Products Ltd, Yun Ka Whu'Ten Ltd., Tolko Industries Ltd. and West Fraser Mills (Quesnel) Ltd.

During preparation of this report, valuable input, particularly on map-based zoning, was received from forest industry (Al Bennett and Gord Rattray) and conservation (Dave Neads) stakeholder representatives.

Signature Page

CCLUP Northern Caribou Strategy

This report and its associated maps document the recommended strategy developed by the Caribou Strategy Committee. This strategy was developed based on the direction in the Cariboo-Chilcotin Land Use Plan, committee Terms of Reference and direction from the Inter-Agency Management Committee (IAMC).

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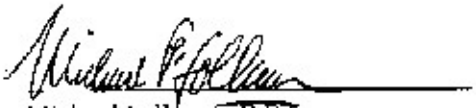

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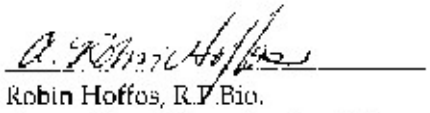

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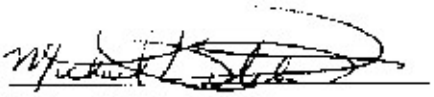

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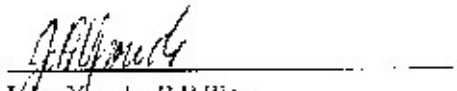

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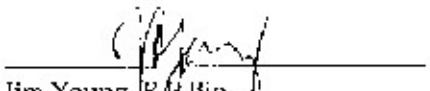

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1 Introduction

The information and recommendations in this report have been prepared as recommendations to the Cariboo-Mid-Coast Interagency Management Committee (IAMC).[1]

The Cariboo Chilcotin Land Use Plan (CCLUP) recognizes that northern caribou in the western portion of the Cariboo Region are of provincial significance. Maintaining habitat values for northern caribou has been identified as an overriding objective in the CCLUP. In 2000, northern caribou were nationally designated as a threatened species.

Photo 1. Bull caribou feeding in alpine in summer. Photo by Stefan Himmer.

As part of the implementation of the Cariboo Chilcotin Land Use Plan, the Caribou Strategy Committee (the committee) undertook the initiation and completion of the appropriate research, inventory, ecosystem mapping and adaptive management work necessary to complete a regional caribou strategy for eastern (mountain ecotype) and Itcha-Ilgachuz (northern ecotype) caribou by 2000. This report presents the strategy for northern caribou. The strategy for mountain caribou was presented in a report released in October 2000.

The terms of reference for the committee (see Appendix 1) included the following specific tasks:

- To initiate and ensure completion of research, inventory and mapping projects required to develop integrated, caribou-habitat-management strategies.
- To complete a caribou strategy that includes an identification of modified-harvest areas for caribou. Within the context of the CCLUP and subsequent implementation direction, the strategy attempts to develop the best option for maintaining caribou habitat at the stand and landscape levels. The strategy will address the CCLUP requirement for modified-harvest areas including the identification of 35 per cent of the existing deferral areas for modified-harvest. In addition, the modified-harvest area identified by the moderate risk option that was outside the deferral area is maintained.
- To develop integrated forest-management approaches for caribou that address CCLUP targets and implementation direction, including identifying operational-management strategies at the stand and landscape levels.
- To develop and define modified-harvesting for caribou habitat.
- To define portions of the caribou range which are sensitive to snowmobile use.

The committee began work on these tasks in 1995. Targets for modified-harvest areas were derived for the western areas through GIS analysis and these were subsequently reviewed and approved by the IAMC.

During development of the strategy, consultations with stakeholder representatives (major forest licensees and regional conservation council) were extensive. This work was initiated in 1998 with a series of meetings to

[1] The Cariboo-Mid-Coast Interagency Management Committee is an inter-governmental regional committee charged with overseeing the implementation of the CCLUP (together with the Regional Resource Board)

review proposed locations of the caribou modified-harvest and no-harvest areas. During 2001 and 2002 more extensive consultation work with stakeholder representatives was completed, with five meetings held to exchange information and input on the proposed strategy over a period of nine months. The 1998 interim map was reviewed and refined in the context of new caribou research information, new predictive ecological map information and input received from stakeholder groups.

Specific consultations with First Nations started in the late 1990s with an information session. In 2001 a meeting and a field trip to the caribou range were held with the Tsilhqot'in National Government chiefs and information from their traditional use study was reviewed in respect to development of the strategy.

Consultation on access management aspects of the strategy was undertaken in 2001 and 2002, including several meetings with local stakeholders. A meeting was held with the Anahim Lake snowmobile club and a field trip with the Nimpo Lake snowmobile group was attended.

Caribou committee members attended planning meetings for the Itcha-Ilgachuz Park held in Anahim Lake and Quesnel. At these meetings they shared information with the public on development of the Northern Caribou Strategy and provided input to the park planning process.

The modified-harvest areas were selected to best maintain caribou values while considering stakeholder values, and making the best use of overlap opportunities. The selection process followed direction from the higher level plan, the IAMC and the committee terms of reference. A large part of this task was a map-based exercise that produced maps (derived at the 1:20,000 scale) showing proposed no-harvest and modified-harvest boundaries. This report presents the background information, explaining targets and presenting rationale for any significant changes from the interim 1998 Caribou Strategy. The report also provides updates on the definition of modified-harvest for caribou and the recommended timber-harvest-management approaches.

2 Background

2.1 Taxonomy and Conservation Status

The woodland caribou (*Rangifer tarandus caribou*) population in British Columbia was estimated at 18,750 in 1999 (Hatter, pers. comm.) and consists of three ecotypes: northern, mountain and boreal. The northern ecotype (hereafter referred to as northern caribou) lives in west-central and northern B.C. During winter, these caribou use low-elevation forests or windswept alpine ridges where they crater for terrestrial lichens. They also feed on arboreal lichens during winter but to a lesser extent. B.C. currently has an estimated 15,000 northern caribou, of which 4,800 are found within the Southern Mountains National Ecological Area (SMNEA).

In the SMNEA, there are 26 caribou herds comprising three meta-populations (4,800 northern caribou and 2,300 mountain caribou) (Map 1). Of the 4,800 northern caribou there are two meta-populations: the north-central meta-population (northern caribou ecotype, blue-listed, total estimated population 2,100) and the west-central meta-population (northern caribou ecotype, blue-listed, total estimated population 2,700).

Within the west-central meta-population there are five herds, three of which occur within the Cariboo Region (Table 1). This strategy report addresses the three northern caribou herds (Itcha-Ilgachuz, Rainbow and Charlotte Alplands) that live within the CCLUP planning area.

Northern caribou are currently blue-listed by the Conservation Data Centre (CDC). Blue-listed species are considered vulnerable or sensitive (at risk) and in need of special management to ensure their survival.

Table 1. Current Herd Sizes within the West-Central Meta-Population

Herd Name	Estimate of Herd Size
Charlotte Alplands	50
Itcha-Ilgachuz	2,000
Rainbow	125
Tweedsmuir-Entiako	500
Telkwa	45
Total	2,720

In 1998, British Columbia signed the National Accord for the Protection of Species at Risk. This Accord provides the framework for the proposed federal Species at Risk Act (SARA). Furthermore it recognizes the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a source of independent advice on the status of species at risk nationally. In 2000, COSEWIC identified Woodland Caribou within the SMNEA as nationally threatened. This threatened status applies to 13 northern caribou herds from west-central and north-central B.C., all mountain caribou in B.C. and approximately 600 - 750 caribou from Alberta (Edmonds 1998). As a signatory to the National Accord, B.C. is obligated to develop a recovery plan that addresses the threats to the species and habitat within 2 years of listing.

In 2000 COSEWIC identified caribou in the SMNEA as threatened

The regional population of northern caribou is referred to as Itcha-Ilgachuz caribou in CCLUP documentation in order to distinguish them from eastern herds. These northern caribou herds occur primarily in the Fraser Plateau Ecoregion and have been observed to utilize two wintering behaviours, either wintering at high elevation on windswept alpine slopes or in mature to old forests at low to mid-elevations. Maps 2, 3 and 4 show areas used in summer and winter based on

existing radio-telemetry information. Most of the low-elevation winter-range habitat for northern caribou is located outside protected areas and will be subject to logging development. Although herds summer in higher-elevation parks or protected areas they will be at increased risk with logging development because the wintering areas that support these caribou are located outside parks.

From a conservation perspective, the Itcha-Ilgachuz herd is very significant because it is currently one of the largest and highest density caribou herds in the province. The conservation of the Itcha-Ilgachuz herd will be vital to the overall recovery of caribou in the SMNEA.

The Itcha-Ilgachuz herd will be vital to recovery of caribou in the SMNEA

2.2 Northern Caribou Distribution and Abundance

The area known as the Cariboo Region was named after the caribou that were much more abundant and widely distributed than they are today. In an 1861 dispatch to the Duke of Newcastle, Governor Douglas mentioned,"Cariboo country, in speaking of which I have adopted the popular term and more convenient orthography of the word, though properly it should be written "Caribоeuf" or "Reindeer", the country having been so called from its being the favourite haunt of that species of the deerkind." Akrigg and Akrigg (1997) note that Cariboo is derived from caribоeuf or cerfboeuf, which is a French folk etymology for xalibu, an Algonquin Indian word meaning the "pawer" or "scratcher".

Historically, northern caribou were also plentiful throughout much of the area known today as the Chilcotin. Records confirm they were important to First Nations for food, clothing and implements (Spalding 2000). One of the earliest written records of caribou in the area is from Alexander Mackenzie's epic journey across North America when one animal was shot on July 17, 1793 in the vicinity of Mackenzie Pass in the Rainbow Mountains. The distribution of caribou was once much wider, particularly in the south Chilcotin, including the upper Bridge, Taseko and Chilko rivers and upper Big Creek. Although records are scanty and lack detail, it appears caribou were abundant in the west Chilcotin throughout the nineteenth century at least until the early 1900s when animals appear to have become scarce. Reports by the Provincial Warden suggest that caribou in the Chilcotin were almost exterminated by 1916. Spalding (2000) speculated that these early declines were likely due to excessive hunting in combination with ongoing predation pressures. The implementation of a wolf control program through the 1950's and 1960's by the Provincial Game Commission coincides with observations of more caribou and longer hunting seasons for the Rainbow and Itcha-Ilgachuz herds. The long seasons, particularly the either-sex seasons from 1963 to 1971, resulted in high harvest levels that were likely not sustainable considering the population estimates for the two herds at the time.

Historically caribou were plentiful throughout much of the Chilcotin

Photo 2. Caribou group during June survey. Photo by Jim Young.

Rainbow Mountains Herd. Ritcey (1956) estimated 100-150 caribou in the Rainbow Mountains in 1956 after observing 68 while hiking during the summer.

Canada Land Inventory (CLI) flights over the Rainbow Mountains during January and February 1967 observed 172 caribou and 109 caribou on January 25, 1968. An aerial survey on May 6, 1971 by regional wildlife staff counted 92 animals on the north side of the Rainbows. A British Columbia Parks wildlife-inventory crew estimated 35 different caribou (minimum of 24 and a maximum of 60) after hiking through the south side of the Rainbow Mountains during the summer of 1975 (Hazelwood 1975). Bergerud (1978) estimated the Rainbow herd likely peaked in the late 1960s at 200-300 after he reviewed the existing harvest and inventory data and observed 41 caribou during a survey on October 31, 1977. Post-calving surveys undertaken in 1985 and 1986 in the Rainbow Mountains reported 72 and 118 animals, respectively. Rut surveys completed in 1986 and 1987 reported 117 and 103 caribou observed, respectively. Annual post-calving surveys from 1995-2001 have found modest calf production with an average of 23.4 per cent of animals observed being calves. Values have ranged from a low of 14.4 to a high of 33.3. Annual rut surveys between 1995 and 2000 have on average observed 124 caribou with a high of 178 in 1995 and a low of 106 in 1997 (Figure 1). Annual late-winter surveys undertaken between 1996 and 2001 have observed poor calf recruitment rates ranging from 2.8 to 16.7 per cent calves and averaging 10.5 for all six years. In summary, this data suggests that over the last fifty years the Rainbow Mountain herd likely peaked in the late 1960s at over 200 animals, then declined to possibly fewer than 100 animals in the late 1970s followed by recovery to close to 200 animals by the mid-1990s with a recent decline to just over 100 animals.

Itcha-Ilgachuz Herd. Although some exploratory surveys were completed in the range of the Itcha-Ilgachuz herd, little census information exists prior to the late 1960s. CLI flights covering the Itcha-Ilgachuz Mountains, undertaken during January and February 1967, observed a total of 255 caribou — 145 on the north side of the Ilgachuz Mountains, 10 on the north side of the Itcha Mountains and 100 on Itcha Flats. On January 25, 1968 another CLI flight observed 81 caribou on the north side of the Ilgachuz Mountains, but the Itcha Mountains were not searched. A flight on May 6, 1971 by regional wildlife staff found 60 caribou in the Itcha Mountains and 42 in the Ilgachuz Mountains. Bergerud (1978) counted 310 on January 6, 1973 when he searched both ranges. Regional wildlife staff completed a census on April 1, 1977 and counted 238 animals followed by a count of 140 on October 31, 1997 by A. T. Bergerud. Recent radio-telemetry work has shown that results from these early flights, undertaken during winter months, must be reviewed cautiously as a portion of the population that winters in the pine forest below tree-line would have not been counted. In addition, a large portion of the caribou seen on the north side of the Ilgachuz Mountains could have been from the Rainbow Herd, as a portion of this herd winters there during some years. Bergerud (1978) after reviewing survey and hunter harvest data speculated that there would have been a maximum of 400 animals in the herd during the early 1970s, followed by a decline in numbers later that decade.

Photo 3. Caribou on Itcha Flats in June. Photo by Jim Young.

By the end of the 1970s a noticeable increase in numbers was reported partly because more surveys

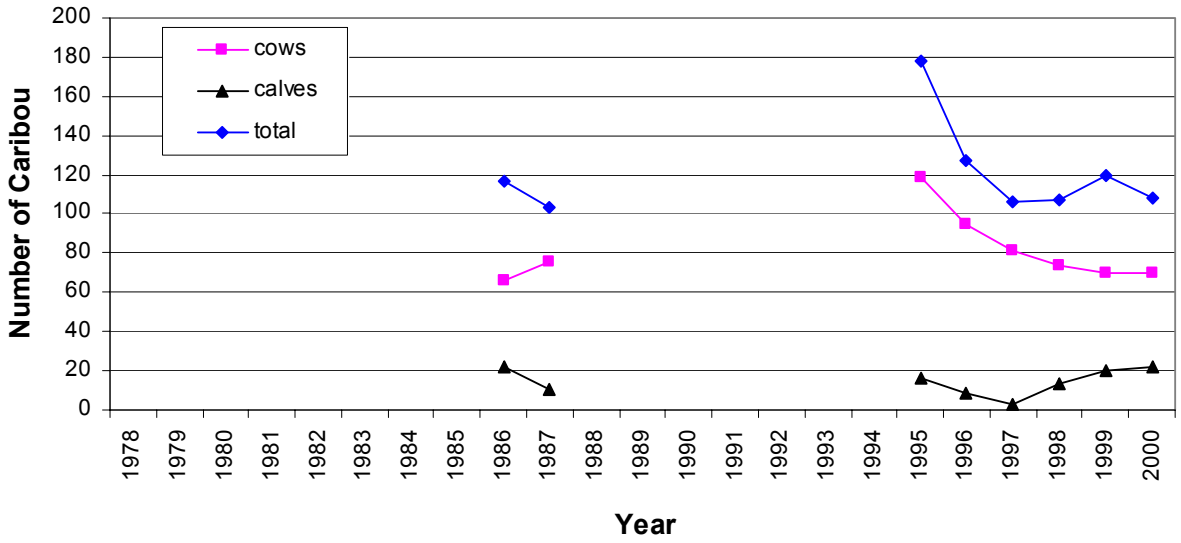

Figure 1. Summary of caribou rut surveys for the Rainbow Mountains Herd.

were being conducted post-calving and in the autumn. In 1978, several surveys were undertaken by regional wildlife staff with a peak count of 236 caribou on November 2. Again in 1979, several surveys were completed with a peak of 513 on November 27. In 1981, 475 caribou were seen on November 4, and in 1982, 711 animals were observed on June 16. By 1985, post-calving numbers had reached a high of 985 and averaged 1,248 between 1989 and 1992. Numbers have continued to grow with over 2,000 animals observed during the post-calving survey in 1998 (Figure 2). In summary this data suggests that the Itcha-Ilgachuz herd may have numbered as few as 400 in the early 1970s when it likely declined slightly, followed by an observed increase in the late 1970s and early 1980s. Over the last 20 years, the herd has continued to grow with a present estimate of 2,000 caribou, following the fall hunting season.

Charlotte Alplands Herd. Ritcey (1956) undertook a reconnaissance survey of Southern Tweedsmuir Park and summarized his discussions with locals by suggesting that caribou were abundant in the Caribou Mountain area in the 1920s, but the population crashed in the 1930s and eventually disappeared. He also reported that seven caribou were spotted on Charlotte Lake during the 1955-56 winter. There are no records of observations in the Charlotte Alplands after that date, suggesting that if any animals were still in the area that they were few in number. In 1984, a Habitat Conservation Fund project was initiated to restore caribou to the area. Between 1984 and 1991, 52 caribou were transplanted to the area from capture locations on the north side of the Ilgachuz and Itcha Mountains. By 1993, the Charlotte Alplands herd numbered over 50 caribou

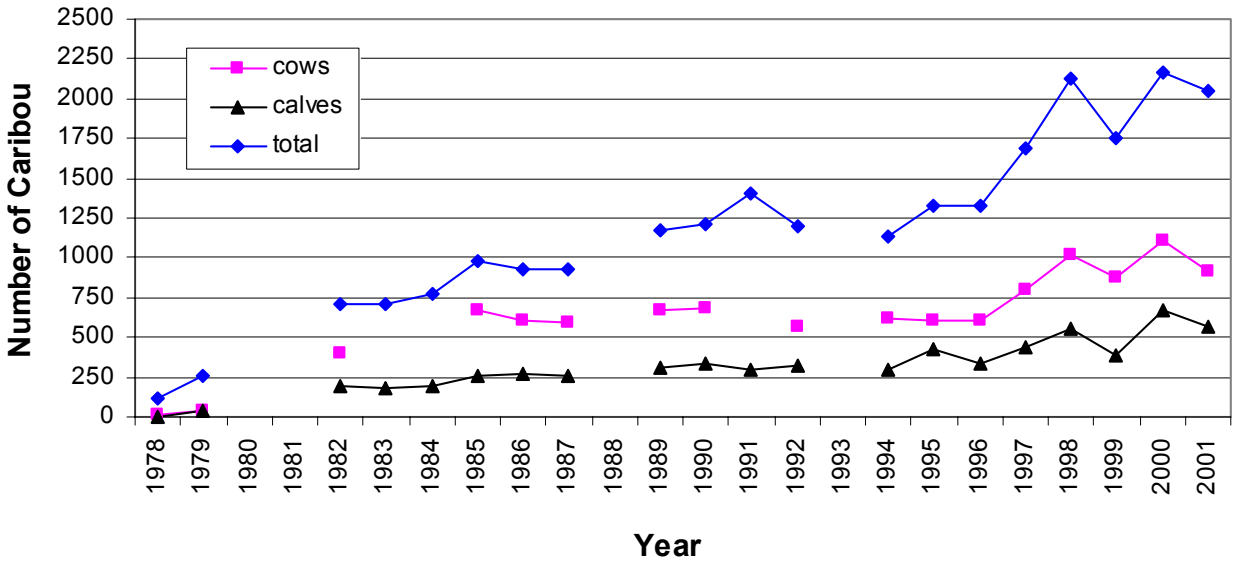

Figure 2. Summary of caribou post-calving surveys for the Itcha-Ilgachuz Herd.

and the population appeared to be increasing. Recent population surveys have observed fewer caribou and suggest that observed bull numbers have increased, cow numbers have declined and calf recruitment statistics, when measured, have been poor. It is uncertain whether caribou numbers have actually declined, remained stable or increased, therefore the official herd estimate has remained at 50 animals.

2.3 History of Forest, Wildlife and Land Use

Caribou Harvest Management. Several attempts to reduce the impacts of hunting on caribou have been implemented. The first hunting closure was enacted in 1916 for five years to protect caribou in the Rainbow and Itcha Mountains (Spalding 2000). A second attempt to stop caribou declines occurred in 1927 with a closure covering the area south of the CNR railway between Prince George and Prince Rupert and west of the Fraser River. This expanded closure provided protection for all five herds located in west-central British Columbia. A third closure of the west Chilcotin occurred in 1948 and persisted until 1954 (Stevenson and Hatler 1985). In 1956, Game Management Areas were established. No open seasons have existed within the range of the Charlotte Alplands herd since that date (MU 5-6). Within the primary range of the Rainbow herd, short hunting seasons were permitted during the late 1950s that grew to lengthy seasons by the late 1960s. There has been no open season since 1975 (MU 5-10). Within the range of the Itcha-Ilgachuz herd (MU 5-12), there were short seasons during the late 1950s, which grew to long seasons by the late 1960s and then were shortened again to provide modest seasons since the early 1980s.

Caribou are more vulnerable to hunting than any other cervid in North America (Bergerud 1974). Although there is no evidence supporting a single, universal factor causing early caribou declines in British Columbia, indications are that hunting with firearms, added to the ever-present natural factors, particularly predation, triggered the major caribou losses observed during the first four decades of the twentieth century (Spalding 2000). Harvest levels before then are not well documented. Estimates from the mid-1960s until 1977 may not be complete. Between 1978 and 1994 compulsory inspection of

caribou provides reliable estimates of harvest. In 1995 and 1996 only, mail-in reporting of caribou harvest replaced compulsory inspection, which raised concern about inaccurate harvest estimates due to poor compliance. In 1997, compulsory inspection of caribou was reinstated. Based on population estimates, the information suggests that harvest rates of greater than 40 animals a year during the late 1960s and early 1970s were not sustainable and may have contributed to the decline as suggested by Bergerud. Since 1974, the annual harvest rate has been more modest, fluctuating between estimates of 0 and 57 and averaging 27 caribou a year (Figure 3). Recent harvest rates amount to less than two per cent of the Itcha-Ilgachuz herd each year.

Indications are that hunting and predation triggered early 20th century caribou declines

Timber Harvest Management. This section describes roadbuilding and harvesting in the modified-harvest and no-harvest zone prior to, and after, 1996 when these zones were established. It does not include First Nations use of these areas.

In the Quesnel District. Most of the road building in the modified-harvest zone occurred during the period 1980 to 1987. This includes the Michelle Baezaeko Forest Service Road (FSR) from 27 km to 90 km, the Michelle Toil 6500 FSR and Michelle Fire 6400 FSR, the Michelle Kluskus 6800 FSR and the Michelle Canyon Mountain South 4200 FSR.

Nearly all the timber harvesting in this area occurred from 1985 to 1995, prior to the establishment of the modified-harvest. It was logged in the conventional manner, clearcut with reserves. No harvesting has occurred in the no-harvest zone in the Quesnel District to date.

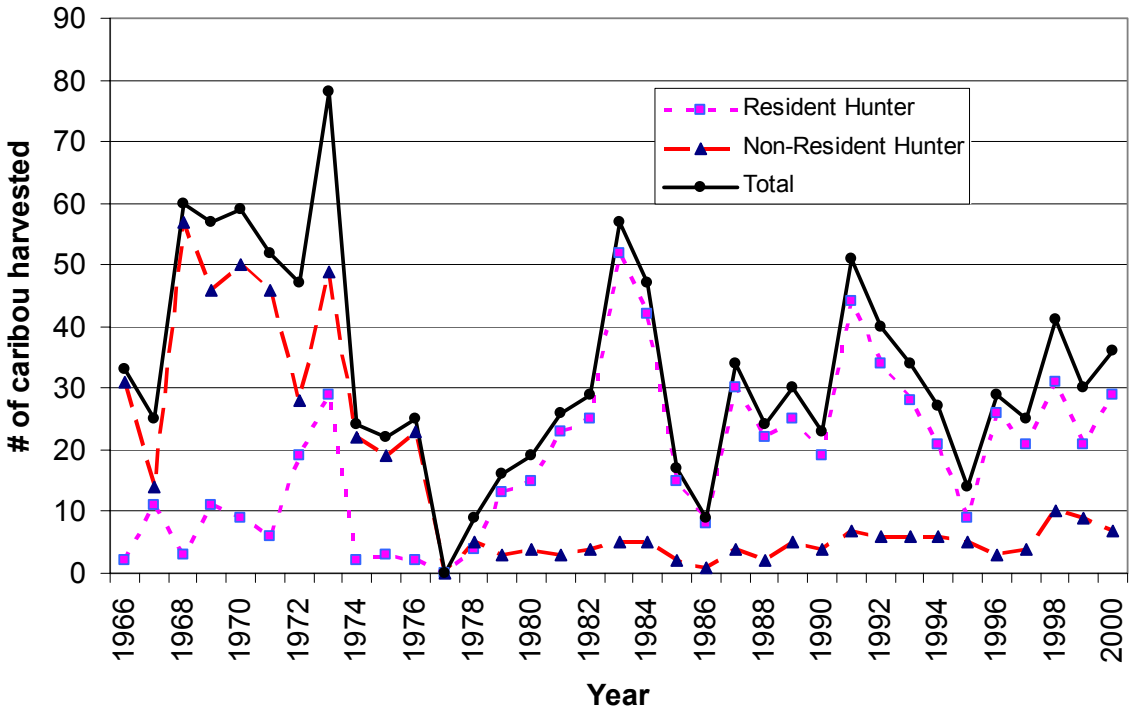

Figure 3. Summary of the annual reported harvest of caribou for the Itcha-Ilgachuz herd within Management Unit 5-12. (Sources for resident harvest, 1966-1977 hunter sample, 1978-1994 and 1997-2000 compulsory inspection and 1995 and 1996 compulsory reporting; source for non-resident harvest 1966-1977 and 1995 and 1996 guide returns and 1978-1994 and 1997-2000 compulsory inspection.)

Based on information supplied by the Ministry of Forests, Quesnel District, the following areas were harvested in the modified-harvest zone prior to 1996:

- SBFEP - 1,630 ha
- Tolko - 883 ha
- Slocan - 1,262 ha
- West Fraser - 104 ha

Recent proposals to harvest modified-harvest zone have not proceeded because harvesting of MPB-attacked timber is the current priority.

In the Chilcotin District. In the eastern part of the modified-harvest and no-harvest zone the main licensee is Riverside Forest Products Ltd. Other licensees that have or continue to operate in this area include SBFEP, Tsi Del Del and Jackpine Forest Products Ltd.

There are two main access roads, the Chezacut Road, most of which was built in the 1980s, and the P-Road-Satah Road built in the early 1990s.

- The Chezacut Road provides access to the east side of Itcha-Ilgatchuz Park. Prior to 1996, there was harvesting along the Chezacut Road in both the modified-harvest and no-harvest zones.
- The harvesting along the P-Road-Satah Road is mostly in the modified-harvest zone.

Harvesting in the eastern part of the modified- harvest and no-harvest zone in 1980-1984 was 200 ha; in 1985-1990 was 2,766 ha; in 1990-1994 was 4,878 ha; in 1995-1999 was 2914 ha; and in 2000-2001 was 415 ha. Over 2,000 ha (approximately 1000 ha of equivalent clearcut) has been harvested under the modified-harvest prescription.

In the western part of the modified-harvest zone, the main licensees are West Chilcotin Forest Products Ltd. (WCFP) and SBFEP. From the mid-1980s to the early 1990s, Carrier Lumber Ltd. operated in this area. There has been harvesting by all three licensees in the Natural-Disturbance-Seral-Distribution zone. To date there has been no harvesting under the modified-harvest prescription for caribou; the current priority is harvesting MPB-attacked timber.

Land Use Planning. Concerted efforts to reconcile forest harvesting with maintenance of caribou habitat began in the early 1990s. A regional steering committee, formed in 1991, established the Western Caribou Working Committee in 1992. The working committee was given the task of assembling pertinent information on both timber and caribou habitat and developing options for management. Membership on the committee included Ministry of Forests (MOF) and the former Ministry of Environment (MOE).

Much of the information on the western caribou herd available at the time was contained in a report prepared by Debbie Cichowski entitled, "Habitat Use, Winter Feeding Ecology and Population Status of Woodland Caribou in West-Central British Columbia." A key aspect of the report was the delineation of the caribou range into 14 zones with a description and ranking of each zone's habitat values.

The committee used this information combined with other radio-telemetry data on caribou distribution, existing TSA agreements, harvest history and harvesting proposals, to confirm relative caribou values by zone and to identify the areas of caribou habitat at least risk from logging. Additional recommendations were also made by the committee regarding salvage of bark-beetle stands within the caribou area.

A "moderate-risk option" was developed by the Western Caribou Working Committee in 1992

A list of management options, including a recommended option, known as the "moderate-risk option" was presented to the steering committee, MOF

region and district managers, and affected licensees. One of the most contentious areas was Zone 9 (Map 5), which included areas around Punkutlaenkut and Moore creeks. The area had been scheduled for logging but contained high-value habitat for caribou.

After meetings between the working committee and the affected licensee, agreements were reached regarding harvesting in the southern portion of the zone, south of Punkutlaenkut Creek. No agreements were reached regarding harvesting north of the creek and in the summary submitted to the steering committee, it was recommended that this issue be referred to the CORE process at the regional level.

At this same time, the Anahim Round Table Concensus Report (1994) identified the need to maintain caribou habitat in part of their planning area: Zone 9 (Punkutlaenkut Lake) and Zone 13 (Upper Corkscrew Creek). Other caribou areas around Charlotte Lake, Kappan Lake and Trumpeter Mountain were also identified as requiring special management. The Upper Dean LRUP recognized the migration corridor between the Rainbow Range and the Ilgachuz Mountains as another zone of special management.

The Dean migration corridor was recognized for special management as early as 1994

Following completion of the initial CCLUP report in 1994 and the 90-day report in 1995, logging was deferred until after 1999 in 56 per cent of the identified Caribou winter range. This included polygon B1, the area north of Punkutlaenkut Creek and west of the Chilcotin River. This deferral was intended to allow completion of research, including a modified-harvest prescription that would integrate logging with maintenance of caribou habitat. Agencies also worked with the affected licensee to find replacement volume for the blocks that had been scheduled in this area.

A new caribou committee was struck at the direction of the 90-day report. The job of the committee was to prepare a caribou strategy based on the moderate-risk option. The deferral area was to be zoned as 65 per cent no-harvest and 35 per cent modified-harvest.

The committee prepared an interim strategy using two different options. Option A achieved the CCLUP targets consistent with each of the individual CCLUP polygon targets within the caribou area. Option B achieved the overall CCLUP targets but did not match each of the individual polygon targets.

Option A was chosen as the preferred interim alternative by the IAMC, which released the report in 1996 (Map 6). Further, IAMC directed that by 2000, some harvest would be permitted in polygon B1 to address licensee-planning commitments in that area.

The caribou committee was directed to delineate an area of modified-harvest necessary to address timber-harvesting commitments for five years, from 2001-2005. Using additional telemetry information, specific polygon targets based on GIS analysis, and stakeholder information, the committee refined modified-harvest areas within the deferral area, addressing the long term as well as the identified five-year period.

The committee produced a strategy update in 1998 and since then has continued work towards the completed strategy. The option A map produced in 1998 (Map 7) has been further reviewed and refined using additional telemetry information, predictive ecological mapping and stakeholder input.

2.4 Caribou Biology and Habitat Management

The initial observation in the 1940s and 1950s that caribou were "wilderness" animals, dependent on large intact blocks of mature forest (Edwards 1954) has been validated with recent scientific studies. The early investigators thought that the loss of arboreal and terrestrial lichens was the primary cause of decline or that human disturbance without major habitat changes

could precipitate the loss of caribou populations (Klein 1982). More direct mortality factors have been identified as the cause in virtually all recent studies (Bergerud et al. 1984; Seip 1992a).

These factors in order of importance have primarily been: 1) predation due to wolves or grizzly bears, 2) poaching or sport hunting, or 3) accidental death, mainly in avalanches. Starvation, which would be expected if loss of forage was the primary cause, is virtually unknown from studies on radio-collared caribou. To minimize loss to these mortality factors requires special habitat management at the landscape level. Although winter habitats for caribou must provide adequate forage, it is also important how the habitat is distributed on the landscape.

An anti-predator strategy of caribou is to space out over very large areas so that it is harder for predators to find them. Caribou populations therefore exist at relatively low densities. If the amount of mature forest that caribou can occupy is decreased, then the density of caribou in the remaining stands will be increased, probably resulting in greater predator efficiency. Predator efficiency may also be increased during winter if roads and snowmobile tracks provide easier travel routes for wolves.

As well, logging, like fire, converts mature forest into early successional stages, creating habitat favoured by moose. An increase in numbers of moose (or other alternate prey) can support a larger predator population and can result in increased predation pressure on caribou. In southeastern British Columbia, predation pressure on caribou was lower in Wells Gray Park, where caribou were spatially separated from moose (the alternative prey), than in the Quesnel Highland, where less spatial separation existed (Seip 1992a). In Ontario, the southern limit of woodland caribou has receded during the last 100 years, coincident with the northern range expansion of white-tailed deer and moose. Wolf predation has been implicated as the major limiting factor of woodland caribou populations in Alaska, the Yukon, western Alberta, and southeastern British Columbia (Gasaway et al. 1983; Farnell and McDonald 1987; Edmonds 1988; Seip 1992a).

Photo 4. A terrestrial-lichen (Cladina) that is a preferred forage species for caribou during winter. Photo by Harold Armleder.

Northern caribou in west-central B.C. feed on both terrestrial and arboreal lichens during winter. As both terrestrial and arboreal lichens are most abundant in mature or old forests, northern caribou are considered an old-growth obligate (dependent) species.

Forests managed under any silvicultural system that eventually eliminates, or substantially reduces, the amount of available forage lichens will not provide winter habitat for caribou.

Available forage lichens are reduced or eliminated through clearcutting

Caribou-habitat-management practices need to provide a continual supply of large, connected areas of suitable summer and winter habitat where there is little or no vehicle access and disturbance**.** Under these conditions, caribou can space out at low densities and avoid predators and poachers (Bergerud and Page 1987; Seip and Cichowski, 1996).

These modified-habitat requirements have been incorporated into caribou guidelines in Ontario,

Manitoba and Alberta, where the forests are most similar to those of west-central B.C. providing caribou with both terrestrial and arboreal lichens in dry pine and spruce stands. As an example, Ontario has adopted the principle of large cutblocks (of up to 10,000 ha) as the primary caribou-habitat-management technique. These blocks are designed to achieve three effects: 1) minimize fragmentation of unharvested or residual habitat, 2) create large areas of habitat for the second rotation, and 3) minimize the quality of moose habitat (OMNR 1994). Large blocks of older forest retain lichen, minimize access and do not create new moose forage that would increase wolf populations.

Based on this knowledge from other studies and provinces, the Caribou Strategy Committee recommends that the modified-harvest that occurs within caribou winter range be aggregated into specific areas.

During the 1980s, extensive areas of important habitat for caribou, identified through the Timber Supply Review process, were deferred from timber harvesting in the short and medium terms. The CCLUP established that 65 per cent of the forest land base within the deferred area, identified as the moderate-risk option by the Western Caribou Working Group, would not be available for timber harvest and that 35 per cent would be available under modified-harvesting practices. The land outside the deferral area, identified for restricted logging, would also require modified-harvesting practices. The deferral was to remain in place until after 1999, with the expectation that the caribou strategy would be completed and produce satisfactory integrated-resource-management solutions.

Modified-harvest dispersed across the caribou range is a poor caribou-habitat-management strategy as it would leave few areas undisturbed and result in maximum access development. Aggregating the modified-harvest into specific areas is a better caribou-habitat-management strategy because this will keep large blocks of caribou habitat intact (undisturbed), thereby minimizing the overall impact on caribou and caribou habitat. Furthermore, this approach allows for a better scientific evaluation of the modified-harvest areas to determine whether suitable habitat for caribou can be maintained.

It is important to emphasize that, based on current knowledge of caribou biology and habitat management, caribou habitat and populations can only be maintained if all three of the following issues are satisfactorily addressed:

Three key aspects for managing caribou are habitat, access and predation

1. maintaining suitable habitat
2. controlling or regulating access
3. managing predation (if necessary)

Strategies for addressing each of these important factors in caribou conservation are presented in this report.

3 Ecology and Research

The terms of reference for developing the Northern Caribou Strategy required the completion of extensive research, inventory and mapping projects to develop integrated caribou-habitat-management strategies. In addition to the caribou and silvicultural systems research and the population and habitat inventory work, research on the ecology of this very unique area has been done over several decades by the MOF Research Section.

3.1 Ecosystems of the Northern Caribou Winter Range in the Itcha-Ilgachuz Mountains

Overview of Biogeoclimatic Subzones. The northern caribou winter range in the Itcha and Ilgachuz mountains occupies portions of three biogeoclimatic zones: Sub-Boreal Pine Spruce (SBPS), Montane Spruce (MS), and Engelmann Spruce Subalpine Fir (ESSF) zones. These zones occur in an elevational sequence in which the SBPS occurs mostly below 1,280 m, the MS extends from about 1,280 m to 1,600 m , and the ESSF is above 1,600 m to the boundary of the alpine tundra at about 2,100 m. The ESSF Zone in this area is within the Itcha-Ilgachuz Provincial Park and is not managed for timber production.

Three subzones of the SBPS Zone (SBPSxc, SBPSdc, SBPSmc) and one subzone of the MS Zone (MSxv) are within the portion of the winter range that will be managed for timber production as well as caribou-habitat values. The ESSF zone within Itcha-Ilgachuz Provincial Park is represented by one subzone (ESSFxv). A schematic representation of the elevational position of these subzones in the Itcha and Ilgachuz mountains area is shown in Figure 4.

The SBPS and MS subzones of the Itcha-Ilgachuz winter range area do not occur extensively outside of the Cariboo Forest Region. Only the SBPSmc extends significantly into the Prince Rupert and Prince George Forest Regions, north from the Itcha and Ilgachuz mountains to about Eutsuk Lake. The SBPSxc, SBPSdc, and MSxv are nearly restricted to the Cariboo Forest Region and have ecosystems very distinct from other subzones of British Columbia. For example, the MSxv is the most distinctive subzone of the MS Zone in British Columbia and lacks many of the common species of other MS subzones (Hope et al. 1991). The abundance of ground-dwelling lichens and the small number of herbaceous plants distinguishes it from other MS as well as Sub-Boreal Spruce (SBS) Zone ecosystems. The SBPSxc is one of the most distinctive ecosystems of British Columbia and has many similarities, both in terms of climate and vegetation, to the dry, cold southwestern Yukon (Pojar 1993). It's dry, low snowfall climate, dominance of the forest floor by lichens rather than mosses and the climax status of lodgepole pine distinguish it from all SBS subzones to the north.

The SBPSxc and MSxv subzones of the Itcha Ilgachuz winter range are unique in BC

Photo 5. An aerial view of the Itcha and Ilgachuz Mountains. Photo by Harold Armleder.

Very Dry, Cold Sub-Boreal Pine Spruce (SBPSxc) Subzone. The SBPSxc Subzone lies south of the Itcha and Ilgachuz mountains on level to gently rolling topography at elevations below 1,300 m. It is entirely within the Cariboo Forest Region. The climate is strongly affected by the Coast Mountains rainshadow, making it the driest subzone of the SBPS (mean annual

precipitation=389 mm, mean annual temperature=1.7°C). Vegetation production, including tree growth, is severely limited by the cold, very dry climate. Lodgepole pine is by far the most common tree species and dominates all upland forests with the exception of scattered small stands of trembling aspen (Steen and Coupé 1997). Spruce is present on moist lower slopes and at the perimeters of wetlands but is very uncommon on drier sites. Due to the history of frequent and extensive natural disturbances (fire and insect attacks) in this subzone, forest canopies of older stands are usually open and lodgepole pine regeneration is often abundant beneath the canopy. Young, dense stands that have regenerated after recent wildfire are also common. Dwarf shrubs, grasses, and lichens dominate the ground vegetation. In contrast to other SBPS subzones, lichens are more abundant than mosses.

Dry, Cold Sub-Boreal Pine Spruce (SBPSdc) Subzone. The SBPSdc Subzone occurs northeast of the Itcha and Ilgachuz mountains, at elevations below about 1,280 m. It occurs on the northeastern edge of the caribou winter range and a very minor area of the subzone extends into the Prince George Forest Region. The intensity of the Coast Mountains rainshadow lessens slightly in this area and precipitation is higher (mean annual precipitation=508 mm) than in the SBPSxc. As a result, tree growth rates are slightly greater and mature forest canopies are more closed. Although lodgepole pine is still by far the principal tree species of upland forests, white spruce is often scattered throughout mature stands. Tree regeneration under mature forest canopies is less abundant than in the SBPSxc and is predominantly lodgepole pine, although scattered white spruce is often present. Dwarf shrubs, grasses, lichens, and feathermosses dominate the ground vegetation.

Moist, Cold Sub-Boreal Pine Spruce (SBPSmc) Subzone. The SBPSmc occurs north and northwest of the Itcha and Ilgachuz mountains to the Eutsuk Lake area at elevations below about 1,250 m, on level to gently rolling topography. Climatically, this area is apparently moister[2] than other parts of the SBPS Zone and has a climate and vegetation that is transitional to the Sub-Boreal Spruce Zone to the north, in the Prince George and Prince Rupert Forest Regions. Although lodgepole pine dominates the upland forests, spruce is more common than in the SBPSxc or the SBPSdc. Mature forest canopies are moderately closed and the ground vegetation is dominated by dwarf shrubs, feathermosses, and lichens. Pine regeneration in mature stands is generally less dense than in the SBPSxc or SBPSdc. In contrast to other parts of the SBPS, grasses are not abundant and moss cover is extensive.

Photo 6. View of Itcha Range from Itcha Flats. Photo by Jim Young

[2] No climatic data are available from the SBPSmc in the Cariboo Forest Region. Climate interpretations are based on vegetation.

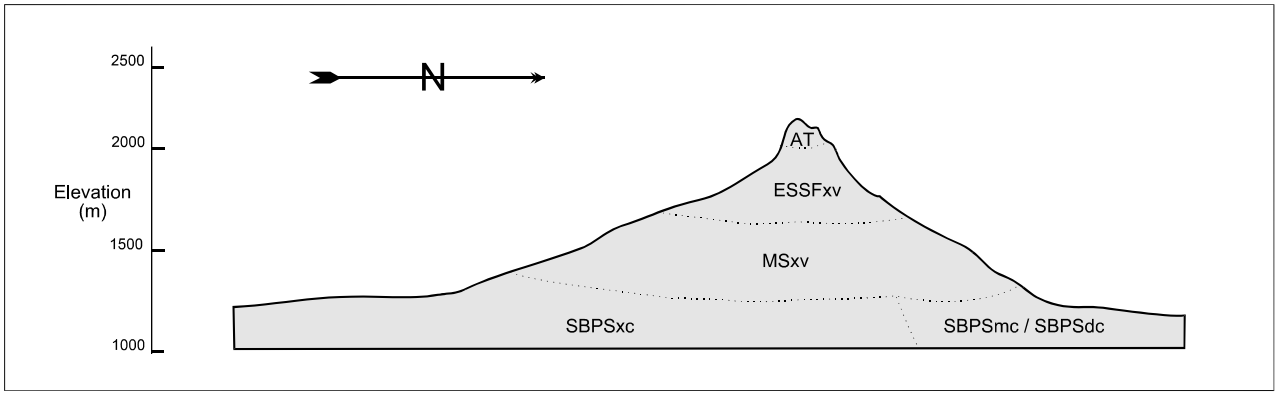

Figure 4. Schematic representation of the distribution of biogeoclimatic subzones in the Itcha-Ilgachuz caribou winter range area. The SBPSdc occurs northeast of the Itcha Mountains while the SBPSmc occurs north and northwest of the Itcha Mountains

Very dry, very cold Montane Spruce (MSxv) Subzone. The MSxv subzone occupies middle-elevation slopes surrounding the Itcha and Igachuz mountains. It extends only very slightly into the Prince Rupert and Vancouver Forest Regions, west of the Ilgachuz Mountains (Coupé and Steen 1998). It occurs above each of the SBPS subzones in this area and below the ESSF, at elevations from about 1,280 to 1,600 m. The climate is very cold but slightly more moist (mean annual precipitation at one station=563 mm) than in the SBPS, resulting in deeper, longer-lying snowpacks. Growing seasons are short and characterized by frequent radiation frost (Steen et al. 1990). Lodgepole pine dominates upland forests although spruce is more common than in the SBPS and is usually scattered throughout both the canopy and regeneration layers of mature stands. Canopy trees tend to be more vigorous, more dense, and taller than in the SBPS. Due to the more closed canopy, few pole-sized stems are present beneath the canopy and stands generally have a more even-sized appearance. Regeneration is predominantly spruce. Dwarf shrubs, feathermosses, lichens, and a small number of low herbaceous plants dominate the ground vegetation. The feathermoss cover is generally thicker and more extensive than in the SBPS.

The MS Zone in the Itcha and Ilgachuz mountains area does not have the same degree of geographic variation as the SBPS Zone. Only one subzone (MSxv) is present within the MS Zone and a comparison of ground vegetation from southern (above SBPSxc) and northern (above SBPSdc or SBPSmc) parts of this subzone demonstrates general similarity in composition and abundance of shrub, herb, and moss species. However, some of the geographic patterns evident in the SBPS are also present, though less pronounced, within the MSxv. For example, observations suggest that tree cover is slightly greater (canopy more closed) and spruce is more frequent on upland sites on the northern than on the southern slopes of the Itcha and Ilgachuz mountains. There is also a slightly greater cover of mosses in mature pine stands on northern slopes. Reconnaissance observations also suggest that dwarf mistletoe is somewhat less common in northern than southern areas. These differences, which probably reflect a slightly moister climate on the north side of the Itcha and Ilgachuz mountains, are most evident at lowest elevations of the MSxv and become less evident with increased elevation. These differences are generally not significant to the selection or evaluation of silviculture systems.

Comparison of Selected Attributes of SBPS and MS Subzones. Some of the key differences between the SBPS and MS subzones in the northern caribou winter range are important to the development and evaluation of silviculture systems for these areas.

Climate. All four subzones are climatically dry, although moisture appears to be most limiting for growth of lodgepole pine in the SBPSxc and least limiting in the MSxv. Dryness, together with cold, limits tree growth and reduces tree vigor. Decreased vigour increases susceptibility to damaging insects and diseases.

All four subzones are climatically cold, with the coldest and shortest growing seasons in the MSxv. Due to low humidity and clear skies, radiation cooling is rapid and growing season frost can occur on any night of the year. In the MSxv, frost has been recorded in a clearcut during more than 50 per cent of the nights during one growing season (Steen et al. 1990). Frost is also common but generally less frequent in the SBPS. Frequent frost and low growing-season temperatures can limit regeneration success, especially of spruce, which is more susceptible to frost than is lodgepole pine. Partial shading, which limits radiation cooling, may reduce frost injury.

The MSxv and SPBSxc are climatically very dry and cold

Damaging Agents of Mature Stands. Significant differences occur among the four subzones in apparent susceptibility of mature stands to damaging agents, especially mountain pine beetle and dwarf mistletoe. Observations suggest that tree mortality rates resulting from endemic levels of mountain pine beetle are greater in the SBPSxc than in the MSxv. The MSxv also contains a greater representation of old (>140 years) stands than the SBPSxc, suggesting a higher probability that stands will survive an epidemic pine beetle attack as well as a wildfire.

The incidence of dwarf mistletoe on lodgepole pine is highest in the SBPSxc and lowest in the MSxv. Within the MSxv, mistletoe has been most commonly observed near the SBPSxc boundary and least commonly observed at middle and upper elevations of the MSxv. Dwarf mistletoe appears to have been less common in the past in the SBPSdc than in the SBPSxc.

Natural Stand Ages. Past wildfires and other stand-replacing disturbances have been frequent in the SBPS and the MSxv. Based on forest inventory, stand-age profiles for relatively unlogged watersheds, mean disturbance intervals are approximately 70 to 100 years in the SBPS and 120 years in the MSxv and 175 years in the ESSFxv, which occurs above the MSxv. As a result, landscapes of both the SBPS and MSxv contain a high proportion of young (<80 years) stands. However, the presence of stands much older than the mean disturbance interval indicates that stands can survive for much longer periods if they escape fire and bark beetle epidemics. Although, few stands more than 175 years old have been observed in the SBPSxc, pine stands more than 250 years old have frequently been noted in the MSxv. Lodgepole pine stands more than 500 years old have been noted in Tweedsmuir Park, adjacent to the Itcha-Ilgachuz winter range. The greater frequency of stands > 200 years old in the MSxv than in the SBPSxc may be due to the reduced susceptibility of pine to bark beetle induced mortality.

Pine stands more than 250 years old have been frequently observed in the MSxv

Mature Stand Structure. As noted above, mature stands in the SBPSxc have a more open forest canopy and a higher density of tree regeneration than stands in the SBPSdc, SBPSmc, or MSxv. The MSxv generally has the greatest canopy closure and the lowest density of regeneration within mature stands. As a result, small natural or artificially created openings in the MSxv are generally more shaded than those in the SBPSxc. Stands within the MSxv also tend to be more uniform, both vertically and horizontally than those in

the SBPS. The relatively open stands of the SBPS, and especially the SBPSxc, are due to several factors, including a higher endemic level of damaging agents, slower growth, and lower tree vigour.

Forest Regeneration. Lodgepole pine regeneration is common in mature stands in the SBPS. In the SBPSxc, regeneration is scattered throughout stands and is often relatively dense beneath small (<0.1 ha) natural canopy openings. In the SBPSdc and SBPSmc, pine regeneration is generally less abundant than in the SBPSxc but quickly establishes beneath small, natural openings in the canopy. Pine regeneration is nearly absent beneath a mature forest canopy in the MSxv but quickly establishes beneath small canopy gaps, although densities are generally smaller than in the SBPS.

Lodgepole pine is the principal species of natural regeneration on logged and other disturbed areas in both the SBPS and MS subzones. Spruce regeneration is common in the MSxv and is often present, although much less common, in the SBPSdc and SBPSmc where soils are generally drier. Natural spruce regeneration is nearly absent from the SBPSxc on all but moist and wet sites such as at the perimeter of wetlands.

The density and survival of lodgepole pine and spruce regeneration can be limited by growing season frost and low temperatures, especially in the MSxv. Spruce is more susceptible than lodgepole pine to growing season frosts. Partial shade, as in a partially harvested area, can reduce the frequency and intensity of radiation frosts.

3.2 Mountain Pine Bark Beetle

The mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins (Coleoptera: Scolytidae) is widely considered to be the most damaging of all the insects that attack lodgepole pine in western Canada. The insect is a small, cylindrical-shaped bark beetle that kills mature trees by boring through the bark, mining the phloem -- the layer between the bark and the cambium or inner wood of a tree -- and interrupting the flow of nutrients up the tree stem. The MPB thrives in forests of mature lodgepole pine, and in the past two decades has widely infested British Columbia's Cariboo Forest Region.

Due to abundant host material and a series of mild winters that have failed to kill off the MPB larvae, the current infestation has spread rapidly. Over the past ten years it has reached epidemic proportions in the Quesnel Forest District and in parts of the Williams Lake timber supply area (which includes the Chilcotin, Williams Lake and Horsefly Forest Districts).

The mapping of MPB attacks in stands of predominantly lodgepole pine is usually carried out to show the three stages of advancement.

green-attack in the first year, the insect migrates to and establishes `brood trees' (where larvae will later mature into adults and eventually spread again to surrounding trees) - this stage is hard to identify visually from a distance

red-attack in the next year, beginning in spring, the attacked trees are obviously dying and clearly identifiable from the air

grey-attack in subsequent years, the trees are standing dead without needles

MSxv forest stands may be less susceptible to MPB infestation

The current mountain pine beetle infestation in the Cariboo Forest Region is impacting some habitat utilized by the northern caribou herds. Infestation levels are minor south and southeast of the Itcha-Ilgachuz range. Directly north of this mountain range, infestations are numerous but currently do not cover a significant land base. Along the Blackwater River, in Tweedsmuir Park, and in the area known as the Dean River Corridor between the

Rainbow Mountain and Itcha-Ilgachuz ranges, infestations are heavy with widespread lodgepole pine mortality. In cooperation with West Chilcotin Forest Products, control efforts in the western portion of the Chilcotin Forest District are concentrated in the Dean River Corridor to protect timber adjacent to Tweedmuir Park and the western Itcha Ilgachuz. Control efforts are focused in the corridor in an attempt to block the beetle expanding further into the Chilcotin Forest District. Bark beetle winter mortality during 2001 in the Chilcotin Forest District was very low (14 per cent) and mountain pine beetle population expansion is projected to continue at a high rate.

The current attempt to control the damage done by the beetle is through maximizing the number of green-attack trees harvested. This is achieved primarily through a clearcut silvicultural system, as well as group- and single-tree removal and the falling and burning of infested trees.

For the current epidemic level of infestation in much of the northern portion of the region, clearcutting green attack trees is the only option that may slow its rate of spread. However, eliminating the infestation could only be achieved by a population collapse, either from very cold weather or from complete infestation of all susceptible host trees.

Specific recommendations for addressing the MPB problem in the Northern Caribou range are described later in this document.

3.3 Northern Caribou Seasonal Patterns of Habitat Use

Two radio-telemetry studies have significantly improved our understanding of habitat-use patterns of western caribou (Cichowski 1993, Young and Freeman, *in prep*). Cichowski's study in the Itcha-Ilgachuz and Rainbow Mountains from 1985 to 1988 included 1,464 relocations from 27 animals. Beginning in 1995 and continuing until 2000, the latest telemetry study undertaken by MELP reported 3,959 relocation points from 40 animals fitted with VHF collars and over 13,000 GPS relocation points from 6 caribou fitted with GPS collars between December of 1998 and August of 2000. Until recently, little effort was directed towards monitoring caribou resident to the Charlotte Alplands, although three caribou were periodically monitored for a short period in the late 1990s.

Two major radio-telemetry studies of these caribou have been completed

Photo 7. Releasing a caribou fitted with a radio-collar for monitoring. Photo by Jim Young.

Herds have been identified based on the location of their calving areas. Two basic winter habitat use strategies have been identified for each herd through the use of radio-telemetry; either wintering in the alpine on windswept ridges or in forested habitats at lower elevation. As animals from the Itcha-Ilgachuz, Rainbow and Charlotte Alplands herds occasionally share common winter range they are considered to be of the same population. The caribou that calve in the Rainbow Range, winter either in the alpine habitats of the Rainbow or Ilgachuz Mountains or in low elevation pine stands along the Dean River in the vicinity of Anahim Lake. The caribou that calve in the Itcha Range and Ilgachuz Range, winter in the alpine areas of the Itcha-Ilgachuz Mountains or in mid-elevation pine stands north, east and south of the Itcha

Mountains. The caribou that calve in the Charlotte Alplands, winter on windswept alpine areas or in pine stands between the Alplands and the Itcha-Ilgachuz Mountains.

Monitoring of radio-collared animals has confirmed that there is some mixing between each herd. Three animals have switched calving grounds between the Rainbow and Itcha-Ilgachuz herds and one animal from the Charlotte Alplands calved in the Ilgachuz and then returned to the Alplands area later the same summer. It should be noted that although there are similarities in habitat use, variations in terrain and snow conditions result in different strategies between individuals, herds and years.

Itcha-Ilgachuz Herd Winter Forest Dwelling. During calving in June, and through July, radio-collared female caribou use primarily high-elevation alpine or subalpine habitat in the Itcha and Ilgachuz Mountains with the majority of relocations occurring above 1,800 m. In August, some caribou disperse, shifting to forested habitats adjacent to the mountains. Movements between the Itcha and Ilgachuz Mountains occur throughout the summer (Map 2 and Figure 5).

In September and during the rut in October female caribou again shift to high-elevation habitats in both the alpine and subalpine with the majority of relocations above 1,600 m. By November, the majority of caribou generally begin moving to large fescue-lichen meadows and pine forests east of the Itcha Mountains. Snow conditions appear to influence the length of time caribou remain in meadow areas before selecting forested habitats for the remainder of the winter.

From December until into April, radio-collared caribou are usually found in pine forests north, east and south of the Itcha Mountains. Mature (81-140 years) and old pine stands (141+ years) are preferred and used in about equal proportions. Winter use is predominately within the Montane Spruce biogeoclimatic zone between 1,200 and 1,600 m elevation (Figure 6). Snow conditions appear to influence winter use at both the landscape and stand level. Caribou appear to seek out areas with low-snow depths within their winter range. As winter progresses and snow becomes deeper and more crusted, there is usually a shift from drier forests containing an abundance of terrestrial lichens to wetter forests where arboreal lichens are more common. Fecal-fragment analysis suggests that caribou consume both terrestrial and arboreal lichens in about equal proportions (Figure 7).

Diet analysis has shown that caribou use both terrestrial and arboreal lichens

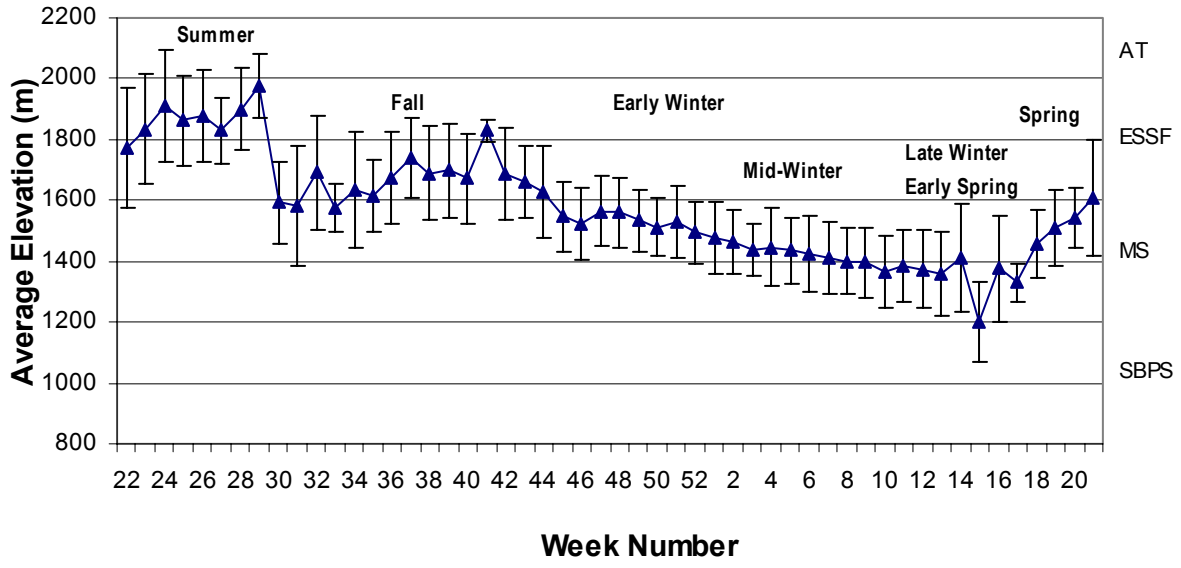

Figure 5. Mean elevation (+/- 1 standard deviation) of winter forest-dwelling, radio-collared caribou locations by week for the Itcha-Ilgachuz Mountains herd.

Photo 8. Craters left in snow by caribou foraging for terrestrial lichens in old, open pine stand. Photo by Jim Young

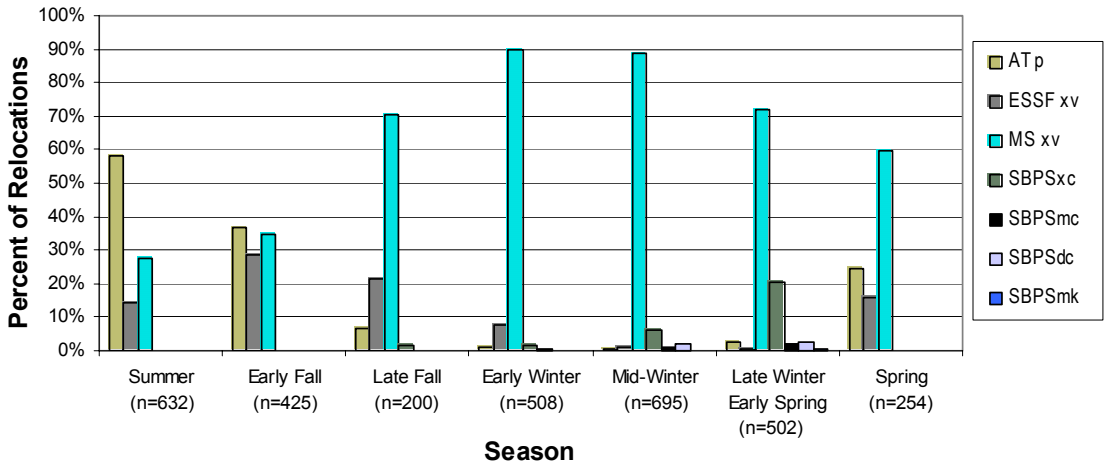

Figure 6. Percentage of winter forest-dwelling, radio-collared caribou within each biogeoclimatic sub-zone, by season, for the Itcha-Ilgachuz Mountains herd.

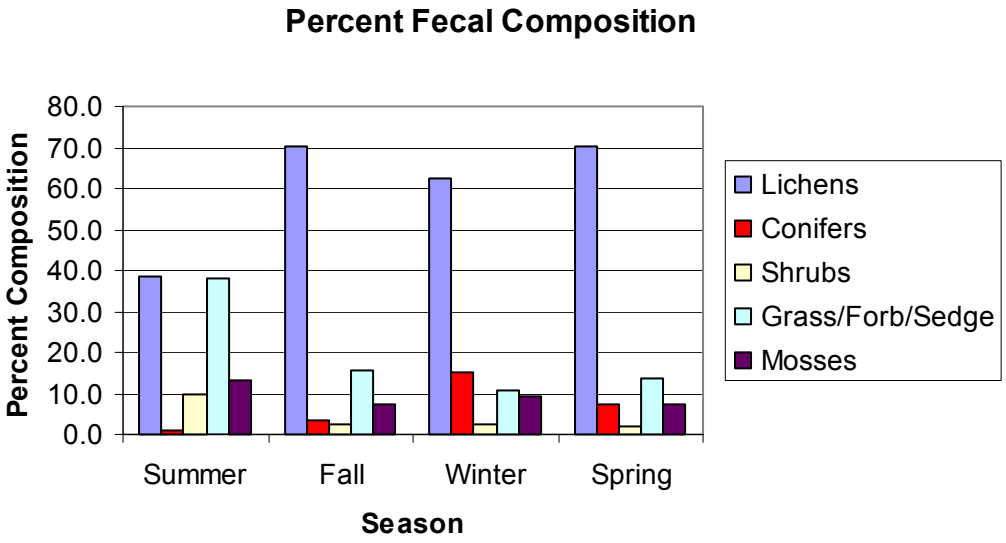

Figure 7. Percentage of vegetation types found in caribou-fecal samples collected in the Itcha-Ilgachuz Mountains area; summer: June to August, fall: September to November, winter: December to April and spring: May.

The month of April is often a period of transition from late winter to early spring. During this month, Itcha-Ilgachuz caribou are found at their lowest elevations of the year where the largest use of recently logged areas is observed. Snow conditions appear to influence habitat use as caribou seek out areas with minimal snow cover. In May, the majority of adult female caribou migrate towards the alpine calving grounds following the receding snowline.

Rainbow Herd Winter Forest Dwelling. From calving in June through to following the rut in October, adult female caribou almost exclusively use high-elevation alpine and sub-alpine habitats within the Rainbow

Range, with the majority of observations above 1,800 m throughout this period. During the rut, many caribou concentrate in the alpine on the north and northwest side of the Rainbow Mountains. November is usually a transitional month with caribou leaving the alpine habitats of the north side of the Rainbow Range and moving to lower elevations along the Dean River in the vicinity of Anahim Lake (Map 3).

From December through to March, Rainbow Herd radio-collared caribou are usually found at low elevations (<1,200 metres) within the Sub-Boreal Pine Spruce biogeoclimatic zone. Here they utilize mature (81-140 years) and old (>140 years) pine and pine/spruce forests. Old forests are used slightly more than mature stands.

During late winter and spring, there has been an observed marked increase in use of recently logged areas. Although these areas contain minimal terrestrial or arboreal lichens, they do provide long sight distances to detect predators and are usually adjacent to valuable winter forest habitat. From March to May a substantial number of relocations have occurred in these open habitats where minimal crown closure allows for early snowmelt compared to adjacent forested sites.

Rainbow and Itcha-Ilgachuz Herds Winter Alpine Dwelling. In some winters, the Rainbow herd and a portion of the Itcha-Ilgachuz herd remain at high elevation (1,800 – 2,000 m) where they are found on windswept slopes in the alpine. Highest observed use was in the Rainbow and Ilgachuz Mountains by the Rainbow herd. Cichowski (1993) observed a shift into lower-elevation pine forests north of the Ilgachuz during mid-winter by animals wintering on the Ilgachuz Range. It is not clear what environmental conditions trigger use of these higher-elevation winter habitats as compared to the lower-elevation forested habitats.

Some years the caribou from the Rainbow Mountains herd migrate from their summer range in Tweedsmuir Park to the north side of the Ilgachuz Mountains to winter. Most movement is from the north side of the Rainbow Mountains to the north side of the Ilgachuz Mountains or vice versa (see Map 8). This migration occurs in both spring and fall and although radio-telemetry data is incomplete, it appears that when the animals decide to move, it happens quickly, in a matter of one to a few days.

3.4 Habitat Suitability Index Modelling

Multi-scale habitat modelling for northern caribou, utilizing telemetry data from over 70 animals and over 6,000 radio-telemetry relocations, was completed in 2001 (Apps, Kinley and Young 2001). This project utilized data from radio-telemetry studies undertaken in the mid-1980s (Cichowski 1993) and late 1990s (Young and Freeman, *in prep*) to develop predictive multivariate habitat models. Model habitat variables were selected from forest cover, terrain, baseline thematic mapping and Landsat image attributes. Selection was analyzed at three spatial scales from a broad or landscape level to a fine or stand level of analysis and for two broad seasons (winter and summer).

Through cluster analysis, in conjunction with sample-size considerations and knowledge of seasonal movements of animals from each herd, data was pooled into five main groups: Itcha-Ilgachuz herd summer, Rainbow herd summer, Itcha-Ilgachuz herd winter forest-dwelling, Rainbow herd winter forest-dwelling, and Itcha-Ilgachuz/Rainbow herds winter alpine-dwelling. During summer both the Itcha-Ilgachuz and Rainbow herds were associated with high elevation, dry, alpine landscapes of little vegetative productivity or understorey cover. During winter, alpine-dwelling animals from both herds were associated with high elevation, dry landscapes with little forest cover and low productivity. Winter habitat selection by forest-dwelling caribou included broad landscapes of closed-canopy, lodgepole pine overstorey and higher site productivity at lower elevations. At a broad scale, both herds utilized old

forests to a similar degree but Itcha-Ilgachuz caribou exhibited associations that were strongly positive for old forests and strongly negative for young forests, while Rainbow animals did not show a strong preference for old forest and apparently preferred young forests. The latter result was likely due to the extensive recent logging that has occurred within the winter range of Rainbow caribou resulting in cutblocks occurring in the immediate proximity of winter foraging areas.

Maps 2 through 4 summarize important northern caribou habitat for each herd, season and wintering strategy generated from these habitat models.

3.5 Silvicultural Systems Research

Specific research designed to find ways of maintaining habitat in managed forests within northern caribou range has been ongoing in the Cariboo Forest Region since 1994. A pilot trial of partial-cutting, designed to continuously maintain terrestrial lichen, occurred in the late winter of 1995. This trial was followed by a comprehensive, replicated-research trial of an irregular group-shelterwood and a group-selection system in the mid-to-late winter of 1996. Many things are being studied on this trial including: natural and planted regeneration, windthrow, lichens, and breeding bird response.

Two adaptive management trials were harvested in the winters of 1997-2000. Each of these trials involve more than 600 ha cutblocks. This phase provides information on the use of large partially logged areas by caribou and allows a better assessment of operational issues.

This research has been documented in various reports (Armleder and Waterhouse 1994, 1996; Miège et al. 2001a, 2001b; Waterhouse et al. 2001). Several other reports are in preparation or are being planned.

Photo 9. Planted pine growing well in opering within irregular group shelterwood prescription (6 years after planting). Photo by Harold Armleder.

Major results of the research conducted in the region, based on fifth year results include:

- very high survival of lodgepole pine and spruce in the partial cuts
- planted-pine-seedling performance in openings approximately 30 m diameter is adequate and should meet current free-growing standards
- long-term yield modelled in the CCLUP Integration Report can be achieved
- spruce survival is better in the partial cuts than in clearcuts
- lichen biomass is reduced by partial cutting but to levels probably still usable by caribou

- windthrow has not been a problem with the treatments tested

The recommended silvicultural systems are viable options for maintaining caribou habitat and harvesting timber

- breeding-bird diversity and abundance is maintained by the treatments although some shift in habitat use within treatments does occur with some species
- the need for continued monitoring of the replicated and adaptive-management trials is highlighted

Overall, the recommended silvicultural systems are viable options for both maintaining caribou habitat and harvesting timber at the level modelled in the CCLUP integration report.

The Itcha-Ilgachuz and Rainbow herds occupy unique biogeoclimatic subzones (MSxv and SBPSxc) not found elsewhere in British Columbia. Therefore, other research on silvicultural systems for northern caribou has limited applicability to the Cariboo Forest Region.

4 Habitat Strategy

4.1 CCLUP Targets for Northern Caribou

CCLUP targets for northern caribou by subunit were indicated in the 1996 Caribou Strategy Report, though the report also identified a need to better define the area-based targets for northern caribou. A thorough review of boundaries, GIS calculations of productive-forest landbase, and direction received from the IAMC (see Appendix 2), clarification of the targets resulted in the modified-harvest and no-harvest targets indicated in Table 2 and outlined in the 1998 update. IAMC direction to the committee on targets can be summarized as follows:

- The basis for the northern caribou target is the moderate-risk option identified by the Western Caribou Working Group and as modified by the CCLUP and the integration report. The map titled "Itcha-Ilgachuz Approved Integrated Management Areas" and dated June 8, 1995 defines the boundaries of the moderate-risk option.
- Within the moderate-risk option mentioned above, areas for deferral and modified harvest were identified. Of the area initially proposed for deferral, 65 per cent of the forest landbase has been assumed to be not available for harvesting while 35 per cent is assumed to be available under more sensitive harvesting practices. In addition, the modified-harvest area, identified by the moderate-risk option, which was outside the deferral area, is maintained.
- Adjustments or refinements to the no-harvest and modified-harvest areas within and between CCLUP sub-units are possible as long the adjustments do not adversely affect the meeting of other CCLUP targets.

Rainbow Herd Low Elevation Winter Range. Radio-telemetry data collected during the 1990's showed that caribou from the Rainbow Mountains herd not only wintered in alpine habitats but during some years, wintered in low elevation forests in the vicinity of Anahim Lake. Although there is a limited amount of CCLUP target allocated to caribou, efforts were initiated to provide some level of protection to the habitat values in the area. As the wintering area is primarily within the Sub-boreal Pine Spruce biogeoclimatic zone which is more prone to pine beetle and mistletoe than the Montane Spruce zone, an alternative silvicultural system was considered rather than the approach endorsed for the caribou modified-harvest area.

Maintaining the natural seral distribution of older forest age classes was considered beneficial as the approach would allow for some stands to grow to an age that would allow terrestrial lichens to become established and provide foraging opportunities for caribou. As a result portions of the Sub-boreal Pine Spruce BEC zone within priority Landscape Units were identified for special management. However, the amount of productive forest land that could be managed in this way was considered limited by the amount of caribou target present within the ART SRP at the time that it was finalized. As a result a detailed analysis was undertaken to insure adjustments to the no-harvest and modified-harvest areas and creation of the natural-seral-distribution-polygon balanced with previously established caribou targets within the ART SRP.

GIS Analysis Criteria. The calculated productive forest land estimates for this analysis utilized a newer version of forest-cover mapping and line-work than previous analyses. The inventory files were accurate to January 1, 1999. Also the most recent line-work outlining the boundaries for Parks and Protected Areas was utilized as it was more accurate. When more than one line was available to delineate boundaries, they were considered in the following

Table 2. Summary of Approved CCLUP Targets by Subunit (Areas in Hectares of Productive Forest Land)

CCLUP Subunit	Total Deferral Area	35% Modified Harvest	65% No Harvest	Modified Harvest Outside Deferral Area	Total Modified-Harvest Area
Baezaeko E-1	33,209	11,623	21,586	10,815	22,438
Kluskus I-A	1,427	486	903	391	877
Anahim Lake I-B	0	0	0	2,270	2,270
Chezacut I-C	0	0	0	48,541	48,541
Itcha-Ilgachuz S-F	101,400	35,490	65,910	90,701	126,191
U. Blackwater S-P	6,067	2,123	3,944	0	2,123
Total	**142,103**	**49,722**	**92,343**	**152,718**	**202,440**

priority: protected area line-work, MOF District boundaries line-work, and lastly, ownership boundaries line-work. This resulted in the delineation of a few hectares of productive forest land outside the newer boundaries but inside the original CCLUP protected area boundaries. In addition, updated MOF District files from February 2000 were incorporated into the analysis. These adjustments were made to develop the most accurate analysis possible, while insuring the approved targets were being met.

Boundaries of no-harvest, modified-harvest and natural-disturbance-seral-distribution areas were digitized at a scale of 1:20,000.

4.2 Criteria for Delineating Caribou Habitat Areas

Itcha-Ilgachuz Herd Winter Forest-Dwelling Animals. At the landscape level no-harvest areas were selected based on the following criteria:

- areas of moderate or high caribou use (from radio-telemetry studies)
- areas of moderate to high suitability (from recently developed habitat suitability mapping)
- relatively large areas instead of small areas (i.e., large, contiguous areas of suitable habitat)
- proximity to Itcha-Ilgachuz Provincial Park
- areas with limited road development

At the landscape level, the identification of modified-harvest areas for Northern Caribou utilized similar criteria as outlined in the interim 1996 caribou strategy report as follows:

- areas of lower use were identified instead of areas of high use (from radio-telemetry studies)
- areas of lower present suitability instead of areas of high suitability (based on biophysical capability mapping)
- relatively large areas were identified instead of small areas
- more peripheral areas instead of central areas that provide connectivity between winter range

Rainbow Herd Winter Forest-Dwelling Animals. At the landscape level, the identification of the natural-disturbance-seral-distribution area was selected based on the following criteria:

- areas of moderate or high caribou use (from radio-telemetry studies)
- areas of moderate to high suitability (from recently developed habitat suitability mapping)
- areas within the Sub-boreal Pine Spruce biogeoclimatic zone

Detailed ecosystem mapping was not yet completed for the area and therefore was not utilized during this review. However, the habitat suitability index mapping developed by Apps et al (2001) was central to the refinement of no-harvest and modified-harvest areas and the creation of natural-disturbance-seral-distribution areas. The line-work from the 1998 Caribou Strategy Update was refined utilizing the following criteria:

Itcha-Ilgachuz Herd Winter Forest-Dwelling Animals.

- The seasonal-habitat, suitability-index-model maps (winter forest dwelling, winter alpine dwelling and summer) developed by Apps et al (2001) from local radio-telemetry data for this general area.
- Input from the forest industry and the conservation sector that was considered neutral or beneficial for caribou.
- For winter forest-dwelling animals from the Itcha-Ilgachuz herd generally valuable habitat within the Montane Spruce biogeoclimatic zone was given priority over similar valued habitat within the Sub-boreal Pine Spruce biogeoclimatic zone due to lower risk to pine beetle attack and mistletoe infestation.
- Where existing or approved logging occurs near the edge of valuable northern caribou habitat, the upper edge of these openings has been utilized to delineate the upper limit of conventional harvest.
- Where the present suitability of an area near the edge of valuable habitat was identified as low, but the area is expected to have high capability in the long term, the outer edge of the area was used to delineate the upper limit of conventional harvest.

Rainbow Herd Winter Forest-Dwelling Animals.

- For winter forest-dwelling animals from the Rainbow herd, habitat within the Sub-boreal Pine Spruce biogeoclimatic zone was given priority over similar value habitat within the Montane Spruce zone.

4.3 Recommended Location of Northern Caribou Target

Map 9 depicts the distribution of northern caribou target as recommended by the committee. The sum of no-harvest, modified-harvest and natural-disturbance-seral-distribution areas identified in Map 9 meet the overall area-based targets for Northern Caribou but not specific sub-unit targets as outlined in Table 3.

Overall area-based targets for northern caribou are balanced

The total area of identified no-harvest and modified-harvest within Table 3 is less than the approved targets as 1,491 hectares of no-harvest and 21,267 hectares of modified-harvest was utilized to create the natural-disturbance-seral-distribution area (Section 5.1) within the boundaries of the Anahim Round Table SRP. The caribou target to create this new area was located primarily within the migration corridor between the Rainbow and Ilgachuz Mountains. This new polygon

overlaps the Anahim Lake and Itcha-Ilgachuz CCLUP sub-units. Combined with previously existing constraints to timber access, this shift in target insures that of the 50,250 hectares of productive forest land within the polygon, 45 percent (22,613 ha) will have stands greater than 80 years of age, 30 percent (15,075 ha) will have stands greater than 120 years of age and 25 percent (12,562 ha) will have stands greater than 140 years of age at all times.

Refinement of the locations of caribou modified-harvest areas in 2002 may have resulted in previously approved cut-blocks being located within areas now delineated as modified-harvest. Where this occurs previous approvals will be honoured. Where licensees have flexibility and are able to adapt silvicultural practices on these blocks to match the modified-harvest approaches of the Northern Caribou Strategy (refer to Section 5), this would be appreciated and best meet the spirit and intent of the strategy.

4.4 Rationale for Changes to Strategy

The modified-harvest, no-harvest and natural-disturbance-seral-distribution areas were selected to best maintain caribou values while taking into account stakeholder values and making the best use of overlap opportunities to better meet all CCLUP targets, as directed by the committee terms of reference (see Appendix 1). The rationale for the various changes by sub-unit is summarized as follows:

Anahim Lake Sub-Unit. In 1998, some modified-harvest target (about 15,000 ha) was shifted from low-elevation habitat within the Chezacut sub-unit to the headwaters of Holtry Creek within the Anahim sub-unit in order to address risk to pine beetle infestation and mistletoe issues in the SBPS zone, and to account for recent caribou telemetry information within the MS zone. Although this adjustment was intended to be a neutral change for maintaining caribou habitat values,

Table 3. Recommended Northern Caribou Strategy Area Summaries by Sub-Unit (areas in hectares of productive forest land)[3].

	Modified-Harvest		No-Harvest	
CCLUP Sub-unit	**Target**	**Actual**	**Target**	**Actual**
Baezaeko E-1	22,438	29,498	21,586	2,691
Kluskus I-A	877	9,336	903	0
Anahim Lake I-B	2,270	15,307	0	0
Chezacut I-C	48,541	34,599	0	1,497
Itcha-Ilgachuz S-F	126,191	92,434	65,910	86,665
U. Blackwater S-P	2,123	0	3,944	0
TOTAL	**202,440**	**181,174**	**92,343**	**90,853**

[3] Refer to Section 4.3 for an explanation of where the remaining target was used to create the Natural-Disturbance-Seral-Distribution polygon.

there is an associated risk that the areas where the modified-harvest target has been shifted to is in a higher snowfall area (in MS zone) and therefore may be less able to support caribou during hard winters.

For 2002, adjustments involved:

- refining boundaries to follow natural features and
- establishment of the natural-disturbance-seral-distribution polygon.

Baezaeko Sub-Unit. In 1998, some of the no-harvest target was shifted from the Baezaeko sub-unit to the Itcha/Ilgachuz sub-unit with a subsequent increase in modified-harvest area. This shift resulted in the no-harvest target being more central to the caribou winter range rather than peripheral and placed it outside the original deferral area. Both stakeholder groups had suggested this change and it had a neutral effect for caribou.

For 2002, most adjustments involved refinement of boundaries to follow natural features or used the results of the habitat suitability modelling. The no-harvest area north of North Hill was reduced in size by following a watercourse, and the modified-harvest areas east of Toil Mountain and between the Baezaeko River and Narcosli Lake were converted to conventional-harvest as they had low suitability and are peripheral to the caribou winter range.

Chezacut Sub-Unit. As noted above, in 1998, some modified-harvest target (about 15,000 ha) was shifted from low-elevation habitat within the Chezacut sub-unit to the Anahim sub-unit, in order to address mistletoe issues in the SBPS zone and risk to pine beetle infestation. This shift takes into account recent caribou telemetry information. Additional modified-harvest target was also moved within the sub-unit from low-elevation SBPS zone habitat to the MS zone within the headwaters of Jorgensen and Knoll creeks.

For 2002, most adjustments were to align boundaries to follow natural features or were based on the results of the habitat suitability modelling.

Itcha-Ilgachuz Sub-Unit. In 1998, due to first-pass harvesting in the Baldface Mountain area, it was recommended that the area be changed from no-harvest as indicated in the 1996 Caribou Strategy Report to modified-harvest as that area was fragmented by logging. Due to higher-level direction that identified a commitment to allow timber harvest in Polygon B1 beginning in 2000, the committee also shifted some no-harvest out of Polygon B1 to south of Punkutleankut Creek (outside of the historic deferral area). The new area of no-harvest is an area of high caribou use based on radio-telemetry information. The shift was favoured by the licensees.

For 2002, further refinement of the line-work in the upper Chilcotin River occurred. Based on long-term capability of the area, the portion of modified-harvest between Itcha-Ilgachuz Park and Moore Creek Meadow was converted back to no-harvest with an expanded area of modified harvest to the east of the no-harvest. Several other line adjustments were made to expand the amount of modified-harvest within the MS zone of this sub-unit. Other adjustments included refining boundaries to follow natural features or using the results of the habitat suitability modelling. Finally, the modified-harvest area within the Dean River corridor between the Rainbow and Ilgachuz mountains was converted to natural-disturbance-seral-distribution in portions of the SBPS zone near Anahim and Nimpo Lakes.

Kluskus Sub-Unit. Due to low use and the present low suitability at the western end of this sub-unit, all the important habitat in the moderate risk option was identified as modified-harvest in 1998 even though a portion of the area was originally to contain no-harvest area.

For 2002, the modified-harvest area was shifted from the west end of the sub-unit to an area of higher suitability, west of Bishop Bluff within the MS zone.

Upper Blackwater Sub-Unit. The 1998 clarification of CCLUP targets by the IAMC confirmed that there was to be a 35 per cent modified-harvest target in this CCLUP subunit. Previously, in 1996, there was only no-harvest caribou target in this subunit. The same criteria as used in 1996 were utilized to locate the 35 per cent modified harvest.

For 2002, all available caribou target was removed from the Upper Blackwater sub-unit in order to accommodate the shifting of no-harvest target into upper Pan Creek adjacent to Itcha-Ilgachuz Park and modified-harvest target into the Montane Spruce zone north of the Coglistiko River.

5 Timber Harvest Strategy

Historically, as fires burned part of the caribou range, the caribou merely used other areas that had recovered. This strategy worked because the range was so extensive. However, the range of northern caribou in the west Chilcotin has shrunk from its historical extent due to past harvesting, access issues, private land and other development. There is no longer the option of managing all of the range with the natural disturbance pattern so the area remaining must be maintained as habitat continuously. The recommendations for a timber harvest strategy represent a balanced approach that recognises both the development history and ecological realities of the northern caribou range.

The current range of the northern caribou in the west Chilcotin has been well defined by years of radio-telemetry data (Maps 2, 3, 4 and 10). The range these caribou occupy covers about 1,500,000 ha (or 15,000 km^2) including the area of parks, no harvest, modified harvest, and conventional harvest. Given this setting, there should be a fourfold approach for managing the habitat of the northern caribou in the region.

Conventional-Harvest	**52%**
Modified-Harvest	**13%**
Natural-Seral-Distribution	**4%**
No Harvest	**6%**
Park	**25%**

1) **Park and No-Harvest Areas (31 percent of the caribou range).** These areas provide a core habitat that will have little or no road access (some salvage harvesting in no harvest may be permitted as per the CCLUP Integration Report). The Itcha-Ilgachuz and Tweedsmuir parks will protect calving habitat and the surrounding no-harvest areas will maintain a significant part of the winter habitat. These areas provide caribou with suitable space (habitat) in which to meet their needs, and also a large area relatively free of harvest and harassment by humans (provided the use of snowmobiles and ATVs, and other activities are adequately controlled). Because logging will not create more early-seral habitat, moose and deer habitat will not be enhanced, which will help protect caribou from additional predation pressures caused by increased wolf numbers.

2) **Modified-harvest areas (13 percent of the caribou range).** These areas will be managed to maintain caribou habitat continuously through time and space. All recommendations are fully compatible with the impacts modelled in the Cariboo-Chilcotin Land Use Plan Integration Report (1998). Harvesting approaches will also discourage the enhancement of moose and deer habitat as increases in these ungulates can lead to more wolves and greater predation on caribou. Stringent access control measures will be necessary.

3) **SBPS Natural-Disturbance-Seral-Distribution (NDSD) Zone (4 percent of the caribou range).** The SBPS zone contains valuable winter range for caribou but maintaining it presents unique challenges. The pine in this zone is highly susceptible to mountain pine beetle (MPB). This ecological reality means that partial cutting to maintain habitat is likely to fail because the beetle will attack the partially cut stands even though partial cutting may provide some level of "beetle proofing". Dwarf mistletoe is also ubiquitous and aggressive in this zone, which means that large areas of partial cutting are not an ideal solution.

The NDSD zone copies the natural-disturbance-seral distribution

The most important part of the SBPS is in the Anahim and Nimpo Lake areas where the Rainbow herd often spends the winter. This is

the area where the SBPS will be managed with a seral distribution that mimics the natural disturbance level as defined by the Biodiversity Guidebook (1995). The mature and old forests that provide the caribou winter habitat can be shifted within the SBPS of each landscape unit in this area as harvesting to address MPB proceeds. Access control measures will have to be addressed although we recognize that access management will not be ideal given the more fragmented nature of the suitable habitat under this approach.

This approach is far less desirable than the modified-harvesting recommended in this strategy because much of this area will not be caribou habitat during most of the rotation whereas modified-harvesting should be able to maintain habitat continuously. However, in the face of MPB and dwarf mistletoe, this approach becomes the best alternative in this heavily used part of the SBPS.

4) **Conventional-Harvest Areas (52 percent of the caribou range).** Because such a large proportion of the caribou range is within areas designated for conventional-harvest, it is important to provide approaches that will minimize the negative impact on caribou. However, conventional-harvest areas outside of OGMAs and other reserves will not be suitable caribou habitat for most of the rotation. Harvesting approaches should discourage the enhancement of moose and deer habitat. The best possible access control measures will be necessary within conventional areas.

5.1 General Forest Development Recommendations within the Modified-Harvest Zone

The following timber management approach is recommended in all modified-harvest areas:

- An even flow of timber access by the four groupings of landscape units is recommended (see Table 4, Map 11). The start date for measuring even flow of timber will be January 1, 2002.[4]

13 per cent of the volume is available from 2002 to 2022 and every 20-year period thereafter

Table 4. Caribou target associated with the four groupings of landscape units for timber access management.

Quadrant	Modified-harvest (ha)	No-harvest (ha)	Natural-disturbance-seral-distribution (ha)
Quesnel East	46,282	29,562	0
Quesnel West	41,536	22,270	0
Williams Lake East	59,474	38,146	0
Williams Lake West	33,883	875	50,252
Total	**181,174**	**90,853**	**50,252**

- This means that 13 per cent of the volume would be available every 20 years (i.e., 2002-2022, 2022-2042, etc.) from each of these areas.
- Forest development in caribou range must be spatially and temporally concentrated. Aggregate harvesting in major parts of landscape units over short time periods, then deactivate roads

Aggregate harvesting in parts of LUs over short time periods

[4] Biologically, the soundest way to view even-flow is the previous 20 years from planned development; however, using January 2002 is a reasonable compromise.

and do not enter the area again until the next cutting cycle.

- Concentrate logging by harvesting large cutblocks (i.e., up to 1,000 ha or more).
- Licensees should track all harvesting and report compliance with the above on development plan applications.

5.2 General Forest Development Recommendations within the SBPS Natural-Disturbance-Seral-Distribution (NDSD) Zone

The following timber management approach is recommended for this zone:

- Seral targets apply to the SBPS area of each landscape unit or partial landscape unit as in the case of the Holtry unit.
- Seral targets reflecting the natural disturbance distribution are presented in Table 5.
- Retain large patches (preferably >250 ha) of mature and old forest with much interior forest condition.
- Plan for recruitment patches of mature and old forest to replace areas harvested.
- Concentrate logging by harvesting large cutblocks (e.g. up to 1,000 ha).
- Locate wildlife-tree patches in areas of highest lichen abundance.

[6] from Biodiversity Guidebook (1995) p.92.

Table 5. Natural seral distribution for SBPS based on a 100 year stand destroying disturbance return interval[6].

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

5.3 Operational Location of Harvesting Boundaries

The caribou strategy's boundaries for no-harvest and modified-harvest areas were developed to best maintain caribou habitat values within the planning framework of the CCLUP and, therefore, are integral to the overall strategy. These boundaries were located using caribou-habitat modelling, topographical analysis, caribou research, local knowledge, and stakeholder input. Major revisions to these boundaries should only be considered as part of a comprehensive, overall review of the caribou strategy. The intent of this strategy is to provide long term certainty for resource agencies, First Nations, industry and conservation groups.

Operational boundary adjustments up to 200 m can be made

The boundaries in the caribou strategy were drawn as accurately as possible (1:20,000 maps) at the strategic level. In order to provide some flexibility at the operational level, the boundaries may be adjusted to address local topography, optimization of timber development, worker safety issues and the establishment of windfirm boundaries.

The following recommendations are provided for making operational-level boundary adjustments:

- operational boundary adjustments of up to 200 m can be made using this process

- these adjustments must be neutral or beneficial for maintaining caribou habitat
- proposed boundary adjustments, in either direction, must include a similar adjustment in the opposite direction in the local area to balance the hectares involved
- proposed adjustments will require the approval of the statutory decision makers
- approved adjustments should be sent electronically to the Ministry of Sustainable Resource Management regional office for boundary updating.

5.4 Identifying Terrestrial and Arboreal Lichen Sites within Modified-Harvesting Areas

In order to meet allowable impacts identified in the CCLUP process, 80 per cent (144,939 ha) of the modified-harvest area will be managed as terrestrial lichen sites while 20 per cent (36,235 ha) will be managed as arboreal sites. For management purposes, sites must be classified as one or the other type because different harvesting approaches are used in each (Table 6 and 7); in reality, most sites within the MSxv contain significant amounts of both lichen types.

Two principles should guide the allocation of the two management approaches:

The best arboreal lichen sites should be managed as such

- the best arboreal lichen sites should be managed as such, and
- arboreal lichen sites should be well distributed throughout the modified-harvest area.

Table 6. Identifying Terrestrial and Arboreal Lichen Sites

- Stands that are mapped as SBPS (4,825 ha) and stands that classify as SBPS with ground surveys should be managed as terrestrial lichen sites.
- Stands that are mapped as ESSFxv (1,988 ha) and stands that classify as ESSFxv with ground surveys should be managed as arboreal lichen sites.
- The best arboreal lichen sites are often located adjacent to sources of humidity such as wetlands and creeks.
- The best arboreal lichen sites are typically located at higher elevations within the MSxv away from the ecotone with the SBPS.
- Any existing clearcuts within the modified-harvest area should be designated as a terrestrial lichen site
- A total of 20 per cent of the modified-harvest area within each Landscape Unit or parts thereof, as identified in Table 7 and Map 11 should be managed with the arboreal-lichen prescription to ensure a good distribution of the lichen types. Even within these areas the arboreal-lichen sites should be well distributed.
- Using all of these criteria, each licensee should identify which cutblocks, or parts of cutblocks, will be managed with the arboreal- and terrestrial-lichen prescriptions.
- Each licensee should track and report the percentage of arboreal versus terrestrial lichen cutblock area by the units delineated in Table 7 and Map 11 at the time of development plan submission.

Table 7. Allocating the arboreal- and terrestrial-lichen sites in the modified-harvest area (the best arboreal-lichen sites amounting to 20 per cent of the non-reserved land in each of the areas identified in the table should be harvested with the arboreal-lichen prescription and the remainder with the terrestrial-lichen prescription).

Area	Timber Supply Area	Landscape Unit(s)	Sub-division of Landscape Unit
1	Williams Lake	Upper Dean and Christenson Creek	Christenson Creek LU north of Hump Creek only
2		Christenson Creek	South of Hump Creek
3		Corkscrew Creek	North of Lehman Creek and its tributary
4			South of Lehman Creek and its tributary
5		Holtry	North part of modified harvest
6			South part of modified harvest
7		Nimpo	None
8		Puntzi	None
9		Palmer/Jorgenson	South of Palmer Creek
10			North of Palmer Creek
11		Punky/Moore	West of Chilcotin River
12		Punky/Moore	East of Chilcotin River and south of Chezacut Road (100 Road)
13		Punky/Moore	East of Chilcotin River and north of Chezacut Road (100 Road)
14	Quesnel	Clisbako	None
15		Toil	None
16		Coglistiko and Chine	East of tributary of Coglistiko River
17		Coglistiko	West of tributary of Coglistiko River
18		Kluskus	East of tributary of Kushya River
19			West of tributary of Kushya River
20		Pan	East of Pan Creek and its tributary
21			West of Pan Creek and its tributary
22		Eliguk	None

5.5 Modified-Harvesting Approach on Terrestrial-Lichen Sites

An irregular group-shelterwood silvicultural system is recommended to maintain stands continuously as terrestrial-lichen habitat. By harvesting small openings, the remaining stand provides partial shade for terrestrial lichen in the openings. When trees in the openings regenerate and grow to a size comparable to the remaining forest (estimated to take 70 years) then the remaining forest can be harvested. In the long-term with this system trees will be up to 140 years old at time of harvest (50 per cent removal every 70-years)[7].

Irregular group shelter-wood with 50 per cent removal for terrestrial lichen sites

Harvesting recommendations are provided in Table 8. All recommendations for modified- harvest are fully compatible with the impacts modelled in the Cariboo-Chilcotin Land Use Plan Integration Report (1998).

Photo 10. Processing at the stump showing the piling of slash to minimize contact with terrestrial lichens. Photo by Harold Armleder.

Photo 11. Operational modified-harvesting in contrast with conventional clearcutting. Photo by Harold Armleder.

[7] Until two entries occur, trees will often be older than 140 years at time of harvest.

Table 8. Harvesting recommendations for implementing an irregular group-shelterwood silvicultural system on terrestrial-lichen sites in modified-harvest areas of northern caribou habitat in the West Chilcotin.

Irregular Group Shelterwood Recommendations For Terrestrial-Lichen Sites
• 50 percent harvest by area including all in-block roads.
• Harvest on a 70 year cutting cycle.
• Openings should not be more than two tree-lengths wide by up to three to four tree-lengths long to provide adequate shade for lichens, while allowing enough sun for the growth of pine regeneration (use the wider openings on cool aspects and the smaller openings on warm aspects).
• Shape of the openings can vary but experience has shown that a regular rectangular pattern is best for maximizing harvesting efficiency.
• If a systematic layout of openings is used it is usually not necessary to flag more than one side of the openings (the feller-buncher operator can estimate the length and width of the openings).
• If a systematic layout is not used, then use GPS to map openings and skid trails to track the target removal by area.
• Place openings, as much as possible, to target dwarf mistletoe infections if it is present in the stand. Beyond this, mistletoe obligations should be waived in all modified-harvest areas.
• Harvest on a snowpack (usually at least 30 cm is required) to avoid physical damage to terrestrial lichen.
• Harvest carefully to minimize damage to residual stems.
• Utilize pulpwood dimensions to minimize slash contact with terrestrial lichens.
• Pile slash along the edges of the openings to minimize the slash contact with terrestrial lichens.
• Take appropriate steps to ensure that the residual stand will be windfirm (note: if feathering is used, incorporate this into the target removal level)
• Retain standing dead trees within the safety regulations of WCB.
• Conventional or no tail-swing feller-bunchers can be used to implement the prescription.

5.6 Modified-Harvesting Approach on Arboreal-Lichen Sites

A group-selection silvicultural system is recommended to maintain stands continuously as arboreal-lichen habitat. By low-volume harvesting of small openings the remaining stand maintains the structure necessary for arboreal lichen. When combined with a long cutting cycle (80-years), this system should maintain arboreal lichen in sufficient quantity to be useful to caribou. In the long term with this system, trees will be up to 240 years old at time of harvest (33 per cent removal every 80-years)[8].

Group selection with 33 per cent removal for arboreal lichen sites

Harvesting recommendations are provided in Table 9. All recommendations for modified-harvest are fully compatible with the impacts modeled in the Cariboo-Chilcotin Land Use Plan Integration Report (1998).

[8] Until three entries occur, trees will often be older than 240 years at time of harvest.

5.7 Timber Harvesting in the Dean River Migration Corridor

Migration of the Rainbow Mountains herd between Tweedsmuir Park and the Ilgachuz Mountains needs to be managed for in terms of providing suitable forest stand conditions.

As this event occurs over a short period, it suggests that foraging needs are not as important as providing open stands that do not impede travel and provide adequate sight distance to detect predators. As a result stands within the identified corridor should be managed as follows:

- Cut blocks should be oriented in an east-west direction to provide the maximum amount of forest cover for the caribou as they migrate.
- The stands to be harvested should be rated on the level of difficulty that caribou would experience in moving through them. Dense stands with heavy undergrowth and stands with a high level of blowdown are likely to be avoided by migrating caribou. These types of stands should be prioritized for harvesting.
- Stands with terrain features (i.e., escarpments) and or manmade features (i.e., fences) that will limit caribou movement should be prioritized for harvest.
- Stand-stocking levels should be at the low end of the spectrum with the objective of maintaining 1,000 stems per hectare (sph) and a minimum of 500 sph.
- Stands will be managed to normal-rotation ages, except where constraints other than those for caribou are imposed.

5.8 Appraisal Allowances for Implementing the Recommended Modified- Harvesting

Total costs (pre-harvesting to post-harvesting) associated with these silivicultural systems are higher than clearcutting. Licensees have indicated that the appraisal system does not adequately recognize these costs.

Resolving the appraisal issue is essential to the success of the strategy

Actual-cost data incurred from applying the recommended prescriptions in this region are currently available for research, adaptive management and operational cutblocks covering almost 2,000 ha. These data were collected by, and are available from Riverside Forest Products Ltd. and Tsi Del Del Enterprises Ltd.

A timely resolution of the appraisal allowance issue in relation to the recommended silvicultural systems is essential to the successful implementation of the Northern Caribou Strategy.

Table 9. Harvesting recommendations for implementing group-selection silvicultural system on arboreal-lichen sites in modified-harvest areas of northern caribou habitat in the West Chilcotin.

Group-Selection Recommendations for Arboreal-Lichen Sites
• 33 percent harvest by area including all in-block roads.
• Harvest on a 80-year cutting cycle.
• Openings should be two to three tree-lengths wide by three to four tree-lengths long (use the larger opening on cool aspects and the smaller opening on warm aspects).
• Shape of the openings can vary but experience has shown that a regular rectangular pattern is best for maximizing harvesting efficiency.
• Distribute openings throughout the block so that subsequent entries can also be well distributed.
• If a systematic layout of openings is used, it is usually not necessary to flag more than one side of the openings (the feller-buncher operator can estimate the length and width of openings).
• If a systematic layout of openings is not used, then use GPS to map openings and skid trails to track the target removal by area.
• Place openings, as much as possible, to target dwarf mistletoe infections if it is present in the stand. Beyond this, mistletoe obligations should be waived in all modified-harvest areas.
• Season of harvesting does not impact arboreal lichen.
• If significant terrestrial lichen is also present, use the smaller end of the opening sizes and harvest on a snowpack to prevent physical damage.
• If significant terrestrial lichen is also present, minimize the contact of slash with terrestrial lichen by piling slash along the edges of the openings.
• Retain standing dead trees within the safety regulations of WCB.
• Harvest carefully to minimize damage to residual stems.
• Conventional or no tail-swing feller-bunchers can be used to implement the prescription.

5.9 Mountain Pine Beetle Strategy for the Northern Caribou Range

High levels of mountain pine beetle (MPB) attack are undesirable for maintaining northern caribou habitat and for maintaining the timber resource within caribou range. However, not all levels of beetle attack destroy caribou habitat.

On terrestrial lichen sites, light levels of attack (<30 per cent merchantable stems per ha) seem to have little or no impact on lichen production and fallen dead trees should not impede movement. These sites often support heavy terrestrial lichen communities. Moderate levels of attack (30-50 per cent) seem to have limited impact on terrestrial lichens probably because of the relatively gradual reduction in shading and the presence of the residual stand. In contrast, higher attack levels (>50 per cent) can significantly impact terrestrial-lichen production and create significant physical obstacles when the attacked trees fall.

The impact of mountain pine beetle attack on arboreal-lichen sites is less clear. Certainly, at high levels of attack, the micro-climate needed for arboreal-lichen growth will no longer exist and the biomass of lichen will be significantly less when these trees fall. However, at lower levels of attack, the specific impact on arboreal lichens depends on a variety of site conditions. For example, a stand opened by beetle-induced mortality may have little impact on lichen growth if adjacent to a high humidity source (e.g., wetland) while the same level of attack on a dry site may reduce lichen growth.

Stands with up to 50% tree mortality still provide valuable habitat for caribou

Generally, attacks of less than 30 per cent are probably not a problem while attacks more than 50 per cent would undoubtedly have a significant impact on arboreal lichen available to caribou.

Factors contributing to the susceptibility of stands to MPB include: species composition (percentage lodgepole pine), high stem density, age, elevation and aspect, and tree vigour (Safranyik et al 1980). A hazard rating for mountain pine beetle that includes these factors was presented by Maclauchlan and Brooks (1999). The age factor is high when stand age is greater than 80 years. The density factor is highest between 751-1500 sph (≥7.5 cm dbh). The location factor includes a combination of longitude, latitude and elevation. Therefore, while many pine stands within the caribou range rate high for pine content, age and density, the elevations produce a moderate to low hazard rating for the modified areas. As the no-harvest areas are at higher elevation than the modified-harvest areas, they are general rated lower hazard.

The MSxv has a lower incidence of beetle attack than the SBPSxc. Almost all of the modified-harvest and all of the no-harvest areas for caribou are located in areas mapped as MSxv. This will allow aggressive beetle control activities to occur in the more susceptible SBPS surrounding the caribou modified- and no-harvest zones.

Both the terrestrial and the arboreal-site prescriptions may convey some beetle-proofing advantage to the stands. However, the extent of this advantage is unknown and it may make little difference in epidemic conditions.

It is essential to remember that the CCLUP established the no-harvest zone for caribou and the modified-harvest zone for caribou while extracting limited amounts of timber. Keeping these objectives in perspective should guide what is done for MPB management.

Two separate issues must be addressed in dealing with mountain pine beetle problems:

1. controlling beetle spread, and
2. salvaging attacked trees.

The following recommendations cover these two issues (Tables 10, 11 and 12).

Table 10. Recommendations to Control Mountain Pine Beetle Spread (Sanitation).

- Promote aggressive action outside of caribou range to prevent spread of beetles into the caribou modified-harvest and no-harvest areas including harvesting highly susceptible stands.
- MPB management zones are often large areas. To effectively manage MPB for the special values associated with northern caribou range, the four areas into which the no-harvest and modified-harvest are divided (see section 5.4 and map 9) should be individually treated as separate beetle management zones.
- During outbreaks, the leading concern is limiting extensive mortality to no-harvest and modified-harvest areas. Where the threat exists for significant spread of MPB to highly susceptible pine stands, aggressive sanitation harvesting within modified-harvesting areas is warranted. This should be applied only where modified-harvest areas clearly meet the definition of a suppression zone as defined by the Bark Beetle Management Guidebook (1995).
- The Caribou Strategy Committee should be consulted during significant MPB outbreaks in no-harvest areas. If harvesting is proposed as a control action, the area must clearly meet the definition of a suppression zone. If significant harvesting occurs in this situation, uncut areas of modified-harvest will have to be designated as temporary no-harvest areas until the harvested areas of the no-harvest recover habitat value (e.g., forage-lichen biomass).
- Within the caribou modified-harvest area, harvest the oldest pine stands first, leaving the younger, less susceptible stands for the future.
- Within caribou no-harvest areas, encourage fall and burn, pheromone baiting and MSMA application as appropriate to the site to control beetle spread while not cutting trees that are not attacked.
- Within caribou modified-harvest areas where road access is not present, encourage fall and burn, pheromone baiting, and MSMA application as appropriate to the site, to control beetle spread.
- Adequate funding is essential for successful management of MPB in the no-harvest and modified-harvest zones.
- Where access is present and small areas within caribou modified-harvest have been attacked, apply the recommended harvest prescriptions, but distribute harvest openings to target green-attacked trees, while limiting the cutting of trees not attacked.
- Where access is present and large areas of modified-harvest have been attacked, sanitation harvesting should leave all non-attacked trees in the stand to help retain as much structure as possible.

Table 11. Recommendations for Timber Recovery of Mountain Pine Beetle Caused Mortality

- Within caribou modified-harvest areas, in stands having up to 50 per cent mortality (merchantable stems per ha) and in stands having greater than 50 per cent mortality over areas smaller than 40 ha, apply the recommended prescriptions but distribute openings to target areas with the heaviest beetle mortality.
- In caribou modified-harvest areas, in stands greater than 40 ha and having more than 50 per cent (merchantable stems per ha) beetle-induced mortality, retain all green trees while removing the dead trees.
- Within the modified-harvest areas in the mapped SBPS (4,825 ha), harvest openings can be increased to three-tree-lengths wide by five-tree-lengths long. This will make salvage easier and the larger openings will help reduce mistletoe infection within openings; however, a significant impact on terrestrial lichens will occur on all but the most shaded parts of the openings.
- Within caribou no-harvest areas, no salvage activities should be considered at mortality levels below 50 per cent (merchantable stems per ha). At levels above 50 per cent mortality over areas larger than 200 ha salvage should be possible but consult with the Caribou Strategy Committee first.
- The extent of all harvesting in the no-harvest area must be carefully tracked to avoid exceeding the CCLUP maximum of 10% over a normal rotation.

Table 12. Additional Recommendations for Mountain Pine Beetle Attack within the SBPS Natural-Disturbance-Seral-Distribution (NDSD) Zone

Control (Sanitation)

- This applies when and where the SBPS NDSD Zone area is designated as a MPB suppression zone or maintain-low zone.
- The target seral distribution above what biodiversity emphasis dictates for a given SBPS within a LU can be met in other LUs within the SBPS NDSD Zone (i.e. in this zone the BEOs have been raised and the increment in seral associated with this increased BEO can be managed across LUs). This increased flexibility is provided to help control MPB spread, thereby leaving sufficient uncut mature and old forest in SBPS NDSD Zone as a whole.

Salvage (Timber Recovery)

- This applies when and where the SBPS NDSD Zone area is designated as a MPB salvage zone.
- The increased flexibility noted in the above bullet applies to salvage only for stands with greater than 30 per cent (merchantable stems per ha) beetle-induced mortality.

5.10 Post-Harvesting Recommendations

General. The MSxv subzone surrounding the Itcha-Ilgachuz Mountains occupies the majority of the caribou modified-harvest zone. Small inclusions of SBPSxc and ESSFxv occur in the south, while SBPSmc and SBPSdc occur to the north and east of the modified-harvest zone. To varying degrees, all these subzones are characterized by cold, dry conditions resulting in slow growing, relatively old forests with sparse shrub, herbaceous, and moss layers, and an abundance of terrestrial lichens.

Lodgepole pine dominates this landscape. Spruce increases in presence, as either regeneration or a secondary species, on relatively moister site series and subzones. Mosses and grasses also become more common as moisture increases and there is an associated reduction in terrestrial and an increase in arboreal lichens. Limiting factors to regeneration are primarily moisture deficits and growing-season frosts, which have hindered regeneration in clearcuts. More detailed ecological descriptions are found in Section 3.1.

Dwarf mistletoe. Over 96 percent of the modified-harvest area is located in the MSxv subzone. Dwarf mistletoe reaches its ecological limit in this zone and is far less common and aggressive than in the SBPSxc. In partial cutting, which is necessary to maintain caribou habitat, it is not possible to eradicate all mistletoe that might be present in a stand. Therefore, mistletoe obligations should be waived in all areas identified for modified harvest.

Mistletoe obligations should be waived in all areas identified for modified-harvest

Species selection for regeneration. Regeneration of harvested stands should be primarily with lodgepole pine to maintain and promote lichen-bearing pine stands. Spruce should only be considered for regeneration where ecologically appropriate, such as on the moister site series or on shady edges, wetter micro-sites, or on opening edges if dwarf mistletoe is a concern. However, stands should never be converted from pine dominating to any thing else.

Fifth year results from the research trials indicate that seedling survival and condition in the partial cutting systems are comparable, or in the case of spruce, better than under clearcut conditions. Total height and leader length are also significantly better under partial cutting, likely due to the reduction in growing-season frost and improved moisture conditions. However, diameter growth is notably less than that found under clearcut conditions. Height/diameter ratios for pine, particularly under the recommended arboreal-lichen management strategy (33 per cent removal), are indicating that available light is approaching limiting levels and seedling performance should be monitored.

It is important to remember that the CCLUP Integration Report (1998) modelling has allowed 140 and 240 years, on terrestrial and arboreal lichen sites, respectively, to produce the timber available in 80 years under conventional-harvest.

Site Preparation. The primary objective is to protect lichen cover. Therefore, site preparation is not considered an option on terrestrial-lichen sites and is discouraged on arboreal sites if any terrestrial lichen is present.

Site preparation is not an option on terrestrial-lichen sites

Vegetation competition is low and soil temperature is unlikely to be improved under the proposed silvicultural systems. Protection of soil organic layers and woody debris are considered key to maintaining site productivity. Under these conditions, site preparation is not generally required to establish regeneration in these ecosystems.

Moisture deficits and frequent summer frosts are the primary factors inhibiting seedling establishment and

growth. It is expected that the small opening sizes will increase snow retention and, combined with summer shading, will reduce moisture deficits. Research trials have shown that the incidence of summer frosts is lower in the smaller openings.

Advanced regeneration. Advanced regeneration in the SBPSxc is mainly lodgepole pine, while spruce is more common in the other subzones due to denser canopy closure and increased moisture availability. Growth response of advanced pine regeneration to overstorey removal is usually slow. Protection of spruce advanced regeneration is not recommended to meet management objectives, except on the moister site series.

Advanced regeneration is often of poor form and usually not protected during the logging of the openings in both silvicultural systems. Advanced regeneration might be protected if it is considered of value as future crop trees. However, this may have implications on equipment selection, logging method and harvesting efficiency.

Natural Regeneration. Adequate stocking will likely be achieved with natural regeneration without any site preparation. Natural regeneration densities are similar to those recorded after three years in clearcuts, based on data from research trials. However, natural regeneration is often patchy as a result of post-harvest cone-distribution patterns, and drag scarification is not recommended due to the negative impact on terrestrial lichens. Past experience indicates it may be difficult to achieve minimum heights at free growing by relying on natural regeneration.

Artificial Regeneration. Planting is considered the most effective treatment to establish stocking and achieve minimum height requirements at free growing. One-year-old PCT 410, 412 and 415B are all acceptable stock-types for lodgepole pine, depending on soil characteristics. One-year-old PSB 415B is recommended for spruce.

Regenerate the same species as was harvested

Stocking levels lower than normally prescribed are preferred to manage terrestrial lichens. The recommended stocking standard for the strategy is a target of 1,000 stems per ha and a minimum of 500 stems per ha.

Use a lower stocking level target of 1,000 stems per ha and a minimum of 500 stems per ha

Vegetation Management. The MSxv, which comprises almost all (96.2 percent) of the modified-harvest area, typically has little or no need for vegetation management. The fact that terrestrial lichens flourish in this zone is a function of the low levels of competing vegetation that are present. There are even fewer vegetation management issues in the 2.7 percent of the modified-harvest area that is in the SBPS zone.

Seeding and Planting. Roadsides and landings should not be seeded to grass within caribou areas to discourage grass competition with terrestrial lichens. There is also anecdotal evidence that this practice could potentially enhance bear populations. Instead, choose plant species for seeding and access stabilization that are less likely to invade the cutblock and are not as attractive to bears.

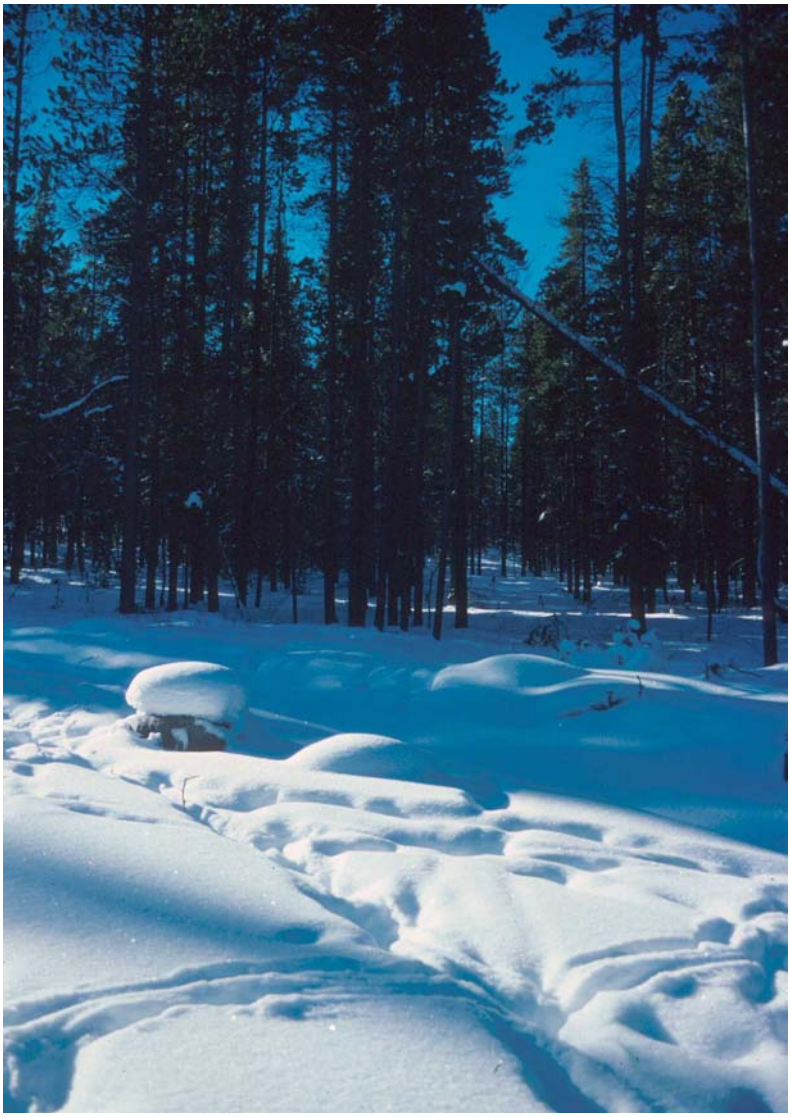

Photo 12. Caribou use in a harvested opening on a terrestrial lichen site (irregular group shelterwood). Photo by Harold Armleder.

6 Access Management

Forest harvesting in and adjacent to caribou habitat will require construction of new roads. New logging roads built in previously remote areas can lead to excessive hunting pressure, illegal killing, increased predation, and population declines if access is not properly managed. Roads and packed snowmobile trails allow wolves to travel more quickly, increasing encounters with caribou, and improving their success rate (James and Stuart-Smith 2000; Oberg 2001).

Better access also increases the potential for harassment or disturbance of caribou (refer to Appendix 4). Harassed animals may be forced into lower quality habitat, or concentrated into smaller areas. Displacement from preferred habitats into less desirable habitats can increase caribou exposure to other risks such as wolf predation. In fleeing from harassment they expend extra energy, which is in short supply during winter. Caribou are in their poorest body condition during the winter, and increased stress during this period can further decrease their condition. Poor body condition can lead to increased vulnerability to predation, increased susceptibility to disease, and decreased rates of reproduction and calf survival the following year.

Current knowledge suggests that the long-term persistence of northern caribou depends upon the perpetual supply of large, contiguous areas of suitable summer and winter habitat, with little or no vehicle access and human disturbance. In such areas, caribou can space out at low densities and reduce predation risk (Seip and Cichowski 1996). As a result, the overriding objectives of access management are:

Caribou depend on the perpetual supply of large, contiguous areas with little or no vehicle access

- develop strategies for motor vehicles within northern caribou range that minimize motorized access to the area but allow development to occur;
- promote non-motorized recreation opportunities within the range of northern caribou rather than motorized recreation;
- minimize vulnerability of caribou to predation;
- minimize disturbance of caribou; and
- minimize displacement of caribou.

General Access Recommendations in Respect to Forest Development Practices. The Northern Caribou Strategy partially addresses access management concerns by aggregating no-harvest and modified-harvest in large, contiguous areas. This strategy will minimize access development across the entire caribou winter range, while still allowing access for forest development and recreational use.

- Access recommendations apply to modified-harvest and no-harvest zones, and surrounding areas within caribou range (Map 10).
- Forest harvesting should be aggregated in time and space to the greatest extent possible over short time periods (5 years), with no harvest planned for the area again until the next cutting cycle.
- The northern caribou habitat area (Map 10) is mostly within Natural Disturbance Type 3. The upper end of the block-size distribution for NDT 3 as specified in the Biodiversity Guidebook (up to 1,000 ha) should be utilized where practicable for harvesting and for leave or undisturbed areas.
- The amount of road kept open by snow plowing during winter months should be minimized within caribou habitat as plowed roads provide wolves and people easier access to caribou.
- The number of main haul roads should be minimized throughout the caribou habitat area.

- To date, salvage harvesting has not been proposed in the no-harvest zone. Roads in this zone should be used for industrial purposes only, and measures to prevent access for other purposes will be applied. Consult with the Caribou Strategy Committee regarding any possible road construction within the no-harvest zone.
- Where there are effective access-control points on a main road, it will not be necessary to block access on side roads beyond that control point.
- Where there are no effective access control points on the main haul road, appropriate access control measures will be applied to secondary roads.

Access Recommendations for Motor Vehicles. Access recommendations are designed to minimize (or eliminate where necessary) the impact of motor vehicles within the caribou range. A combination of physical access controls and regulatory measures will be used to minimize the impact of motor-vehicle access on caribou populations.

- With the exception of specified corridors to access Itcha-Ilgachuz Park, access in the no-harvest areas will be limited to vehicles used for commercial purposes other than hunting. This applies to all manner of vehicles, including snowmobiles and ATVs and means that only those having tenure in the area (e.g., timber tenure holders or trappers) would be permitted vehicle access within no-harvest areas.
- Access-control points (including physical closure - if possible) are required on each main road accessing areas within the modified-harvest and no-harvest zones. This measure may include one or a combination of barriers, bridge and culvert removal with accompanying signs, as well as legislated closures. In some cases, gates may be effective if agreement on their use (e.g., the disposition of keys for the gate) is reached at the local planning level.
- In areas where there are no effective control points on main roads, secondary roads should be physically closed as soon as possible after harvesting has occurred. For motor vehicles, the most effective access control is to have both a physical closure (e.g., remove bridge, tear up road, and pile debris on road) as well as a legislated closure.

An overall road-access-management plan that addresses existing roads, roads under construction and planned roads within the caribou habitat area is provided in Map 12. A close examination of Map 12 indicates that a network of roads is slowly encircling Itcha Ilgachuz Park. Also, the parts of Tweedsmuir Park where the Rainbow and Charlotte Alplands herds reside are increasingly affected by road development. The impact of this network of roads is likely to have a detrimental effect on caribou and must be managed to minimize the adverse effect.

Most existing access-control structures in the northern caribou habitat area have been proposed by licensees in their Forest Development Plans, or by the Forest Service small business program. In some areas (e.g. Anahim Round Table and Chezacut area) Coordinated Access Management Plans (CAMPs) have been developed, but not all have been approved. Access management will be addressed further through sub-regional planning processes.

Some road closures are best addressed by regulations under the Wildlife Act, while others are best addressed by provisions in the Forest Practices Code Act (e.g., industrial access only with a strategically placed gate). Under the Wildlife Act various types of legislated closures are possible. When referred to in this report, closures under the Wildlife Act apply to all motor vehicles for hunting purposes year round. (Note: Sustenance hunting may not be included in the closure.)

Each type of legislated closure or physical closure has advantages and disadvantages. Local knowledge and experience with various types of closures is important. Measures that are effective in one area or situation may not be effective in another area or situation. Access-management objectives should be clearly understood by forest managers including government and forest companies. This will allow them to identify the most effective option(s).

Access Recommendations for All Terrain Vehicles (ATVs). Regulations under the Wildlife Act, which have been in effect since 1985, prevent the use of unlicensed motor vehicles (ATVs) for hunting purposes (presently during the period September 1 to December 5) in a large area surrounding Itcha-Ilgachuz Park. After early December the snow is usually too deep to allow the use of ATVs. This regulation includes the area north of Highway 20 from Alexis Creek west to Tweedsmuir Park (in the Chilcotin Forest District) and the Bazaeko-Kluskus area in the Quesnel Forest District (Management Unit Areas 5-12 and 5-13). One of the main reasons for establishing these regulations was to protect the Itcha-Ilgachuz caribou herd from excessive hunting pressure.

The current policy for Itcha-Ilgachuz Park does not permit the use of ATVs, but a new management plan for the park is currently under development. The committee recommends little or no ATV access in the park.

Access Recommendations for Snowmobiles. Snowmobile access within caribou winter ranges is considered a major conservation threat due to the potential of moderate and high levels of snowmobile use to disturb and displace caribou from key habitats (see Appendix 4). Packed trails may facilitate wolf access to caribou habitat which could cause displacement of caribou or indirect mortality. Because of these concerns the recreational and commercial use of snowmobiles should be carefully regulated or excluded from sensitive winter-range areas.

Recommendations on snowmobile access are provided separately for the three caribou herds.

The Rainbow herd (approximately 125 caribou) resides mainly in Tweedsmuir Provincial Park in the summer. This herd has declined from about 200 animals in the past 10 years. In winter, these caribou do one or more of the following:

- migrate to the Ilgachuz Mountains (Itcha-Ilgachuz Park),
- stay in the Rainbow Mountains (Tweedsmuir Park), or
- migrate to the Anahim Lake area.

There are management plans that address snowmobile access in caribou habitat within Itcha-Ilgachuz Park and Tweedsmuir Park. These plans appear adequate, and no changes are suggested at this time if the access routes to snowmobile areas are limited to the approved trails shown on Map 12. Additional access routes to the parks would result in increased risk to caribou since packed trails provide easy access for wolves.

The Rainbow herd is at significant risk, as a declining trend in numbers is evident. Caribou mortality from predation is presumed to occur in both summer and winter habitat areas. In some winters the Rainbow herd does not use the Anahim Lake area, but when wintering in the Anahim Lake area, the Rainbow herd is in or near populated areas where there are many roads and trails. Predation by wolves has been observed in the Anahim Lake area.

Snowmobile use in the Anahim Lake area should be planned to avoid caribou wintering areas, as the packed trails increase wolves' ability to access caribou. Snowmobile use near caribou winter habitat should be on designated trails only in order to minimize predator access and disturbance to the winter range.

The committee recommends:

- Work with local snowmobilers to develop a trail network that avoids caribou wintering areas.
- At the local level, education and increased awareness of the need to restrict snowmobile use in caribou winter habitat is required.
- Licensee activity should be planned to minimize the plowing of roads when caribou are wintering in the Anahim Lake area.

The Itcha-Ilgachuz herd (approximately 2,000 caribou) resides mainly within the Itcha-Ilgachuz Park in summer. In winter, most of the caribou migrate to adjacent forested areas outside the park. This herd has increased significantly in the last 20 years, while supporting sustenance, resident and guided hunting pressure.

The current park management planning process addresses snowmobile activity within the park.

- The committee recommends that snowmobile access to Itcha-Ilgachuz Park should be limited to the approved routes shown on Map 12.

The Charlotte-Alplands herd (23 caribou counted in the summer of 2001) usually winter on windswept alpine ridges on or to the south of Trumpeter Mountain or travels to lower-elevation forested areas north and east of the Alplands. Population statistics suggest this transplant herd has declined over the past 10 years. Based on radio-telemetry information collected to date, the major cause of mortality is predation (Young, Youds and Freeman 2001).

- To avoid displacement of this herd from alpine winter habitat it is recommended that the snowmobile access to Trumpeter Mountain be closed.

7 Predator Management

Caribou populations in the boreal forests of North America have historically co-existed with predators, including wolves (Bergerud and Page 1987). Relative to other ungulates, caribou occur at low densities and spread out over large areas, effectively reducing the predation rate. However, this anti-predator strategy is only effective if caribou are the primary prey species in the area (Seip 1991) and have sufficient suitable habitat in which to spread out.

Northern caribou in the western part of the Cariboo region exist within a complex predator-prey system where caribou, moose, mule deer and mountain goat provide food for wolves, grizzly bear, black bear, cougar, coyote and wolverine. It is possible for predator numbers to remain relatively high in this multiple prey-predator system even when predation drastically reduces one of the prey species.

Caribou are extremely vulnerable to predation compared to most other North American ungulates (Seip 1991) because of low densities and lower reproductive rate, when compared to moose or mule deer. Therefore, caribou are usually the most vulnerable species in a multiple prey-predator system and are the first to decline and the last to recover (Seip 1991).

Caribou are extremely vulnerable to predation

Seip (1991) suggested that wolf predation can eliminate caribou from areas where the wolf population is sustained by other prey species, because there is no negative feedback on the number of wolves as caribou decline in numbers. In fact, forest-dwelling caribou have declined or been eliminated from large parts of their historic range in northern Ontario, Saskatchewan, Alberta and British Columbia during the 1900s. Increased wolf predation on woodland caribou populations appears to be related to the range expansion of moose in North America (Bergerud 1974; Seip 1990). In the Cariboo Region, moose did not become numerous until after the early 1900s. Wolf predation is considered the major limiting factor of woodland caribou populations throughout most of their range in Alaska, the Yukon, western Alberta and British Columbia.

Wolf predation appears to be the primary cause of declining mountain caribou numbers in the Quesnel Lake area based on current regional population research associated with development of this strategy and previous work by Seip (1992). Wolves are sustained primarily by moose throughout the year, but become major predators on caribou during summer and winter, when caribou, wolves and moose occupy similar areas.

Strategies such as seasonal migrations of caribou to alpine areas and habitat segregation between different ungulate species allow caribou to coexist through spatial separation from wolves and alternate prey (Bergerud et al. 1984; Seip 1990). However, changes to habitat through timber harvesting or fire, which enhance moose populations, may negatively affect caribou populations by:

- producing early seral stages with enhanced understorey shrub and forb production, which increase the numbers of other prey species (e.g. moose) and in turn increase predator populations;
- restricting caribou into old-growth habitat patches, which may increase the search efficiency of predators; and
- providing easier access, through construction of roads, for predators to travel into caribou habitats.

It is essential that caribou have adequate space to avoid excessive levels of predation. Movement away from areas of high prey numbers, both in elevation and in distance, appears to be critical to their long-term survival (Bergerud 1992).

Direct management intervention may be required to maintain caribou herds in areas where habitats have been degraded, predator levels are high due to alternate prey-species abundance or where there is a high level of road access. Such "compensatory" management (i.e., compensating for loss or alteration of habitat or changes in alternative prey densities) may require management actions such as reducing wolf and moose density in areas where caribou and moose ranges overlap.

Radio-telemetry information collected to date suggests that wolf predation is a significant cause of mortality in at least two of the western herds (Rainbow, Charlotte Alplands). Population-modelling work and current population trend in the Itcha-Ilgachuz herd suggest that wolf predation is not a significant issue at this time for this herd. The possible reasons for this are that the larger size of the Itcha-Ilgachuz herd may buffer it from the destabilizing effects of predation or that there is some form of unsanctioned predator control operating in this area.

Based on the link between caribou population stability and the level of wolf predation, the committee recommends the following predator/prey management measures be developed:

- A moose management strategy that incorporates maximum sustained yield harvesting of moose populations in and adjacent to the caribou range should be developed in consultation with First Nations and stakeholder groups. Moose harvest rates should be adjusted to prevent the moose population density from increasing to levels that would support a higher predator population. In managing moose populations, the economic importance of maintaining sustenance harvest and recreational hunt opportunities must be recognized.
- A wolf management program should be developed within northern caribou range. This program needs to establish inventory and monitoring of the wolf population within all three herd areas. Wolf removal and sterilization (to limit increases in the wolf population) are two measures that will need to be considered in areas where the caribou herds are in decline. The Rainbow herd is currently in decline and therefore is the priority area to implement wolf population reduction at this time. The Charlotte Alplands herd may also be declining and therefore wolf reduction in this area should be given consideration as a second priority. The wolf-management program would be similar in structure to that planned for the Mountain Caribou Strategy (Youds 2001).

A wolf management program should be developed in northern caribou range

- It is recommended that wolf reduction be considered for caribou sub-populations:
  - that are in imminent danger of extirpation or range reduction (e.g., fewer that 30 animals and 30/1,000 km^2, fewer than 15 per cent calves during late winter and population rate of decline greater than three per cent a year), or
  - for which there is a Herd Recovery Action Plan or equivalent management strategy that requires predator reduction to meet recovery goals.
- In addition, predator control should only be considered:
  - where there is strong evidence that predator control will prevent extirpation or promote the recovery of a caribou sub-population, and
  - where predator populations are not considered to be vulnerable and control efforts will not put the population at risk. In cases where a species listed as vulnerable may pose a significant predation threat, alternative means of control, such as translocation, may be used.

- Development of a comprehensive access management strategy within caribou range in order to minimize permanent road development and restrict motor vehicle activities that overlap with seasonal caribou use, thereby preventing the enhancement of wolf travel corridors in caribou habitat.
- Implementation of forest management practices that limit the establishment or persistence of favourable habitat which encourage moose populations within or adjacent to the northern caribou range.

8 Range Management Issues

There is anecdotal evidence from other jurisdictions that fencing can be a hazard to caribou by blocking the movement of animals (O'Donaghue 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. To insure caribou have full access to habitat and are not restricted by range fencing we recommend:

Fencing can be a hazard to caribou by blocking movement

- 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 8).
- Where drift fences are required in the range of caribou in the upper Dean River valley, the fencing should be designed to be wildlife safe.

9 Conservation Risk Assessment

The three northern caribou sub-populations that occur in the Cariboo region (Itcha-Ilgachuz, Rainbow and Charlotte Alplands herds) are now blue-listed in the province and considered as threatened nationally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The overall strategy recommended in this report for northern caribou is comprised of habitat, access and predator management strategies that have been selected to provide the best opportunity for maintaining caribou, while taking into account stakeholder values and meeting the land use targets identified in the CCLUP. These strategies must be applied together, as a package, in order to have the best chance of maintaining northern caribou herds into the future.

Most of the CCLUP land use plan target for northern caribou (modified-harvest and no-harvest targets) has been used to address habitat needs for the Itcha-Ilgachuz herd, primarily because this is the largest and most viable herd amongst the three but also because this follows from the intent of the CCLUP (see 90-day document). Some habitat target has been applied to the Rainbow herd in the wintering area in the vicinity of Anahim Lake through development of the NDSD zone. There has been no specific caribou habitat target applied to the Charlotte Alplands herd though some land use planning measures adopted for this area through the Anahim Round Table SRP will benefit caribou.

The likelihood that the northern caribou herds will persist in this region at viable population levels is dependent on a large number of risks and how these risks are managed over the long term. The committee has completed a preliminary risk assessment to identify some of the most important risks to the three northern caribou herds, and to assess these risks in relation to whether or not the Northern Caribou Strategy is successfully applied. Table 13 summarizes the estimated risks to caribou in the absence of land use plan targets or special management for caribou habitat, while Tables 14, 15, and 16 summarize these risks to the individual herds given application of all land use targets and all components of the Northern Caribou Strategy.

Many of the identified risks to the Itcha-Ilgachuz herd can be reduced if the Northern Caribou Strategy is effectively applied. The designation of the Itcha-Ilgachuz Park will help to maintain calving and summer habitat suitability for this herd. The no-harvest zone and the modified-harvest approaches recommended in the strategy should help to maintain winter habitat suitability over a large portion of the winter range. Hence, in this preliminary analysis, the overall risk of habitat loss or alteration in caribou areas is generally deemed to be moderate for the Itcha-Ilgachuz herd if the Northern Caribou Strategy is adopted and applied over the long term (high to very high if the strategy is not applied).

Risks to the Itcha-Ilgachuz herd can be reduced if the Northern Caribou Strategy is applied

The overall risks to maintenance of the Rainbow and Charlotte Alplands sub-populations are deemed to be higher than for the Itcha-Ilgachuz sub-population. This assessment recognizes that there is insufficient caribou habitat target in these herd ranges to prevent long term habitat loss.

The Rainbow and Charlotte Alplands herds are at higher risk

The Rainbow herd is at moderate to high risk of not being maintained over the long term. Tweedsmuir Park provides high elevation summer and calving habitat suitability, while the northern Ilgachuz provides some high elevation winter habitat suitability. The highest risk to this herd is maintenance of low elevation winter habitat in the Anahim Lake area. The SBPS Natural-Disturbance-Seral-Distribution Zone should help maintain some winter habitat suitability in

this area. However, this approach is far less desirable than the modified-harvesting recommended in this strategy because much of this area will not be caribou habitat during most of the rotation.

The Charlotte Alplands herd is at the highest risk of not being maintained into the future. Though some land use planning measures adopted through the Anahim Round Table SRP will benefit high elevation summer and calving habitat suitability, there is high risk that winter habitat suitability will not be maintained because no specific caribou habitat target was available for the winter range areas of this herd.

The risk to caribou of increased motorized recreation (e.g., snowmobiles, ATVs, helicopters) within the caribou habitat areas are considered to be high if regulations or restrictions are not developed. These risks can be reduced through development, implementation and enforcement of appropriate restrictions within caribou range for snowmobiling and recreational access, as recommended by the strategy. The park planning process for the Itcha-Ilgachuz Park should help to a high degree with regulating access in high elevation, summer habitats for the Itcha-Ilgachuz herd. The challenge will be to implement effective access management in the lower elevation wintering areas as these become roaded and developed through logging.

The risk of predation to caribou population maintenance is considered to be very high in the absence of the recommended strategy. If the predator-management recommendations of the strategy are applied then the predation risk can be reduced substantially, though would still be considered to be moderate or high over the long term. Current knowledge of wolf and caribou densities and predator-prey dynamics suggest that unsanctioned wolf control may already be occurring in the Itcha-Ilgachuz herd range. Otherwise, wolf numbers would be higher in relation to the current caribou density. Development of a wolf management program and a modified moose harvest management program within the caribou range will be essential to reducing the predation risk.

Mountain pine beetle poses a moderate to high risk to northern caribou. At present, there is relatively little MPB activity within the modified- and no-harvest areas. The small quantity of beetles moving in from lower elevations do not seem to be successfully over-wintering and therefore do not appear to be significantly spreading within the modified- and no-harvest areas. However, if the current epidemic in the Quesnel Forest District continues to expand, the risks to caribou range will increase. Further north in the Vanderhoof Forest District, MPB attack has reached to treeline in some areas. The increasing trend of milder winters also increases the risk that MPB will become a bigger problem in the future.

The committee recommends that a more detailed conservation risk assessment[9] be completed for the Itcha-Ilgachuz, Rainbow and Charlotte Alplands herd that identifies critical risks and assesses how well the Northern Caribou Strategy reduces these risks through modelling population viability under different conditions.

A detailed conservation risk assessment should be completed

[9] A formalized assessment of the likelihood of adverse outcome from particular events or hazards as they relate to the conservation of caribou. This assessment probably needs to incorporate population viability modelling.

Table 13. Estimated risks[11] to the maintenance of the Itcha-Ilgachuz, Rainbow and Charlotte Alplands sub-populations, given no applied land use plan targets or special management for caribou habitat. This table is for comparative purposes with Table Y to indicate how the recommended regional mountain caribou strategy can reduce the overall risk of impact to the caribou population.

Risks to Maintenance of the Caribou Herd	Specific Hazard or Concern	Likelihood of Adverse Impact[12] X	Magnitude of Adverse Impact[13] =	Estimated Risk of Impact[14]	Overall Risk[15]
Loss or Alteration of Habitat (Timber Harvest, Fire or Forest Insect & Disease)	Calving-habitat suitability not maintained	2	3	6	High - Very High
	Summer-habitat suitability not maintained	2	3	6	
	Winter-habitat suitability not maintained	4	4	16	
	Moose habitat enhanced	3	3	9	
Access Development and Recreational Use	Permanent ploughed roads enhance predator efficiency and predation rate	3	2	6	High
	Off-trail snowmobiles displace caribou from preferred habitats	4	3	12	
	Increased road access results in increased human recreational activities within caribou range (excluding snowmobiling), with increased risk of disturbance	2	3	6	
	Motorized commercial and recreational use in caribou range increases	2	2	4	
Wolf Predation – Moose Abundance	Alternative prey populations increase resulting in higher wolf densities	3	4	12	Very High

[11] These initial estimates of risk are based on the expert opinions of committee members.
[12] An estimate of the likelihood of an adverse impact on the caribou population from this risk or hazard event, rated as 1=Low, 2=Moderate, 3=High, 4=Very High
[13] An estimate of the magnitude of an adverse impact on the caribou population from this risk event. This is based on the estimated area, extent and intensity of the impact, rated as 1=Low, 2=Moderate, 3=High, 4=Very High
[14] Refer to Appendix 7 for a description of the method for calculating risk ratings.
[15] In this preliminary analysis, overall risk was determined by averaging the scores for individual risks. This assumes that all risks are of equal impact or weight, which may not necessarily be true.

Table 14. Estimated risks to maintenance of the Itcha Ilgachuz sub-population, given application of all land use plan targets and all components of the Northern Caribou Strategy. Applicable components or sections of the strategy are identified in brackets in Column 1.

Risks to Maintenance of the Caribou Herd	Specific Hazard or Concern	Likelihood of Adverse Impact **X**	Magnitude of Adverse Impact **=**	Estimated Risk of Impact	Overall Risk
Loss or Alteration of Habitat	Calving-habitat suitability not maintained	1	2	2	
(Timber Harvest, Fire or Forest Insects (MPB) and Disease)	Summer-habitat suitability not maintained	1	2	2	Moderate
(See Sections 4 & 5)	Winter-habitat suitability not maintained	2	3	6	
	Moose habitat enhanced	2	2	4	
Access Development and Recreational Use	Permanent ploughed roads enhance predator efficiency and predation rate	2	2	4	
	Off-trail snowmobiles displace caribou from preferred habitats	2	2	4	
(See Section 6)	Increased road access results in increased human recreational activities within caribou range (excluding snowmobiling), with increased risk of disturbance	2	2	4	Moderate
	Motorized commercial and recreational use in caribou range increases	1	2	2	
Wolf Predation – Moose Abundance (See Section 7)	Alternative prey populations increase which results in higher wolf densities	2	3	6	Moderate-High

Table 15. Estimated risks to maintenance of the Rainbow sub-population, given application of all land use plan targets and all components of the Northern Caribou Strategy. Applicable components or sections of the strategy are identified in brackets in Column 1.

Risks to Maintenance of the Caribou Herd	Specific Hazard or Concern	Likelihood of Adverse Impact **X**	Magnitude of Adverse Impact **=**	Estimated Risk of Impact	Overall Risk
Loss or Alteration of Habitat	Calving-habitat suitability not maintained	1	2	2	
(Timber Harvest, Fire or Forest Insects & Disease)	Summer-habitat suitability not maintained	1	2	2	Moderate - High
(See Sections 4 & 5)	Winter-habitat suitability not maintained	3	3	9	
	Moose habitat enhanced	3	3	9	
Access Development and Recreational Use	Permanent ploughed roads enhance predator efficiency and predation rate	3	2	6	
	Off-trail snowmobiles displace caribou from preferred habitats	3	2	6	
(See Section 6)	Increased road access results in increased human recreational activities within caribou range (excluding snowmobiling), with increased risk of disturbance	2	2	4	Moderate – High
	Motorized commercial and recreational use in caribou range increases	1	2	2	
Wolf Predation – Moose Abundance (See Section 7)	Alternative-prey populations increase, which results in higher wolf densities	2	3	6	Moderate-High

Table 16. Estimated risks to maintenance of the Charlotte Alplands sub-population, given application of all land use plan targets and all components of the Northern Caribou Strategy. Applicable components or sections of the strategy are identified in brackets in Column 1.

Risks to Maintenance of the Caribou Herd	Specific Hazard or Concern	Likelihood of Adverse Impact **X**	Magnitude of Adverse Impact **=**	Estimated Risk of Impact	Overall Risk
Loss or Alteration of Habitat	Calving-habitat suitability not maintained	2	2	4	
(Timber Harvest, Fire or Forest Insects & Disease)	Summer-habitat suitability not maintained	2	2	4	
(See Sections 4 and 5)	Winter-habitat suitability not maintained	4	3	12	High
	Moose habitat enhanced	3	3	9	
Access Development and Recreational Use	Permanent ploughed roads enhance predator efficiency and predation rate	3	2	6	
	Off-trail snowmobiles displace caribou from preferred habitats	3	2	6	
(See Section 6)	Increased road access results in increased human recreational activities within caribou range (excluding snowmobiling), with increased risk of disturbance	2	2	4	Moderate – High
	Motorized commercial and recreational use in caribou range increases	1	2	2	
Wolf Predation – Moose Abundance (See Section 7)	Alternative-prey populations increase, which results in higher wolf densities	2	3	6	Moderate-High

10 Monitoring and Indicators

The CCLUP Northern Caribou Strategy signifies a shift in management of northern caribou habitat from harvest deferral and study to active management. This includes the application of modified harvesting to maintain habitat within a managed forest environment. With the move to active management, monitoring becomes particularly important.

Two forms of monitoring are required:

- Compliance monitoring to ensure the strategy is applied appropriately and completely, and
- Effectiveness monitoring to determine whether implementation of the strategy actually maintains caribou habitat, while meeting the CCLUP timber access assumptions.

There is particular urgency in establishing a compliance monitoring process. Once the Northern Caribou Strategy is accepted and implemented, tracking requirements for harvesting in the modified zone must be in place. Some key items that should be monitored include:

- Rate and distribution of harvest in the modified-harvest zone
- Access recommendations
- Management of terrestrial and arboreal-lichen sites relative to the 80:20 area target
- Stand-level implementation of modified-harvest prescriptions for both terrestrial and arboreal-lichen sites
- Species composition and stocking levels in treated areas
- Windfirmness of treated areas

Under the current administrative structure it is assumed that statutory decision makers (SDMs) would be responsible for implementation of these tasks.

The effectiveness monitoring done by the Research Section of MOF and Wildlife Section of MWLAP must also continue. Foremost is the need for annual re-measurement of the stand management trials and population surveys of caribou, wolves and moose. It will also be important to assess caribou use in traditional winter range areas outside the management zone, use of the migration corridor and mortality of stands from mountain pine beetle within the Caribou modified- and no-harvest zones. Some effectiveness indicators include: seedling performance, growth and yield, frequency and timing of caribou use of harvested areas, caribou population trends in the different herds, stability and persistence of adjacent unharvested areas and the impact of harvesting pattern on local hydrology and non-target wildlife.

Research to date has focused on identification of harvesting strategies that provide the level of access to timber envisioned in the CCLUP, while minimizing the risk of negative habitat impacts. Many of the recommendations made in this report are based on the early results of research trials established in 1995. The preliminary results indicate that proposed silvicultural systems will provide the desired level of timber access while still maintaining adequate habitat requirements. Longer-term monitoring is required to confirm these results.

It is important to emphasize that research over the last six years represents a relatively short period in the 140-(terrestrial) and 240-(arboreal) year rotation envisioned under this strategy. Monitoring of the adaptive management trial, along with the continued assessment of the earlier research trials and evaluations of future harvesting under the strategy, should be conducted to verify that the dual objectives of caribou-habitat maintenance and timber access are achieved. Regularly scheduled monitoring will ensure the tracking of progress towards desired goals. This will ensure the implementation of required adjustments occurs in a timely manner. Changes may be required should both objectives not be achieved.

Monitoring will ensure the tracking of progress towards desired goals

A commitment for funding the necessary monitoring will be essential to ensure the long-term success of the strategy.

11 Future Review

It is our hope, and the vision of the CCLUP process, that the recommended strategy should bring certainty to northern caribou management in the Cariboo Region for the longer term.

Boundaries of Zones. The forest industry desires that, once approved, the boundaries would be unchanged (excluding minor boundary adjustments as per section 5.3) for at least the next 15 years. Therefore, we do not anticipate making changes to the modified and no-harvest areas again in a few years.

Conversely, a periodic review of the strategy is beneficial to ensure that the overall objectives are being met within the area managed for northern caribou.

Silvicultural Systems. Current recommendations are based on local research on caribou biology and habitat spanning two decades. This includes silvicultural systems research since 1995 and operational experience in harvesting approximately 2,000 ha using these systems.

Current results are encouraging and have led to the recommendations in this strategy. There is no reason to think they will not work on the overwhelming majority, if not all of the sites in the modified-harvest area. This does not mean the door is closed to further refinement and innovation. However, new ideas should meet the following criteria:

- Evidence should be provided to demonstrate that the application of the recommended approaches did not work (or experienced significant problems) on a specific site or situation.
- A clear explanation should be provided of how a change or innovation will address the problem experienced with the existing recommendation while doing as good or better a job of maintaining caribou habitat.
- All suggestions for changes to the recommended approaches should be reviewed by the Caribou Strategy Committee.

The Northern Caribou Strategy should be reviewed every five years

It is recommended that the Northern Caribou Strategy be reviewed in detail every five years to ensure that the caribou and timber objectives are being met.

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13 Appendices

Appendix 1: Terms of Reference

BRITISH COLUMBIA

Ste. 200 - 640 Borland St.
Williams Lake, British Columbia V2G 4T1
Telephone: (250) 398-4345

Inter Agency Management Committee

March 30, 1998

John Youds, Chair
Caribou Strategy Committee
c/o 400 - 640 Borland St
Williams Lake BC V2G 4T1

Dear John Youds:

The attached Terms of Reference for the Caribou Strategy Committee has been approved by the IAMC. The revisions to the earlier TOR reflect the results of the Integration process.

IAMC recognizes that the work that the committee is undertaking is extremely important and that the time frames for the completion of the various phases present some significant challenges. As indicated in the Terms of Reference, the IAMC Implementation Committee will be available to assist the committee.

We commend the committee for the work it has completed to date.

Yours truly,

Gyl Connaty
Acting Chair
Inter Agency Management Committee

attachment

cc: Implementation Committee

Caribou Strategy Committee Terms of Reference
Purpose: To address CCLUP requirements for integrated caribou habitat management.

1. Determine the research, inventory, ecosystem mapping and adaptive management work required to develop integrated management approaches for caribou habitat for Eastern and Itcha Ilgachuz caribou.
2. Ensure the initiation and completion of the appropriate research, inventory, ecosystem mapping, and adaptive management work.
3. Based on the above work and CCLUP and IAMC direction, develop integrated forest management approaches for Eastern and Itcha-Ilgachuz caribou which address CCLUP targets and implementation direction.
4. Based on the above work and CCLUP and IAMC direction, complete a preliminary identification of modified harvest areas for caribou which will address commitments to 2005 by June 30, 1998. This work will be refined annually and will form the basis for the subsequent years' Forest Development Plans, however it will only provide firm direction for the first two years of each FDP. Only minor changes in year 2 would be anticipated. Flexibility to incorporate further research results for years 3, 4, and 5 of the FDP will be maintained.
5. Based on the above work and CCLUP and IAMC direction, complete a caribou strategy which includes an identification of modified harvest areas for caribou by June 30, 2000. The research to support this work will be completed by December 31, 1999. It is likely that the research will continue after 1999 and that this work will be refined in subsequent years as a result.

Membership

MELP-Region
3 Wildlife and Habitat staff
MOF-District
2 staff

MOF-Region
1 Research 1 Planning

Other technical staff from MOF and MELP will work with the committee as required. Planners from BC Parks and BSBT will be kept informed and invited to work with the committee as needed.

See attachment #1

Administration

The committee selects or confirms its own chairperson annually. The current chairperson is John Youds, Regional Wildlife Biologist, Environment and Lands (January 1998).

The committee may choose to strike a caribou technical sub-committee.

Reporting

The Committee will report to the IAMC through the Implementation Committee or as requested by IAMC. Members of the Implementation Committee will work with the committee and where needed facilitate the work of the committee and ensure IAMC direction is provided to the committee. If any unresolvable disagreements arise they will be referred to IAMC.

All recommendations will be provided as drafts to the IAMC for their approval.

Technical involvement by stakeholders

The MLSC will be asked to provide a biologist to work with the committee and the technical sub-committee. The technical contact will not formally sit on the committee but will be expected to review information and provide input to committee and subcommittee members. Other stakeholders may also designate a technical contact.

Committee Mandate and Tasks

1. The committee will initiate and/or ensure completion of research, inventory and mapping projects required to develop integrated caribou habitat management strategies for Eastern and Itcha-Ilgachuz caribou populations. Within the context of the CCLUP and subsequent implementation direction, these strategies will attempt to develop the best options to maintain caribou habitat at the stand and landscape levels. The strategies will address the CCLUP requirements for modified harvest areas including the identification of 35% of the existing deferral areas for modified harvest.
2. The modified harvest areas will be selected to best maintain caribou values while taking into account timber values and making the best use of overlap opportunities to better meet all CCLUP targets. Opportunities for modified harvest in the 3 TSAs will be assessed. The 35% modified harvest and 65% no harvest areas will be identified on 1:20,000 scale maps.
3. The committee will identify operational management strategies, including stand level and landscape level recommendations, for Eastern and Itcha-Ilgachuz caribou.
4. The committee will develop and define modified harvesting for caribou habitat.
5. The committee will define portions of the caribou range which are sensitive to snowmobile use.

Products	**Target Dates**	
Input to STTAA	Short term	Completed
Interim Caribou Strategy	1995-1996	Completed
Updated Draft Identification of Modified Harvest Areas	June 1998	
Annual Progress Reports (to IAMC and RRB)	Annually in April	

Caribou Strategy (a) Itcha-Ilgachuz and (b) Eastern June 2000

- interim result of research and inventory to December 31, 1999, to be available for planning purposes

Analysis of research and inventory data completed by December 2000

(See Attachment #2; Workplan Timelines)

Appendix 2: IAMC Memo dated July 6, 1998

BRITISH COLUMBIA

July 6, 1998

File 204-20/IC/005

To: John Youds
Chairperson
Cariboo Strategy Committee

This letter is in response to your memo of June 23, 1998 regarding the application of Cariboo Chilcotin Land Use Plan (CCLUP) Itcha-Ilgachuz Caribou area based targets. The following is Cariboo Mid-Coast Inter-Agency Management Committee (IAMC) direction on the five issues raised in your memo.

1. The basis for the Itcha-Ilgachuz Caribou targets is the moderate risk option identified by the Western Caribou Working Group as modified by the CCLUP and the Integration Report. The CCLUP states "Based on the area which is currently proposed by the Western Caribou Working Committee for deferral under their moderate risk option, 65% of the forest land base deferred under this option has been assumed to be not available for harvest and the remaining 35% was assumed to be available under more sensitive harvesting practices." In addition, the moderate risk option includes modified harvest areas outside the deferral area. The map titled "Itcha-Ilgachuz Approved Integrated Management Areas" and dated June 8, 1995, defines the boundaries of the moderate risk option. This map, in conjunction with sub-unit boundaries, is to be used to determine the no-harvest and modified harvest areas by sub-unit. IAMC envisions some flexibility exists to adjust the distribution following an assessment of the impact on other targets and values.

2. As outlined above, the distribution of the target by sub-unit will be determined by overlaying the sub-unit boundaries on the moderate risk map.

3. See response #1.

4. It is IAMC's belief that some flexibility exists to shift portions of the no-harvest and modified harvest from areas within the moderate risk option area to areas outside within a sub-unit. Adjustments of this type must not negatively impact the achievement of other CCLUP targets and IAMC's evaluation of a recommendation of this type will include an assessment of its impact on achieving other targets.

5 IAMC also believes flexibility exists to shift portions of both the no-harvest and modified harvest areas between sub-units, again subject to the provision that this transfer of target between sub-units does not adversely affect the meeting of other CCLUP targets. The shifting of caribou management areas between sub-units has the potential to affect the target balance achieved in the Integration Report. The IAMC, in evaluating the overall recommendations as well as any

specific proposal to move caribou management area between sub-units, will determine if the proposal is consistent with the balance achieved in the Integration Report

I trust the above addresses the issues raised in your memo. Should you require further clarification please contact the Implementation Committee

Mike Carlson
IAMC Chair

Appendix 3: Managing for Natural-Disturbance-Seral-Distribution of older forest age classes within the Anahim Round Table Sub-regional Plan through balancing of the Equivalent Excluded Area associated with Northern Caribou target capital

Introduction

The Caribou Committee believes that managing for natural proportions of older forest age classes within identified Sub-boreal Pine Spruce (SBPS) biogeoclimatic (BEC) zone variants within the Anahim Round Table (ART) Sub-regional Plan (SRP) is more appropriate for caribou management than the prescriptions identified for the caribou modified-harvest area which is primarily within the Montane Spruce BEC zone. In order to meet the requirements of the CCLUP and balance the Equivalent Excluded Area (EEA) associated with identified caribou target within the ART SRP, the following procedure was developed. In brief it involved:

1. Considering natural proportions of age forest for Natural Disturbance Type (NDT)3 SBPS,
2. Calculating contribution of ART SRP constraints to meeting natural seral targets,
3. Calculating the EEA costs associated with the remaining natural seral targets,
4. Calculating the EEA cost associated with expansion of the 1998 Caribou modified-harvest polygon, and
5. Calculating the EEA capital available due to reduction in the 1998 caribou modified-harvest polygon.
6. Calculating the EEA capital available due to reduction in the 1998 caribou no-harvest polygon.

Procedure

1. Considering natural proportions of older forest age classes for SBPS NDT3.

Managing for natural proportions of age forest for NDT3 SBPS is expected to maintain caribou populations in the ART SRP area by allowing for some stands to grow to an age that will allow for terrestrial lichens to become abundant and provide foraging opportunities. The disturbance return interval for Biogeoclimatic Subzones are identified in the *Biodiversity Guidebook*, Table 10, Seral Stage definition for biogeoclimatic zones in NDT3 (see Table 1). Natural portions of forest age classes are defined in the *Biodiversity Guidebook* Table A4.2 Landscape percentage based on disturbance return interval (see Table 2). From Tables 1 and 2 the targets for natural proportions of age forest are inferred (Table 3).

Table 1. Mean event interval by biogeoclimatic zone in NDT3 (from Table 10 *Biodiversity Guidebook).*

Biogeoclimatic unit	Mean event interval (years)
SBPS	100

Table 2. Landscape percentage based on disturbance return interval (from Table A4.2 *Biodiversity Guidebook).*

Age (year)	Percent of Landscape (disturbance return interval of 100 years)
<20	18%
<40	33%
>80	45%
>100	37%
>120	30%
>140	25%
>250	8%

Target areas were calculated using the productive forest area (PFA) for all other resources (definition identified in Appendix 10, Integration Report) of a

specified Landscape Unit (LU)/BEC. The PFA is multiplied by the proportion (Table 3) to give an area for each target age. PFA and target areas for select ART LU SBPS variants are listed in Table 4.

Table 3. Modelling age and proportion.

Age (years)	Target age (years)	Proportion (%)
80-120	100	15
121-140	130	5
>140	140	25

2. Calculating contribution of ART SRP constraints to meeting natural seral targets.

Portions of the targets identified in Table 4 are met by other identified ART SRP constraints. All no-harvest constraints were assumed to contribute 100% to meeting the target for >140 years. Thus the target area for >140 years was reduced by the amount of the no-harvest identified in the ART SRP rollup analysis. No-harvest constraints identified in the ART SRP included the Dean River Corridor, Riparian Reserves, Class A Lakes, Trail Reserves, Riparian Top-up and Long-term Old Growth Management Area's (OGMA's).

Non-spatially defined wildlife tree patches (WTP) contribute a no-harvest amount to the ART SRP role-up analysis. In the role-up WTP no-harvest accounted for .68 percent of the ART SRP PFA. In this analysis, the >140 year target was reduced by 0.68 percent of the LU/BEC PFA.

Additionally, ART SRP constraints with a prescription age greater than one of the identified target ages was assumed to have a theoretical contribution to that target age. The formula for the theoretical contribution factor (TCf) follows:

TCf = 1-(TA/PA)
where: TCf = theoretical contribution factor
TA = target age
PA = prescription age

Prescription age is the time required, given ART SRP assumptions, to completely harvest a polygon under an associated constraint.

Prescription age is calculated as follows:
PA = (RA/(1-EEA)
where: PA = prescription age
RA = rotation age as defined by integration (pine = 80 years, other species = 120 years)
EEA = equivalent excluded area factor identified in ART SRP

Table 5 shows the TCf given pine forest, for various constraints identified in the ART SRP. Theoretical contribution factors are applied to the associated constraint area (at the LU/BEC level) identified in the ART SRP rollup analysis to give a theoretical

Table 4. Target area for identified Landscape Unit SBPS variants.

Landscape Unit	BEC Unit	PFA (ha)	140 yrs+ (ha)	121 – 140 yrs (ha)	80 - 120 yrs (ha)
Beeftrail	SBPSmc	4,537	1,134	227	681
Christenson Creek	SBPSmc	4,754	1,188	238	713
Hotnarko	SBPSxc	5,535	1,384	277	830
Telegraph	SBPSxc	9,280	2,320	464	1,392
Tusulko	SBPSmc	1,300	325	65	195
Tusulko	SBPSxc	9,174	2,294	459	1,376
Holtry	SBPSxc	15,670	3,917	783.5	2,351
Total		**50,250**	**12,562**	**2,313.5**	**7,538**

contribution area (TCA). The target area was reduced by the TCA.

As a result of managing for the >140 year target there is an additional non-spatial contribution to the 130 and 110 year targets. Given the 187 year rotation age associated with the 25% greater than 140 year target (see section 3) and an assumed equal age class distribution of this non-spatial constraint, a contribution equal to 1/187(difference in years that provided the target age)(area associated with >140 target). These areas are reduced from the 100 and 130 year targets. Table 6 indicates the target areas remaining after all reductions.

Table 5. Theoretical contribution factors for various ART modified-harvest constraints.

Prescription	Prescription Age RA/ (1-EEA)	EEA of Pine Stands	Theoretical Contribution to 140 yrs = (1-(140/PA)	Theoretical contribution to 130 yrs = (1- 130/PA)	Theoretical contribution to 100 yrs = (1-(100/PA)
Retention Visual	400.00	0.80	0.65	0.68	0.75
Class B Lake	200.00	0.60	0.30	0.35	0.50
NA	160.00	0.50	0.13	0.19	0.38
Caribou Modified	153.85	0.48	0.09	0.15	0.35
RMZ	106.67	0.25	0.00	0.00	0.06
Partial Retention	100.00	0.20	0.00	0.00	0.00

Table 6. EEA requirements to account for the net remaining target area not met by other constraints.

LU	BEC Unit SBPS	PFA (ha)	Remaining >140 yr Require-ment (ha)	Non-spatial Area Associated with remaining >140 requirement (remaining requirement/.25)	EEA Associated with Remaining 140 yr Requirement	Remaining 121-140 yr Requirement (ha)	Remaining 80-120 yr Requirement (ha)	EEA @ 130 (blended .36)	EEA @ 100 (blended .18)	EEA Sum
Beef-trail	mc	4537.4	345.1	1380.2	786.7	79.3	360.7	28.6	66.4	881.7
Christ. Creek	mc	4753.6	373.9	1495.5	852.5	77.7	382.8	28.0	70.4	950.9
Hot-narko	xc	5535.2	77.6	310.2	176.8	243.6	755.3	87.8	139.0	403.6
Tele-graph	xc	9279.8	267.8	1071.1	610.5	349.4	1147.1	126.0	211.1	947.6
Tusulko	mc	1299.7	39.4	157.5	89.8	48.1	156.8	17.4	28.8	136.0
Tusulko	xc	9174.4	790.3	3161.3	1801.9	120.6	663.5	43.5	122.1	1967.5
Holtry	xc	15670.0	1307.3	5229.2	2980.7	210.8	1075.5	76	197.9	3254.6
Total										**8,541.9**

3. Calculating the EEA costs associated with the remaining natural seral targets (Non-spatial area associated with remaining >140 requirement and related EEA calculations)

Within each LU/BEC with a remaining >140 year requirement there is an associated (non-spatial) area. As the remaining requirement is based on a 25% target, the associated area is 1/.25 or four times the remaining >140 year requirement area. To capture the 25% target, the associated area is managed with a prescription age of 140/.75 or 187 years.

Blended EEA is a method of area weighting the average EEA associated with pine and other species when combined. The ART SRP role up analysis found the pine/other ratio over approximately 90,000 ha was 92/8. As a result the blended EEA factor for a PA of 187 years is 0.57. The equivalent excluded area for the area associated with the remaining >140 target was calculated as 0.57(4)(remaining >140 year target).

As the targets for 100 and 130 years are average ages rather than a minimum, there was no additional associated area. The blended EEA for 100 and 130 years are 0.18 and 0.36 respectively.

Table 6 shows the remaining targets, the >140 year associated area and the EEA associated with the various targets.

4. Calculating the EEA cost associated with additions to the Caribou Modified-Harvest Polygon

New caribou modified-harvest polygon areas not previously identified have an EEA cost. In order to calculate the EEA associated with these new areas, each polygon was queried for PFA. This PFA was multiplied by the blended EEA factor for caribou (0.46) to give a base EEA for new caribou modified-harvest areas. The base EEA is net of all no-harvest constraints. From this base EEA, the EEA associated with other constraints ranked, in the ART SRP, below caribou modified-harvest was reduced. The calculations are summarized in Table 7.

5. Calculating the EEA capital available due to reductions in the caribou modified-harvest polygon

The EEA capital available for inclusion in the natural seral polygon is due to the elimination of portions of the caribou modified-harvest polygon. In order to calculate the EEA associated with these areas, the eliminated portion of the polygon was queried for the PFA of both pine and other species (note: as this area was identified in the ART SRP rollup analysis it could be queried for the amount of pine and other species; areas not previously identified could not be queried and had the blended EEA factor applied). The PFA of the pine and other species areas were multiplied by the EEA factors associated with the caribou modified-harvest polygon for pine and other species, respectively. The EEA was summed and then reduced by the EEA associated with Riparian Management Zones and Partial Retention Visual giving the net EEA capital available. Table 8 shows the PFA, EEA and associated reductions. Table 9 summarizes the calculations establishing the net EEA capital available due to the changes.

Table 7. EEA cost of expansion of the caribou modified-harvest zone

382.2	Additional EEA associated with 2002 caribou modified- harvest area not identified in the 1998 strategy (previously unconstrained)
4.8	Less riparian management zone identified in the ART SRP within new modified-harvest area
0.0	Less partial retention visual identified in the ART SRP
377.4	Net cost of expansion of modified harvest zone

6. Calculating the EEA capital available due to reduction of the Caribou No-Harvest Polygon (no-harvest to modified-harvest and no-harvest to conventional-harvest)

Further EEA capital was made available due to the conversion of portions of the no-harvest area into modified-harvest (see Table 10). In order to calculate the EEA associated with this conversion, the converted portion of the polygon was queried for the PFA. This area was then reduced by the PFA associated with other no-harvest prescriptions identified in the area through the ART SRP. The remaining area (695 ha.) was multiplied by 0.9 (the EEA associated with no-harvest in the ART SRP) to give the initial EEA for the converted polygon (625.5). The resultant area was also multiplied by the blended EEA associated with the modified-harvest polygon (0.46). The EEA associated with no-harvest was reduced by the EEA associated with modified-harvest to calculate the gross EEA associated with the conversion (305.8). The converted area was then checked for modified prescriptions that were ranked above caribou modified-harvest in the ART analysis. These modified prescriptions included Visual Retention and Class B Lake which did not exist in this conversion area. Thus the reduced gross EEA associated with the conversion became the net EEA capital associated with the conversion.

Additional EEA capital was available due to the conversion of portions of the caribou no-harvest polygon to conventional-harvest. In order to

Table 8. EEA Capital available due to reductions in the modified-harvest polygon by LU/BEC variant

Landscape Unit	BEC Variant	Caribou MH Pine Area (ha)	Pine EEA @ factor 0.48	Caribou MH Other Area (ha)	Other EEA @ factor 0.21	Total Caribou MH EEA Capital (Pine EEA + Other EEA) (ha)	RMZ Area	EEA RMZ @ factor 0.25 (ha)	PR Pine Area	EEA Visual PR @0.2 (ha)
Beeftrail	MS xv	105	50	0	0	50	10	2		
Beeftrail	SBPSmc	281	135	20	4	139	28	7		
Christenson Creek	ESSFxv	24		21						
Christenson Creek	MS xv	1,934	928	237	50	978	115	29	64	13
Christenson Creek	SBPSmc	1,126	540	285	60	600	43	11		
Christenson Creek	SBPSxc	234	112	29	6	118	32	8	10	2
Corkscrew	MS xv	1,042	500	472	99	599	72	18		
Holtry	MS xv	653	313	0	0	313	7	2		
Upper Dean	ESSFxv	5	2	0	0	2		0		
Upper Dean	MS xv	1,840	883	152	32	915	78	19		
Upper Dean	SBPSmc	9,047	4,343	1,458	306	4,649	666	166	19	4
Total						**8,365.4**		**262.8**		**14.8**

calculate the EEA associated with this conversion, the converted portion of the polygon was queried for the PFA. This area was reduced by the PFA associated with other no-harvest prescriptions identified in the area through the ART SRP. In the ART roll-up analysis caribou no-harvest was modelled above no-harvest constraints of OGMA and riparian top-up. No OGMA or riparian top-up constraints were identified in the area. The resultant area was multiplied by 0.9 (the EEA associated with no-harvest in the ART SRP) to give the initial EEA for the converted polygon. This gross EEA was then reduced by the EEA associated with all ART modified prescriptions.

Modified prescriptions mapped in this are were limited to WTP and RMZ. The net EEA factor associated with RMZ for this area was calculated as 0.9 (No-harvest EEA) less 0.25(RMZ EEA)= 0.65. Due to the method of analysis the net EEA was additional capital (see Table 11).

Table 9. Summary of EEA capital available due to the reduction in the modified-harvest area.

8,365.4	1998 Caribou MH EEA exclusive of 2000 MH areas
262.8	Less RMZ EEA nested below Caribou MH
14.8	Less Partial Retention visual EEA nested below RMZ
8,087.8	Net EEA Capital Associated with 1998-2001 Caribou Modified Harvest Changes

Table 10. Area associated with conversion of no-harvest to modified-harvest.

Landscape Unit	BEC Variant	PFA (No-Harvest to Modified-Harvest)
Christenson Creek	ESSFxv 1	20
Christenson Creek	MS xv	21
Upper Dean	MS xv	655
Total		**695 ha.**

As stated earlier non-spatially defined wildlife tree patches (WTP) contribute a no-harvest amount to the ART SRP role-up analysis. In the role-up WTP no-harvest accounted for .68% of the ART SRP PFA. For this polygon the PFA is multiplied by .68 to calculate the WTP EEA. WTP EEA was calculated as 669 ha X .0068 = 5 ha. The WTP EEA was reduced from the Total EEA capital mentioned above.
The net EEA capital associated with the no-harvest / conventional harvest conversion amounted to 592.6 hectares.

Summary

This lengthy and detailed analysis was undertaken to insure that refinements to caribou no-harvest and modified-harvest areas and the creation of the natural-disturbance-seral-distribution polygon did not create additional timber access constraints within the ART SRP. The analysis not only considered the shifting of caribou target but how

Table 11. EEA associated with conversion of no-harvest to conventional harvest.

Landscape Unit	BEC	Previous No Harvest PFA (ha)	Previous No-harvest EEA (@0.9)	RMZ area within No-harvest (ha)	Net RMZ EEA (No-harvest EEA - RMZ EEA = 0.9-0.25=0.65)	Total EEA capital
Christenson Creek	MS xv	51.7	46.5	1.6	1.0	
Upper Dean	MS xv	592.3	533.1	16.2	10.5	
Upper Dean	SBPSmc	7.2	6.5			
Total			**586.1**		**11.6**	**597.6**

those shifts in caribou target affected other constraints (i.e. visuals or OGMA's). The analysis utilized EEA estimates as the basis for measuring the costs and capital generated by the adjustments.

The following is a summary of the EEA costs associated with the changes:

NDSD Area	8541.9
Conventional to modified-harvest	377.4
Total EEA Cost	8919.3

A summary of EEA capital generated by the changes follows:

Modified to conventional-harvest	8087.8
No-harvest to modified-harvest	305.8
No-harvest to conventional	592.6
Total EEA Capital	8986.2

The adjustments resulted in slightly less cost created than capital generated (66.9 less EEA or a 0.75% difference). As a result the natural-disturbance-seral-distribution target area and other proposed changes are believed to be consistent with ART SRP modelling and analysis.

Appendix 4: Northern Caribou and Access Management

Caribou populations can only be maintained if all of the following issues are addressed together:

1. Maintaining suitable caribou habitat within existing caribou range
2. Limiting and regulating roaded and unroaded access in caribou habitat
3. Managing predation levels on caribou

Road construction to allow timber harvesting throughout much of the range of northern caribou will exacerbate access management issues. There will need to be concessions from all sectors that influence northern caribou negatively, including recreationalists, if caribou are to survive. This will mean creating separate zones for activities such as snowmobiling or other forms of motorized recreation so that these two land uses can co-exist.

Both Direct and Indirect Impacts Occur

An impact can be defined as an alteration, which may negatively or positively effect the environment, as a consequence of human land use or development activities (Shideler *et al*. 1986). Direct impacts are defined as those acting on the animals themselves while indirect impacts are those acting on the habitat, either by changing it or by disrupting the use of it by caribou or other wildlife species (Shideler *et al.* 1986). Direct impacts of linear developments can include the creation of physical barriers to movement or direct mortality due to vehicle collisions. Indirect impacts may occur through habitat loss, habitat alteration, habitat avoidance or improved access.

Concerns about improved access

In areas where ungulates are not hunted, animals may become less wary to the presence of humans (MacArthur et al 1982). Increasing access by way of developing a network of roads and packed trails throughout an animal's range, makes them more likely to be encountered by humans (Lyon 1984, Frederick 1991, O'Neil 1993). As a result, ungulates become more vulnerable to poaching and over-hunting.

Wolf predation, in particular, is often responsible for adult mortality and low calf survival in caribou populations (Gasaway et al 1983, Stevenson and Hatler 1985, Bergerud and Ballard 1988, Seip 1991,). Much of this mortality occurs during the summer and autumn seasons. Research has shown that wolves travel faster and are found closer than random locations to linear corridors (James and Stuart-Smith, 2000). During the winter months there is frequently minimal overlap between wolf and caribou winter ranges as moose are often the wolves primary prey and are often spatially separated from caribou. As such, snowmobile trail networks can provide new or improved mobility for predators to caribou winter range areas, which may increase predation rates, resulting in fewer animals (Neumann and Merriam 1972, Bloomfield 1979). This concern has been observed locally during a wolf survey undertaken in the west Chilcotin during the 1998-99 winter where extensive use of snowmobile trails by wolves was observed in the vicinity of Itcha Ilgachuz Provincial Park (Roorda and Dielman in prep.). Furthermore, reducing snowmobile numbers in a given area does not eliminate predator access to winter range as a result of established snowmobile trails.

Habitat Avoidance Issue

Caribou have been observed to use habitat close to roads and seismic lines less than expected (Dyer 1999,;James and Stuart-Smith 2000; Oberg 2001). Such avoidance patterns are thought to reduce the useable habitat for caribou. During late winter

(January -April) the alpine becomes the destination area for northern caribou where they concentrate on windswept ridges where terrestrial lichen is available as forage. In recent years, demands for subalpine and alpine recreational opportunities have increased throughout the province. Roads to high elevation cutblocks have resulted in increased recreational activity on caribou winter ranges throughout the Cariboo Region . Improved access along with increasing interest in recreational snowmobiling and more powerful machines that are able to traverse most caribou ranges may represent a threat equal to forestry-related habitat loss.

As a result of snowmobile activity, ungulates have been observed to abandon habitat, increase home range size or increase activity during normally inactive periods (Dorrance 1975, Eckstein et al 1979, Simpson 1987). Although caribou are known to shift between wintering areas during different years, locally, there is a large body of evidence accumulating that suggests that caribou are abandoning areas of preferred habitat within the Quesnel Highland due to increased snowmobile activity. Observations suggest that caribou may tolerate low levels of snowmobile use, but avoid areas of repeated high use. As a result of increased snowmobile activity throughout their range, it appears animals are being displaced out of their traditional areas. There is a concern that alternative areas may be poorer quality habitat where caribou are at higher risk to mortality. Also, displacement results in shrinking the amount of winter range available to caribou. When caribou are forced to occupy smaller range it is thought that there is a corresponding decrease in population levels. Similar concerns exist for caribou high elevation wintering areas in the Chilcotin.

Disturbance Issue

Snowmobile activity within ungulate winter range can increase the amount of energy expended when animals react to avoid close contact with machines and riders (Geist 1975). How animals respond and how much energy they expend depends on many factors (McLaren and Green 1985, Fancy and White 1986, Simpson 1987, Tyler 1991) including;

- the degree of previous harassment
- animal activity prior to disturbance
- snow depth and compaction
- visibility
- wind speed and direction, and
- topographic features

For ungulates in poor physical condition, or during particularly harsh winters, increased energy expenditure could seriously threaten winter survival.

How does wildlife respond to disturbance?

Wildlife exhibits a wide range of behaviour around people. Whittaker and Knight (1998) suggest that wildlife have developed situation-specific responses because some combination of learning and genetics has made them successful. In general wildlife responses can be grouped into three categories;

- attraction
- habituation, or
- avoidance

Gilbert (1989) suggests that an animal can find human provided stimuli reinforcing (leading to attraction), aversive (leading to avoidance), or neutral (leading to habituation). The consequences of wildlife responses are not always immediate, direct or obvious.

Why is disturbance of such concern?

It is generally recognized that most wild ungulates inhabiting the northern part of North America are in a negative energy balance during winter. As a result, severe or repeated human disturbance to ungulates could result in negative effects such as reduced growth rates, poor body condition or decreased reproductive rates, that may in turn reduce adult and calf survival rates (Webster 1997). Harassment may result in anything from slight increase in vigilance to panicked flight, with equally variable consequences to the animal (Jakimchuck 1980, Schideler et al 1986). Human activities such as hiking, snowmobiling, low altitude aircraft flights and All Terrain Vehicle use have all been shown to cause disturbance to wildlife (Webster 1997).

Why is there such a concern about snowmobiling in caribou range?

Simpson and Terry (2000) developed a conceptual framework that ranks the relative degree of threat from backcountry skiing, snowcat skiing, heli-skiing and snowmobiling to mountain caribou. Potential negative impacts were assumed to be greater for motorized activities as compared to non-motorized activities and assumed to increase as the size of the affected area increases. The very high magnitude of potential effects from snowmobiling is partly related to accessibility. As road access improves and expands over time, few areas will remain inaccessible to snowmobiling. Potential conflicts from other backcountry recreation activities are expected to occur over a smaller portion of caribou range.

Snowmobile activity in caribou winter range has the potential to influence animals in several ways;

- human use could displace northern caribou from preferred habitat with a resultant increased risk of mortality.
- packed trails could provide improved access for predators and poachers resulting in increased mortality.
- direct harassment would increase energy expenditure or risk of injury.

In summary, snowmobile use in ungulate winter range could cause the daily energy expenditure of ungulates to increase, wolf predation to rise or the displacement of animals from traditional range to occur.

Management principals for assessing and reducing outdoor recreation impacts on caribou

Although the effects of snowmobiling on various ungulates have been investigated, the scientific literature available on the impacts of snowmobile activity and human disturbance on caribou is incomplete. Thus the following principles where utilized to develop management guidelines to reduce potential impacts between caribou and snowmobiling.

Adaptive Management Principle - where scientific studies are lacking, adaptive management should be employed to develop scientifically supportable guidelines for outdoor recreation activities.

Environmental Stewardship – outdoor recreational activities must not impact environmental integrity, and only use land resources within their capacity to sustain use, while maintaining biological diversity.

Precautionary Principle – the precautionary principle, as applied to the impacts of outdoor recreational activities on wildlife means that where there are threats of serious or irreversible impacts to wildlife population viability, lack of full scientific certainty should not be used as a reason for postponing measures to regulate disturbance activities from motorized recreation.

Scientific Basis Principle – management guidelines for sustainable use of wildlife must be scientifically based, and supportable from available research or field studies. Where adequate scientific studies are lacking upon which to base management recommendations, interim recommendations should be based on a combination of best professional opinion and the precautionary principle.

Management Guidelines for Snowmobile Zoning within Northern Caribou Range

The regional caribou strategy committee recommend the following guidelines in an attempt to minimize conflicts between northern caribou and snowmobiling.

1. **At the landscape level, a few small, intensively used areas will have less impact on caribou than several large areas receiving moderate use.**
2. **Designated snowmobile areas should avoid high use caribou areas.** High elevation caribou wintering areas have been identified from radio-telemetry data and winter population surveys. These include the north side of the Itcha, Ilgachuz and Rainbow Mountains and the alpine area in the vicinity of Trumpeter mountain.
3. **Designated snowmobile areas should avoid Mountain Goat winter range.** These areas are very rugged terrain that also poses safety concerns to snowmobilers.
4. **To maximize use of designated snowmobile areas, they should be strategically located to ensure their accessibility from several communities.**
5. **Minimize the number of snowmobile trails to access high elevation riding areas through timbered no-harvest and modified-harvest areas as identified by the Regional Caribou Strategy.** These are considered high value caribou areas, where substantial compromise has already occurred through the Cariboo-Chilcotin Land Use Plan.
6. **Minimize the number of snowmobile trails through the timbered Natural Disturbance Seral Distribution polygon in the vicinity of Anahim Lake.** This area is considered high value caribou habitat, where substantial compromise has already occurred through the Cariboo-Chilcotin Land Use Plan.
7. **Where possible, snowmobile areas should be peripheral to caribou range.**

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Appendix 5: Risk Assessment Calculations (from Harper and Eastman 2000)

There is a need to provide a consistent and explicit basis for assessing risks so that management attention can be focused on the most critical issues. To provide this perspective, we adopted the risk assessment procedure used by the Compliance and Enforcement Branch (Ministry of Forests 1998). Initial risk assessment is based on two considerations: 1) the likelihood of a detrimental impact, and 2) the magnitude of the consequences. Given the lack of quantifiable assessments in the literature, qualitative judgments were used.

Initial risk assessment has the following steps:

1. identifying the detrimental impacts
2. estimating the likelihood of an adverse impact (rated as very high, high, moderate and low)
3. estimating the magnitude of the consequences of the impact, based on the impact and the intensity of an event (rated as very high, high, moderate and low)
4. combining the likelihood of impact with the magnitude of the impact to arrive an overall assessment of risk (rated as very high, high, moderate and low).

The table below presents the rating system applied in this report. The resulting assessment is a list of hazards or risks that is explicit and ranked.

LIKELIHOOD	X	MAGNITUDE	=	RISK*
Very High	X	Very High	=	Very High
Very High	X	High	=	Very High
High	X	Very High	=	Very High
High	X	High	=	Very High
Very High	X	Moderate	=	High
High	X	Moderate	=	High
Moderate	X	Very High	=	High
Moderate	X	High	=	High
Very High	X	Low	=	Moderate
High	X	Low	=	Moderate
Moderate	X	Moderate	=	Moderate
Low	X	Very High	=	Moderate
Low	X	High	=	Moderate
Moderate	X	Low	=	Low
Low	X	Moderate	=	Low
Low	X	Low	=	Low

Appendix 6: Key Questions and Answers in Relation to the Northern Caribou Strategy

1. **Many think that habitat management in the Itcha-Ilgachuz Caribou Range should emulate natural disturbance patterns in the area. How does the Northern Caribou Strategy address this issue?**

   The whole strategy is built on the objective of maintaining northern caribou in the face of modern-day realities. Many of those realities were defined by the CCLUP. We can't go completely back to the natural disturbance patterns any more than we can eliminate logging, snowmobiles, fire control, roads, and other development.

   We have made substantial use of natural disturbance ecology in the development of the strategy. For example, the strategy recommends **copying** the natural disturbance seral distribution on 4.2 per cent of the caribou range in the natural-disturbance-seral-distribution zone. We know of nowhere else in the province where the natural seral distribution is being copied. Another 24.6 per cent of the range is in parks; while 51.8 per cent is in conventional-harvest zones, where the biodiversity guidelines still fully apply and silvicultural systems that mimic natural disturbance are encouraged. On 13.0 per cent of the range, modified-harvesting is recommended with block (disturbance) size designed to mimic natural disturbance. Stand-level prescriptions that are different from natural patterns are necessary to successfully manage for caribou in the face of a shrinking range.

2. **Many pine stands in the modified-harvest area are already over-maturing. The forest industry is concerned about 'how trees will be managed into older ages (e.g. more than 500 years). How is this addressed?**

   This strategy is about caribou — minimizing risk to caribou to maintain populations in the long term. Stands do not suddenly disappear. In the MS pine stands, trees more than 500 years old have been found. If 50 years from now a new approach is warranted, we have the option to cut trees. We do not have the option to replace trees and therefore replace caribou habitat if we do the wrong thing now.

   The Strategy encourages the forest industry to harvest the oldest stands first and to cut in the SBPS first, as pine has a shorter pathologic rotation in this zone. Interestingly, only 39.9 per cent of the modified-harvest area is older than 140 years and only 2.1 per cent is older than 250 years. Applying the even-flow guidelines and targeting the oldest stands first will limit the age at which trees are cut. To date, there has been reluctance on the part of licensees to do modified harvesting on three-quarters of the caribou range. We encourage the industry to promptly get into these areas and to target the oldest stands first. If properly implemented, there should not be stands more than 500 years old in the modified-harvesting zone.

   When the modified-harvest area is fully managed on 80 per cent of the stands, the oldest trees (excluding wildlife tree patches) will only be 140 years prior to harvest while on the remaining 20 per cent, trees will be allowed to grow to 240 years.

3. **Given the forest health concerns surrounding dwarf mistletoe and its prevalence in the SBPS, how much of the modified harvest is located in the SBPS zone?**

The vast majority of the modified harvest has been shifted out of the SBPS for MPB and mistletoe concerns. Now only 4825 ha of mapped SBPS remain representing only 2.7 per cent of the modified-harvest zone.

4. **The strategy provides specific recommendations for dealing with the current mountain pine beetle infestation. Have these been developed in consultation with forest health professionals and licensees?**

Yes.

5. **This strategy has been developed over the past six years. Have formal consultation activities been conducted with stakeholders?**

Yes. During development of the strategy, consultations with stakeholder representatives (major forest licensees and regional conservation council) were extensive. Consultation was also initiated with First Nations and local stakeholders..

6. **Are the current modified-harvest and no-harvest lines carved in stone?**

Certainty in the location of these zones is in everyone's best interest. This allows planning to take place without the fear that the picture will suddenly change. However, changes in the boundaries of these zones of up to 200 m are possible to address on-site realties. The mechanism for doing this is described in section 5.3. Additionally, the whole strategy should be reviewed every five years to ensure that objectives are being met. However, we do not anticipate the need to shift the location of these zones even then.

7. **The forest industry is concerned that "blanket" harvesting prescriptions are being advocated. Is this true?**

This is a misconception. Whereas licensees are presently using only one silvicultural system for virtually all the SBPS and MS zones on the Chilcotin plateau, we advocate several systems to address caribou habitat requirements. Within the natural-disturbance-seral-distribution zone and conventional-harvesting zone covering 4.2 and 51.8 per cent of the range respectively; licensees are free to use whatever silvicultural system they deem appropriate. Two different silvicultural systems are recommended for the modified-harvest zone with variations in opening size and shape allowed to address aspect (see sections 5.5 and 5.6). In the face of MPB within the modified-harvesting zone, clearcutting with green-tree retention is another option licensees have in certain circumstances (see Section 5.8). Additionally, larger partial cutting openings are allowed in the SBPS to address MPB (see Section 5.8).

8. **The forest industry is especially concerned about the applicability of the recommended systems on spruce sites or on sites with a forest floor dominated by moss. Is this a problem?**

These sites are often good arboreal-lichen stands and are valuable caribou habitat. Additionally, caribou habitat is more than just the presence of lichens. These stands often provide valuable cover for caribou adjacent to open areas such as wetlands.

Additionally, the recommended silvicultural systems have been shown to decrease moss cover in openings by allowing more light and heat to reach the forest floor (Waterhouse and Armleder, unpublished data). Therefore if these

sites are able to produce more terrestrial lichen, the recommended treatments will probably enhance terrestrial lichen abundance.

9. **Will predator (wolf) control be required in association with Caribou management in this area?**

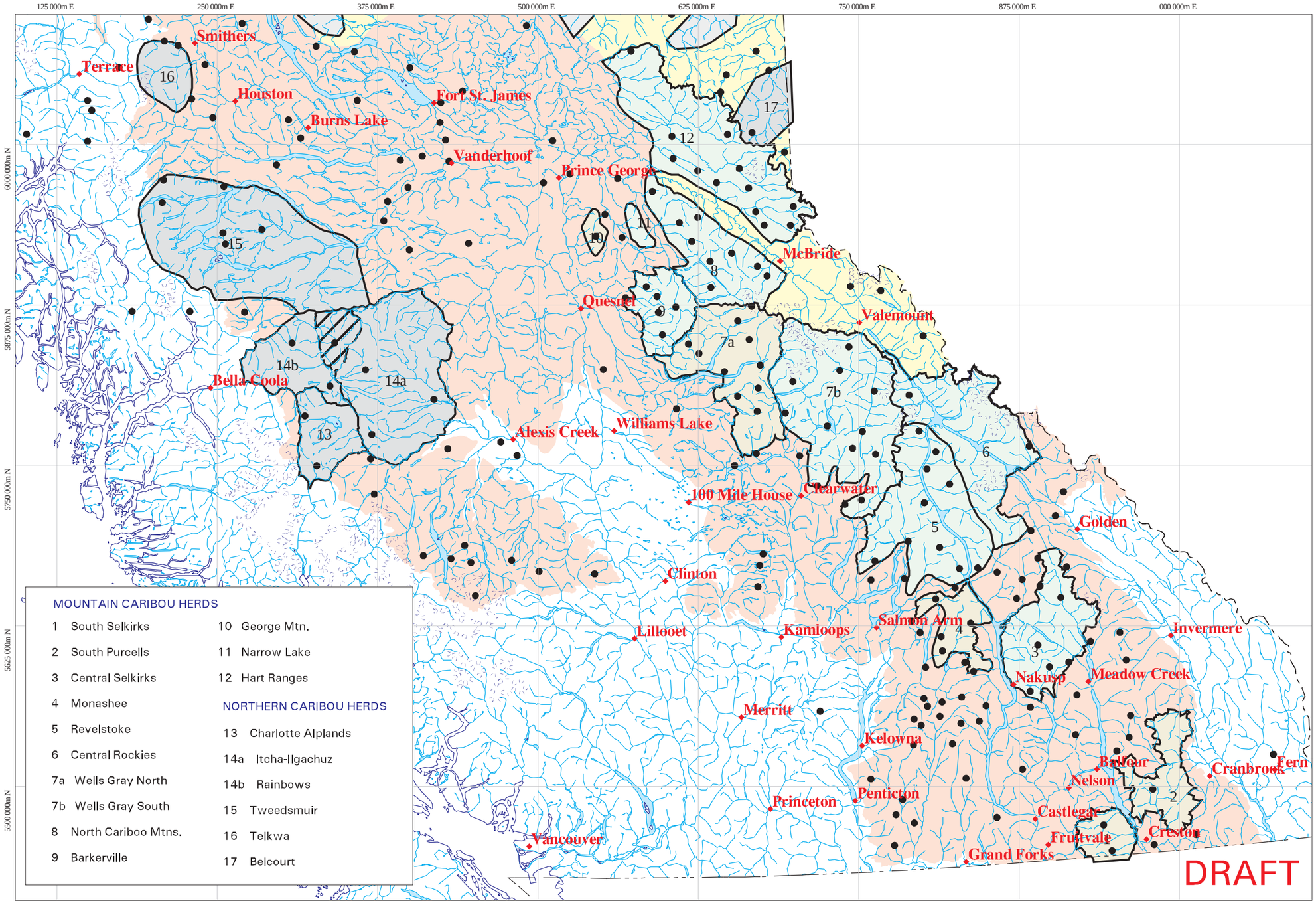
A wolf management program should be developed within northern caribou range. It is recommended that wolf reduction should be considered for caribou sub-populations where: there is imminent danger of extirpation or range reduction; and for which there is a Herd Recovery Action Plan or equivalent management strategy that requires predator reduction to meet recovery goals. The Rainbow herd is currently in decline and therefore is the priority area to implement wolf population reduction at this time.

10. **How is the issue of access management being addressed?**

Current knowledge suggests that the long-term persistence of northern caribou is dependent upon the perpetual supply of large, contiguous areas of suitable summer and winter habitat, with little or no vehicle access and human disturbance. In such areas, caribou can space out at low densities and reduce predation risk (Seip and Cichowski 1996).

The Northern Caribou Strategy partially addresses access management concerns by locating modified harvest in large, aggregated areas. If followed, this strategy will minimize access development across the entire caribou winter range, thereby reducing the overall impact of access development on the caribou population. Specific recommendations for motor vehicles, ATVs and snowmobiles use are outlined in the Access Management section of this report.

Historic and Current Distribution of Caribou in Southern BC



MOUNTAIN CARIBOU HERDS

1 South Selkirks
2 South Purcells
3 Central Selkirks
4 Monashee
5 Revelstoke
6 Central Rockies
7a Wells Gray North
7b Wells Gray South
8 North Cariboo Mtns.
9 Barkerville
10 George Mtn.
11 Narrow Lake
12 Hart Ranges

NORTHERN CARIBOU HERDS

13 Charlotte Alplands
14a Itcha-Ilgachuz
14b Rainbows
15 Tweedsmuir
16 Telkwa
17 Belcourt

BRITISH COLUMBIA

Map 1

- Extirpated
- Declining
- Stable
- Trace Occurences
- Northern Caribou Herds
- Overlap Between Herds
- Historic Observations of Caribou
- City

scale = 1:3,150,000

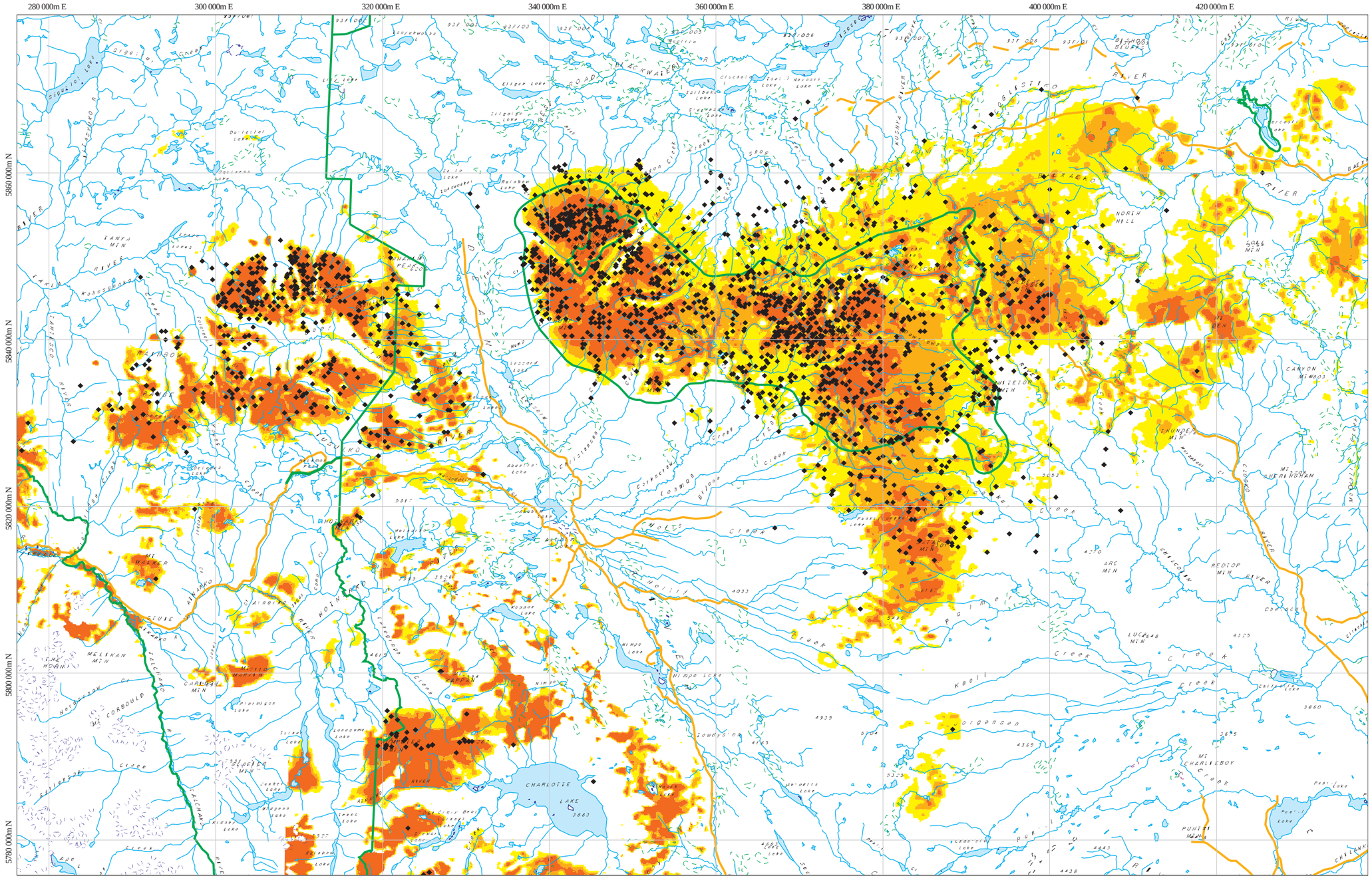
100 km

Produced by the Resource Information Group
Ministry of Sustainable Resource Management
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - April 17, 2002

Northern Caribou Predicted Habitat: 'Summer'



BRITISH COLUMBIA

Map 2

- good habitat class (p > 0.4)
- better habitat class (p > 0.5)
- best habitat class (p > 0.6)
- Provincial Parks
- Main Roads
- Proposed Roads
- Caribou Relocation

Source of Data:
Cichowski 1993 (1984-1988)
Apps, Kinley & Young 2001 (1995-2000)

NOTE: Charlotte Alplands telemetry points were not used to generate the habitat models.

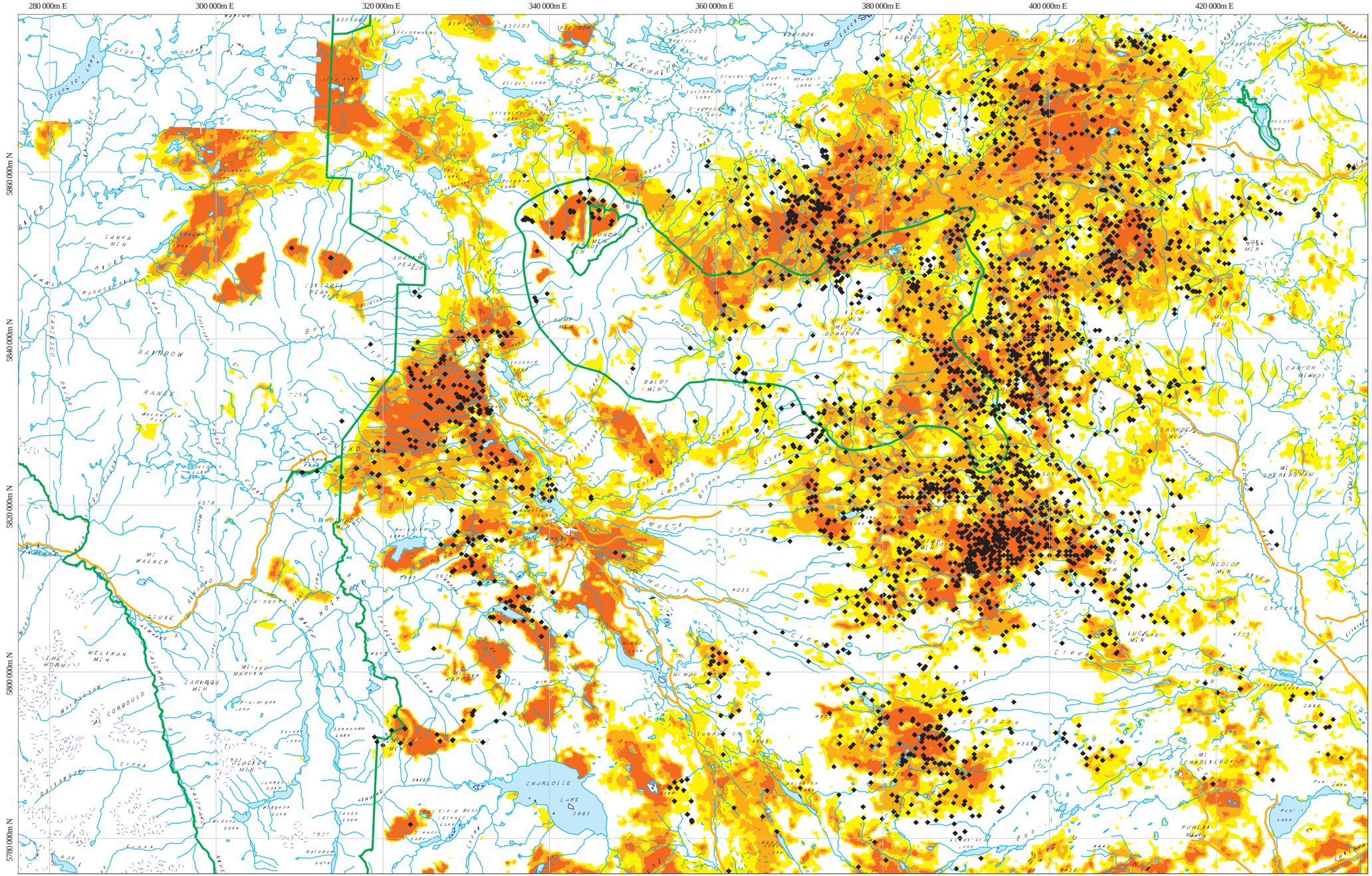
10 km
scale = 1:500,000

Produced by the Resource Information Group
Ministry of Sustainable Resource Management
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805317 - April 02, 2002

Northern Caribou Predicted Habitat: 'Winter-Forest Dwelling'



BRITISH COLUMBIA

Map 3

- good habitat class (p > 0.4)
- better habitat class (p > 0.5)
- best habitat class (p > 0.6)
- Provincial Parks
- Main Roads
- Proposed Roads
- Caribou Relocation

Source of Data:
Cichowski 1993 (1984-1988)
Apps, Kinley & Young 2001 (1995-2000)

NOTE: Charlotte Alplands telemetry points were not used to generate the habitat models.

10 km

scale = 1:500,000

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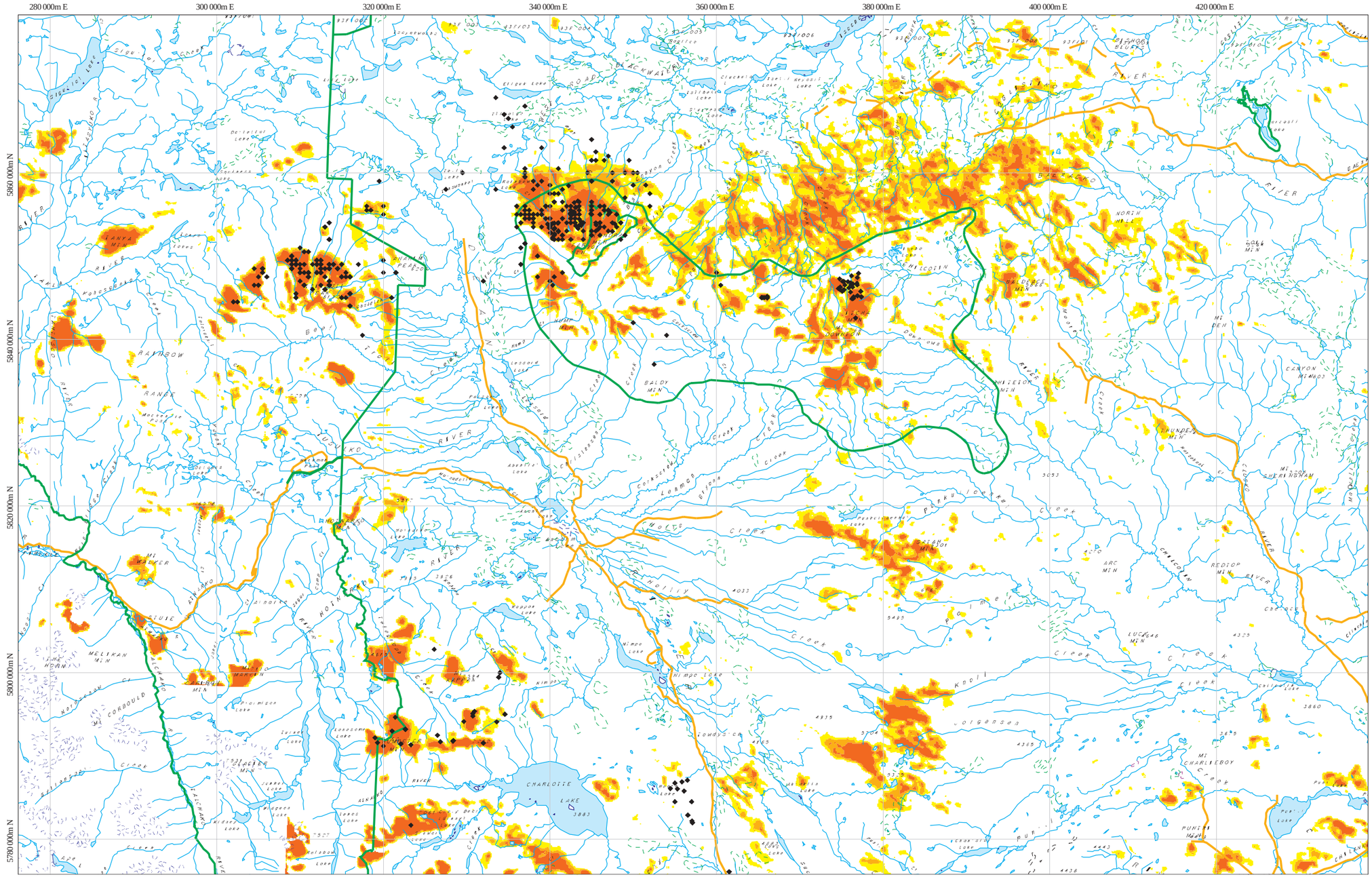
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805317 - April 02, 2002

Northern Caribou Predicted Habitat: 'Winter-Alpine Dwelling'



BRITISH COLUMBIA

Map 4

- good habitat class (p > 0.4)
- better habitat class (p > 0.5)
- best habitat class (p > 0.6)
- Provincial Parks
- Main Roads
- Proposed Roads
- Caribou Relocation

Source of Data:
Cichowski 1993 (1984-1988)
Apps, Kinley & Young 2001 (1995-2000)

NOTE: Charlotte Alplands telemetry points were not used to generate the habitat models.

10 km

scale = 1:500,000

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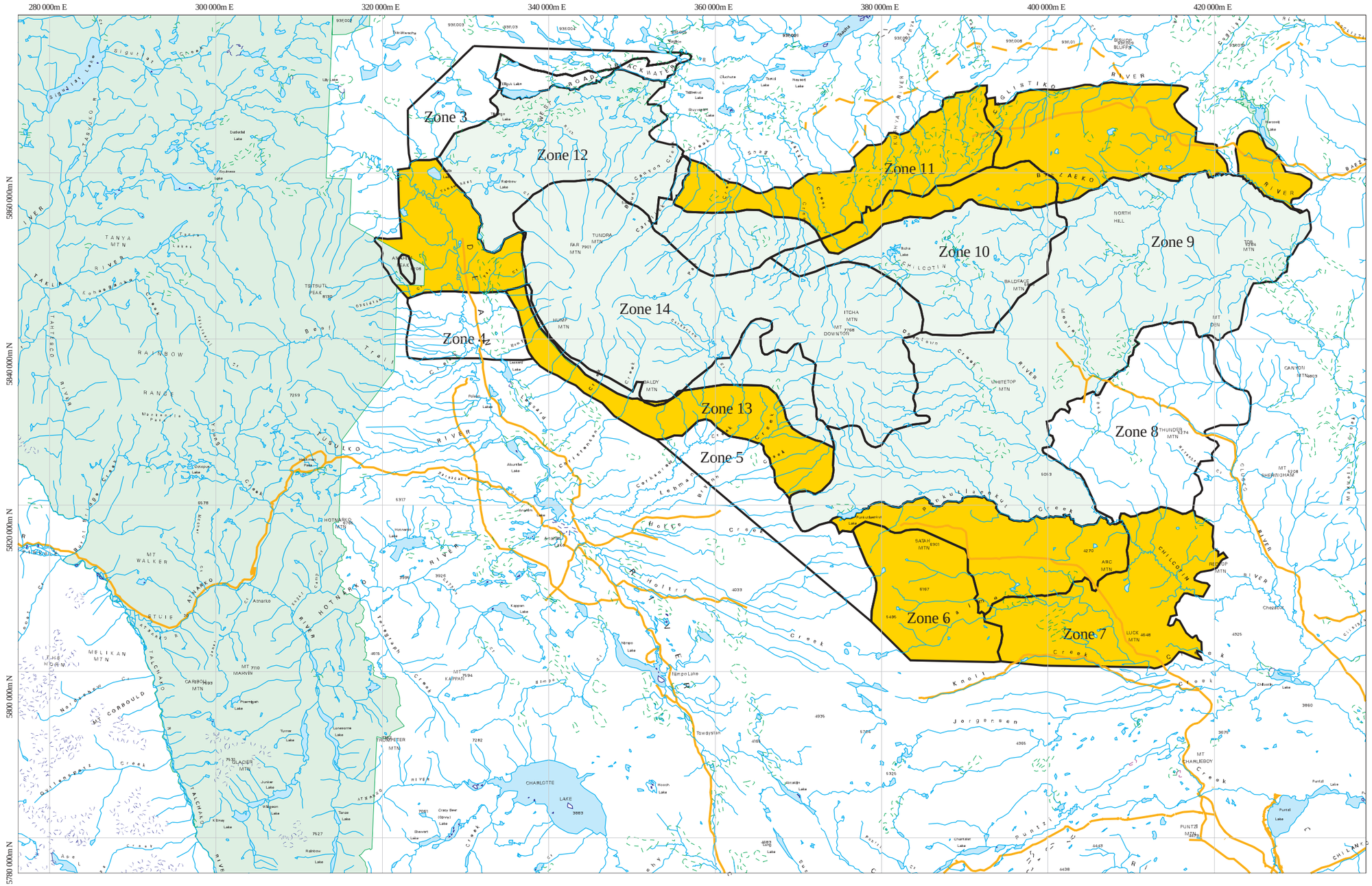
Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805317 - April 02, 2002

Deferral Area and Modified-Harvest Area Boundaries based on the map titled Itcha-Ilgachuz Approved Integrated Management Areas and dated June 8, 1995.



BRITISH COLUMBIA

Map 5

- Deferral Area
- Moderate risk option - modified harvest
- Provincial Parks
- Main Roads
- Proposed Roads

scale = 1:500,000

10 km

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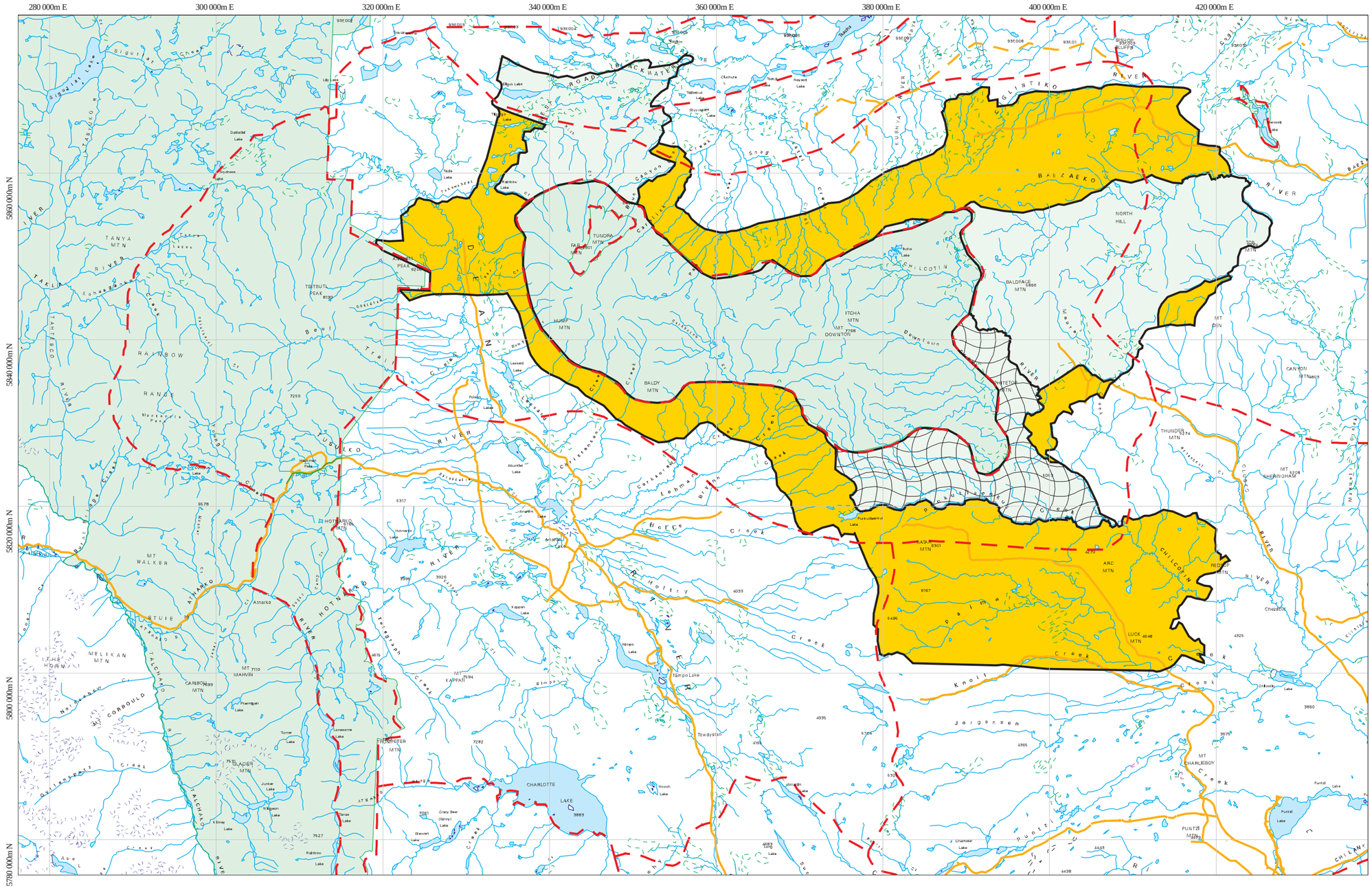
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - March 24, 2002

Areas of No-Harvest and Modified-Harvest for Itcha-Ilgachuz Caribou as proposed by the Caribou Strategy Committee (1996 Option A)



BRITISH COLUMBIA

Map 6

- No Harvest
- Modified Harvest
- B1 Polygon
- Provincial Parks
- CCLUP sub-units
- Main Roads
- Proposed Roads

scale = 1:500,000

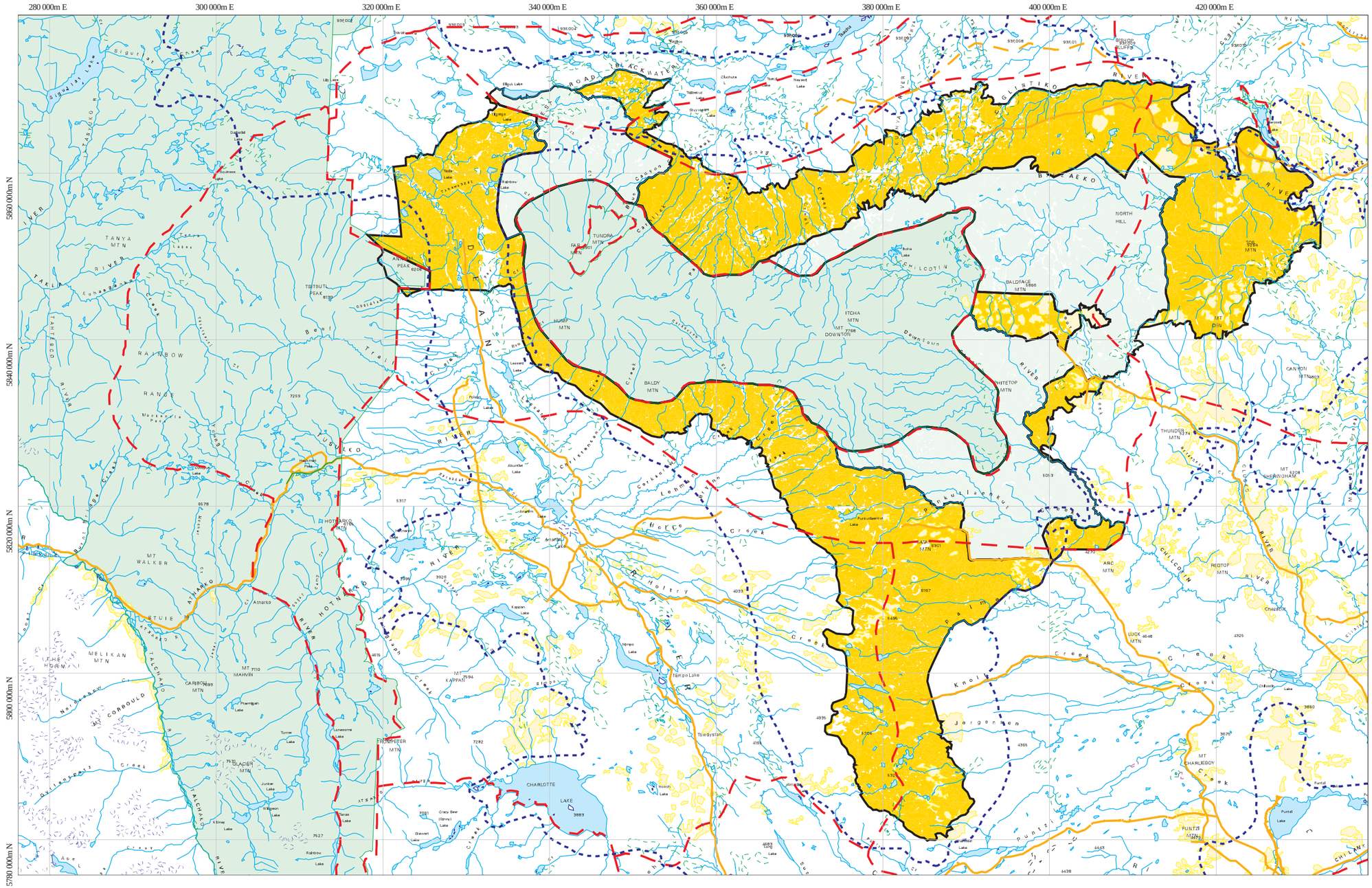
10 km

Produced by the Resource Information Group
Ministry of Sustainable Resource Management
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - March 24, 2002

Areas of No-Harvest and Modified-Harvest for Itcha-Ilgachuz Caribou as proposed by the Caribou Strategy Committee (1998 Option A)



BRITISH COLUMBIA

Map 7

- No Harvest - Productive Forest
- Modified Harvest - Productive Forest
- Recently Logged or Burned Areas
- Provincial Parks
- CCLUP boundary
- MS - SBPS Biogeoclimatic zone
- Main Roads
- Proposed Roads

scale = 1:500,000

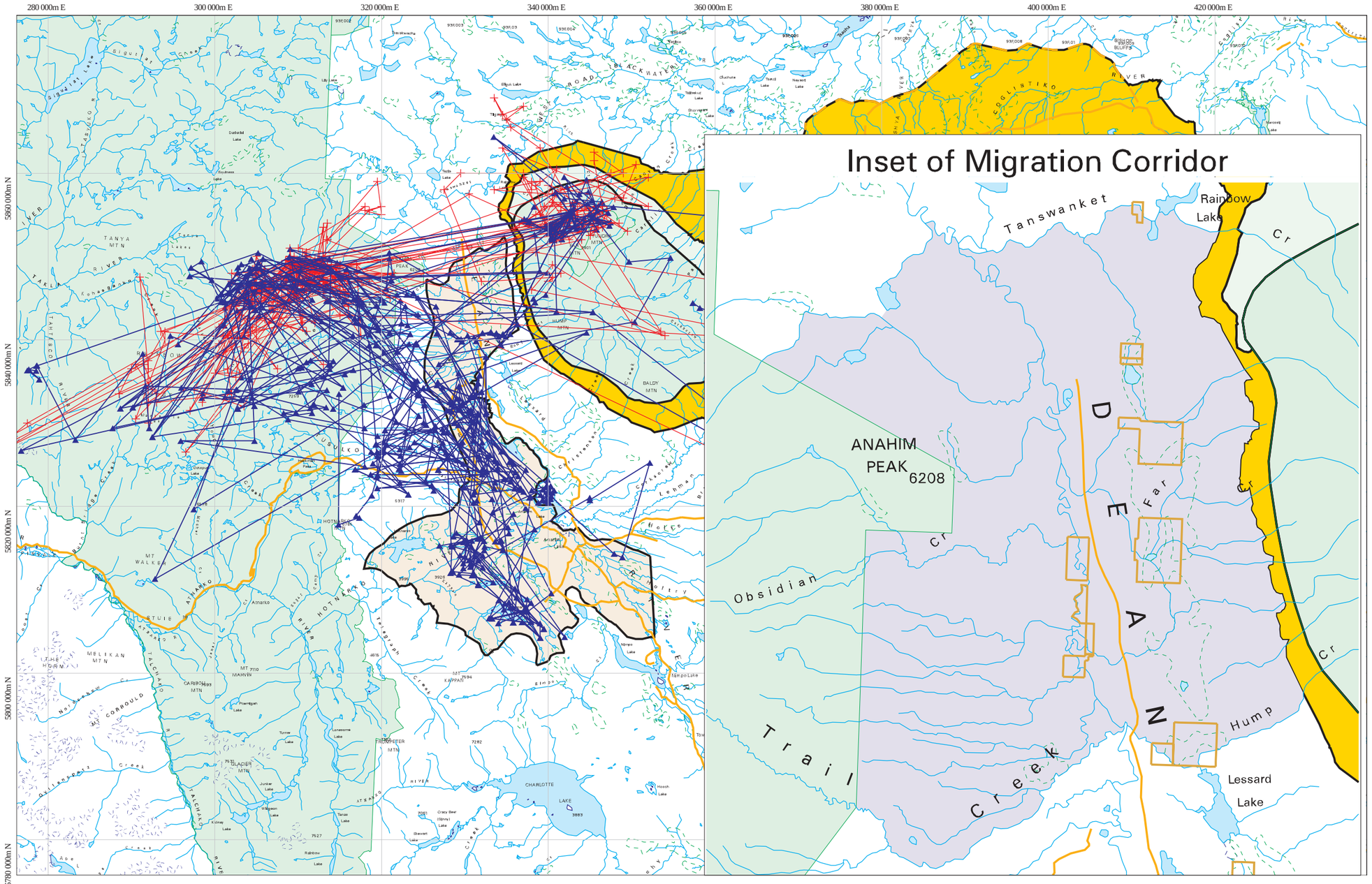
10 km

Produced by the Resource Information Group
Ministry of Sustainable Resource Management
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - March 24, 2002

Movement Patterns of the Rainbow Caribou Herd



BRITISH COLUMBIA

Map 8

- No Harvest
- Modified Harvest
- Natural Seral Distribution Area
- Dean River Migration Corridor
- Provincial Parks
- Crown Grant & Indian Reserve
- Main Roads
- Proposed Roads
- 1980's Telemetry Data
- 1990's Telemetry Data

scale = 1:500,000

10 km

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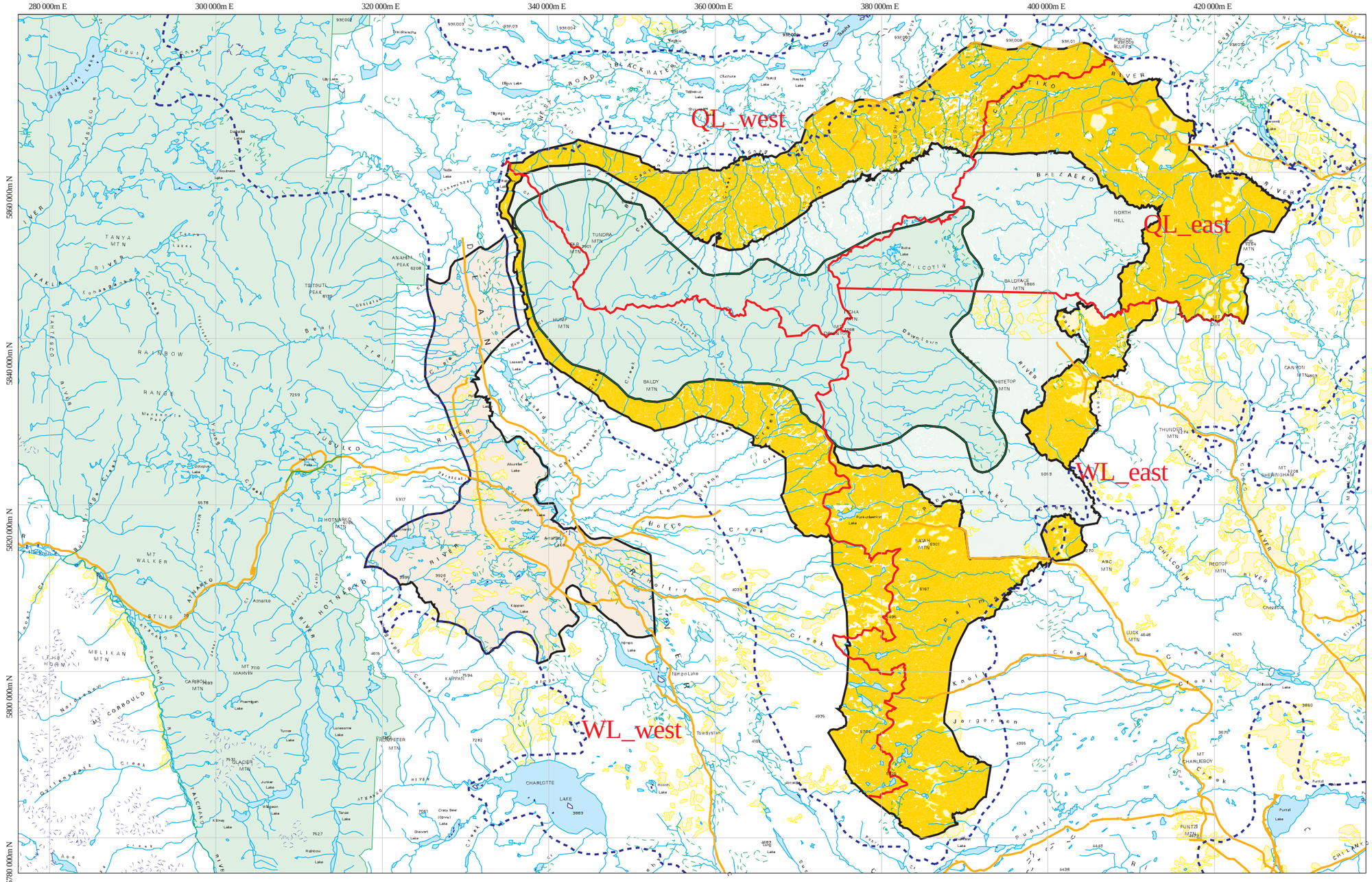
Ministry of Sustainable Resource Management
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - March 25, 2002

Areas of No-Harvest and Modified-Harvest for Itcha-Ilgachuz Caribou as proposed by the Caribou Strategy Committee (2002)



BRITISH COLUMBIA

Map 9

- No Harvest - Productive Forest
- Modified Harvest - Productive Forest
- Natural Seral Distribution Area
- Recently Logged or Burned Areas
- Provincial Parks
- MS - SBPS Division BEC Zones
- Caribou Quadrant Boundary
- Main Roads
- Proposed Roads

scale = 1:500,000

10 km

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Management Approaches Within the Range of the Itcha-Ilgachuz, Rainbow and Charlotte Alplands Caribou Herds

280 000m E 300 000m E 320 000m E 340 000m E 360 000m E 380 000m E 400 000m E 420 000m E 440 000m E

5880 000m N
5860 000m N
5840 000m N
5820 000m N
5800 000m N
5780 000m N
5760 000m N
5740 000m N

BRITISH COLUMBIA

Map 10

- No Harvest
- Modified Harvest
- Natural Seral Distribution Area
- Conventional Harvest
- Provincal Parks
- Charlotte Alplands Herd
- Rainbow Mtns. Herd
- Itcha-Ilgachuz Mtns. Herd

scale = 1:600,000

10 km

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Williams Lake, British Columbia

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Projection DATUM is NAD83

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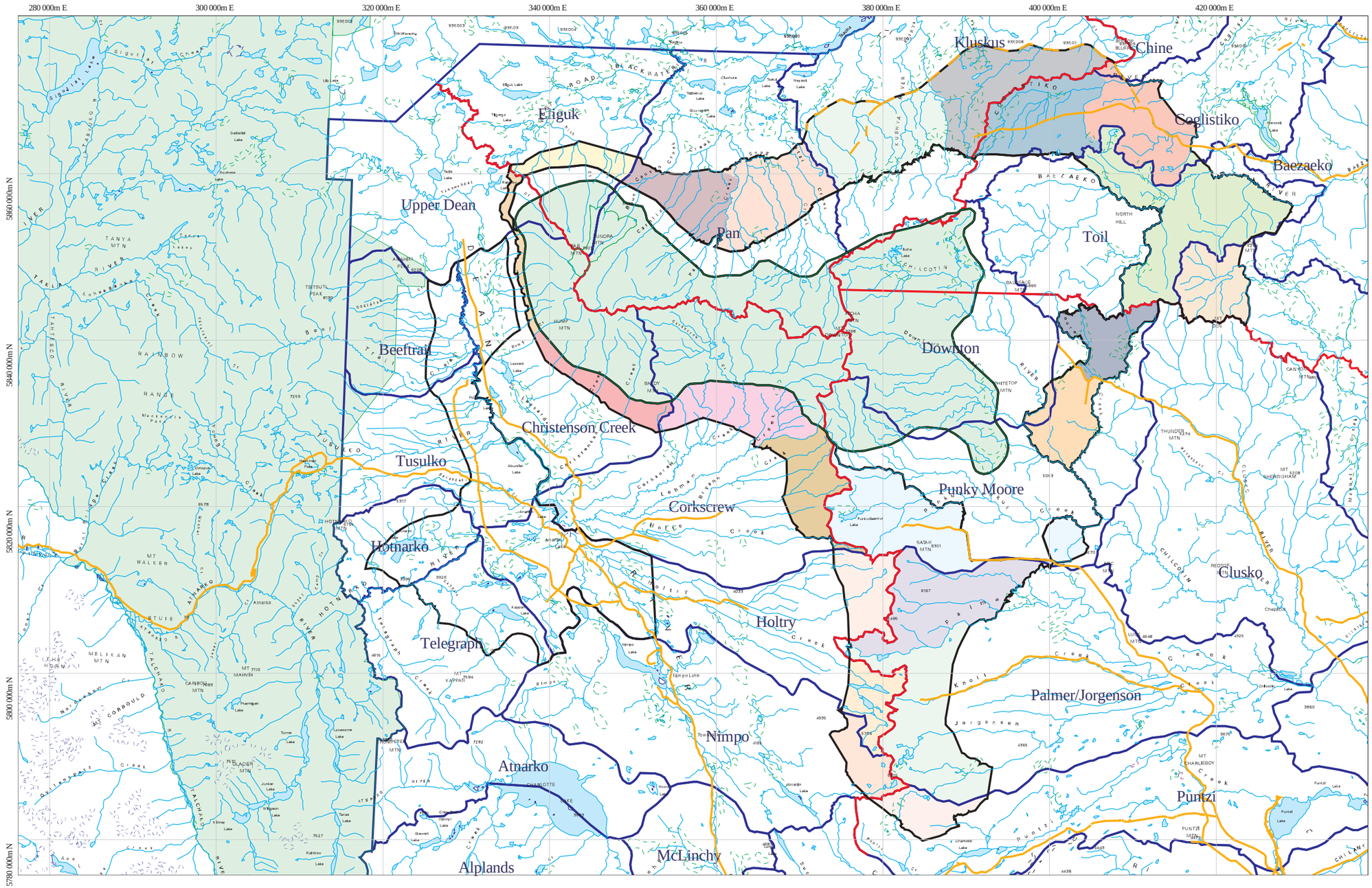
Sub-Units of the Caribou Modified-Harvest Zone to which the 80:20 Terrestrial/Arboreal Objectives Apply



BRITISH COLUMBIA

Map 11

- Provincial Parks
- Quadrant Lines
- Landscape Units
- Caribou Habitat Management Zones
- Main Roads
- Proposed Roads

ALLOCATING ARBOREAL VS TERRESTRIAL LICHEN SITES

* 20% of the non-reserved area of each uniquely coloured polygon should be managed with the arboreal lichen prescription; the remainder with the terrestrial lichen prescription

* in addition to this map, follow the guidance in section 5.4 for allocation of arboreal and terrestrial sites

scale = 1:500,000

10 km

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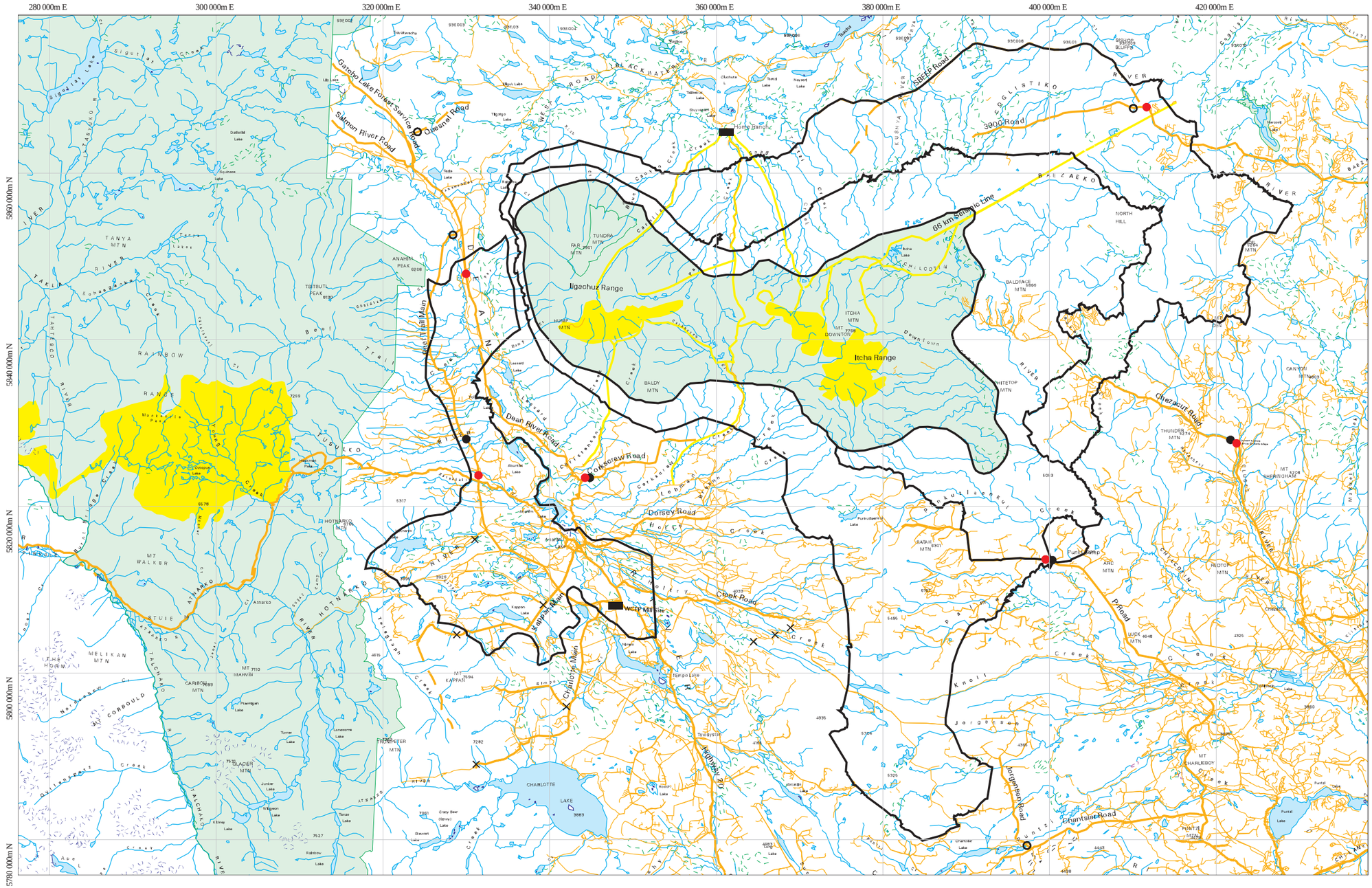
Williams Lake, British Columbia

Projection is Universal Transverse Mercator, Zone 10
Projection DATUM is NAD83

Project #p9805038 - March 25, 2002

Access Management for the Northern Caribou Strategy



BRITISH COLUMBIA

Map 12

- Provincial Parks
- Snowmobile Access Trails
- Caribou Habitat Management Zones
- Main Roads
- Secondary Roads
- Proposed Roads
- Access Restrictions:
  Road Physically closed to 4x4 Trucks (e.g. a deep ditch); authorized via Road Permit/FDP or CAMP process
- Wildlife Act Restriction - Existing
- Wildlife Act Restriction - Proposed
- Industrial Use Only - Existing
- Industrial Use Only - Proposed

scale = 1:500,000

10 km

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Williams Lake, British Columbia

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Projection DATUM is NAD83

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