POPULATION STATUS AND HABITAT USE OF WOODLAND CARIBOU (*RANGIFER TARANDUS CARIBOU*) IN THE ITCHAS, ILGACHUZ AND RAINBOW RANGES, BRITISH COLUMBIA

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April 1996

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Objectives

The purpose of this document is to synthesize the existing information pertaining to the Itchas-Ilgachuz-Rainbow (Western) caribou population. This paper was designed as a resource aid for the Regional Caribou Strategy Committee when developing an integrated management approach for caribou habitat in the Western Cariboo Region as directed by the Cariboo-Chilcotin Land-Use Plan (CCLUP).

The objectives of this report are as follows:

- To give an overview of the general biology of the Itcha-Ilgachuz-Rainbow caribou herd.
- To review and assess available information on population status, distribution, and management of the Itcha-Ilgachuz caribou herd
- To review important aspects of the animal's ecology such as food habits and seasonal habitat use in the Fraser Plateau.
- To review the patterns of human activity that may influence the status of the herd such as forestry, silviculture, and hunter harvest.
- To review the non human factors that may influence the status of the herd such as predation, fire, insect attack.
- To review current policies for habitat protection (including the Cariboo-Chilcotin Land-Use Plan) of the Western caribou herd, and the options that are available for combining timber harvest and caribou management.

Background

The Itchas-Ilgachuz and Rainbow mountains provide a home to many species of wildlife including woodland caribou of the northern ecotype, *Rangifer tarandus caribou*. Caribou of this ecotype migrate in a vertical direction and primarily crater in snow for terrestrial lichens over the winter. Arboreal lichens are eaten during winter when circumstances do not permit usage of their primary food source. They are diurnal, feeding mostly in the early morning and late evening and rest at mid periods of the day and night (Cowan 1973).

In general, a herd consists of a group of caribou that congregate in a particular rutting area (Bergerud and Elliot 1986). A population is a collection of herds sharing common winter range (Cichowski 1989). Even though the rutting grounds of the Itchas-Ilgachuz and Rainbow herds are most often separate, there is believed to be some mixing between the two (Jim Young, personal communication). Members of the Itchas-Ilgachuz herd and

the Rainbow herd may, during different years share a common winter range and for management purposes will be considered two herds of the same population.

There are concerns that caribou within the Itchas, Ilgachuz and Rainbow mountains will follow the trend of many other caribou populations in North America which declined over the last century. It has been hypothesized that increased predation partially due to an increase in moose populations, increased hunting, the destruction of lichen habitat by logging and fire and various combinations of these factors were largely responsible for the decline in other areas (Bergerud 1974b, 1978a, Edwards 1954, Stevenson and Halter 1985).

Distribution

Caribou within the Itchas, Ilgachuz and Rainbow mountains experience three annual periods of congregation: in late winter before the spring migration, shortly after calving period, and just prior to fall migration and rutting period. During the rest of the year they are widely dispersed over a large area, usually traveling in small bands of 3 to 20 animals. The Itchas-Ilgachuz and Rainbow caribou herds move constantly and extensively, migrating from alpine tundra in the summer to lower forested areas in the winter (Cichowski 1989).

Known home range for the radio-collared Itchas-Ilgachuz-Rainbow population extends from the Western Rainbow Range in Tweedsmuir Park, East to Toil Mountain and the headwaters of the Coglistiko and Baezaeko Rivers. They have been located as far North as the Dean and West Road (Blackwater) Rivers, while the southernmost limit is marked by Nimpo Lake and Palmer Creek (Cichowski 1993). The distribution and relative abundance of caribou in B.C. as of 1995 is shown in figure 4 (Seip and Cichowski 1995, in press). Figure 5 illustrates the location of the Itchas-Ilgachuz and Rainbow herds on the British Columbia Fraser Plateau and the local biogeoclimatic zones (Campbell et al 1990). As classified by the BC Environment, caribou of the Itchas-Ilgachuz-Rainbow population primarily inhabit the Nechako and Chilcotin Plateau Ecosections within the Ecoregion of the Fraser Plateau and the Ecoprovince of the Central Interior (Campbell et al 1990).

Cichowski (1989) undertook a telemetry study of the Itchas-Ilgachuz-Rainbow caribou population between 1985 and 1989. Winter and Summer locations are shown in figures 2 and 3. In November, radio-collared caribou of the Itchas-Ilgachuz herd were located both in high elevation fescue-lichen meadows near the headwaters of the Chilcotin and Baezaeko Rivers and in mature pine forests in sub-alpine areas throughout the Chilcotin River, Punkutlaenkut Creek, Baezaeko River and Coglistiko River drainages. Late winter habitat consisted almost entirely of low elevation mature pine forest which the caribou migrated from in May, moving to high elevation forest and meadow habitats at the base of the Itchas and Ilgachuz mountains and in-between the two ranges. Calving occurred in

high alpine habitats of the Itchas and Ilgachuz ranges in early June. Although most of the collared caribou remained in high mountain alpine during the summer and into the October rutting season, some moved to the meadows and forests adjacent to the mountains. Throughout the four winters of the study, 5-15% of the radio-collared caribou were located on the north side of the Ilgachuz mountains during winter and remained at high elevations until early-mid-December. These caribou then descended to forested or sub-alpine habitats north of the Ilgachuz mountains until mid-late-January before returning to the high elevation north slopes of the Ilgachuz range in March (Cichowski 1993).

The basic habitat types chosen each season by the caribou of the Rainbow range were similar to those of the Itchas-Ilgachuz herd. The collared caribou of the Rainbow range were widely distributed throughout the alpine habitat of the Rainbow mountains during the summer, and concentrated on the northern sides of the mountains throughout the winter and into May. Some of the Rainbow caribou moved to the Itchas-Ilgachuz winter range on the north side of the Ilgachuz mountains in November and returned to the Rainbow mountains in the late winter (Cichowski 1993, 1989). In order for the Rainbow and Itchas-Ilgachuz herds to intermix, it is imperative that a suitable habitat corridor be maintained between the Rainbow range in Tweedsmuir park, over the Dean River and into the Ilgachuz Range.

A caribou radio-tracking program began in October of 1995 and locations have been recorded until April 1996 for the 28 radio-collared cows in the Itchas and Ilgachuz Mountains (figure 1.) These cows were net gunned from a Bell Helicopter during the winter months, measured, collared, tagged, and a blood sample obtained to determine how many were pregnant at that time. It is hoped that some of the collared caribou are among those that winter in the Ilgachuz and return to the Rainbow range in the spring. Tracking during this migration time may help to pinpoint the location of the corridor used by the two herds at this time, providing better information of critical habitat range for the entire population. The areas that are most extensively used by the collared caribou will be protected from timber harvest practices in an attempt to conserve range necessary for the survival and health of the population.

The disappearance of caribou from historic range is of great concern to biologists province wide. In an attempt to ascertain if re-establishment of these herds was possible, a number of caribou transplants from the Itchas-Ilgachuz Mountains were carried out from 1984 to 1991. The first relocation of caribou in 1984 to McClinchy creek (75km south of the Ilgachuz Range) was largely unsuccessful since many of the adult transplanted caribou returned to their home range over the course of the next few years. In the following four attempts in April 1986, and March 1987, 1988 and 1991 more calves were captured and relocated in order to reduce the risk of animals returning to traditional ranges. A total of 52 caribou were translocated from the Itchas and Ilgachuz Mountains into the Kappan Mountain and Trumpeter Mountain areas. As a result of these transplants a survey in 1993 observed 53 caribou (29 cows, 15 calves and 9 bulls) inhabiting historical caribou range in the mountains west of Charlotte Lake. Relocation

of juvenile animals in the spring appears to be a successful technique for relocating and establishing caribou over relatively short distances (Habitat Conservation Fund 1985 - 1987, Coast Mountain Caribou Inventory 1993). In a longer distance translocation one dozen caribou were moved from Anahim Lake to Ball Creek, Idaho in 1987 and an additional 14 animals were taken to the same location in 1988. Half of these animals made major northward movements, and all assimilated themselves into existing caribou herds present in the Selkirk Mountains, confounding attempts to create another distinct herd (Audet & Allen 1996).

Habitat Use and Home Range

The Engelman Spruce Sub-Alpine Fir (ESSF) zone is used extensively by caribou in the warmer parts of the year, however the land used as winter range by the Itchas-Ilgachuz caribou consists primarily of the Montane Spruce biogeoclimatic zone. The cold and dry regional climate, combined with hot fires often results in very open lodgepole pine stands which are conducive to the growth of numerous lichen species. Animals that inhabit this sub-zone must be well equipped to survive the long periods of snow during winter. The forests offer good thermal cover, and over winter caribou must crater in the snow to get at the lichen forage beneath. Terrestrial lichen species are the primary food source for the caribou through the winter months. Terrestrial lichens are slow growing and the natural succession from *Stereocaulon* to *Cladonia* to *Cladina* species appears to take somewhere between 100 and 150 years (Clement 1987). Moister areas of this biogeoclimatic zone are also important as sources of arboreal lichen, which contribute significantly to the caribou winter diet. The MS zone is used extensively for cattle grazing, fur harvest, and forest harvesting. Mountain Pine Beetle have caused widespread mortality in mature pine stands, and much of the logging in the MS provincially, was prompted by the need to remove beetle-affected timber (Meidinger and Pojar 1991).

Early winter habitat consists of high elevation fescue-lichen meadows, alpine areas and the mature pine forests of the sub-alpine. In the late winter, caribou usually move to low elevation pine forests, however some are found on the high wind-swept ridges of the Itchas, Ilgachuz and Rainbow Mountains where terrestrial lichens have been exposed by high winds. The home range of woodland caribou over the winter depends on the availability and quality of forage, the number of animals in the herd, snow conditions and predators. Ranges calculated in Alberta and Manitoba average 250 square km in the winter, the largest range of any North American ungulate (Racey et al 1991). Wintering areas of the individual members of these small groups often overlap and the area required per caribou must be taken into account when managing the habitat.

Calving usually occurs where there is maximum security from predators. The Itchas-Ilgachuz-Rainbow population calve in high alpine habitats, away from con-specifics and predators. Summer home range is usually the smallest home range when compared to fall and winter (Racey et al 1991).

Diet

Winter diet of these caribou consists almost entirely of terrestrial and arboreal lichens, whereas a wide variety of vegetation types, such as mosses, grasses, shrubs, forbs and lichens are consumed during the warmer parts of the year (Cichowski 1989). The change in diet that accompanies the annual migration from alpine tundra in the summer to lower forested areas in the winter is a result of metabolic requirements, snow conditions, weather, wind and seasonal growth of vegetation. The low nutrient content of the lichen diet over winter is partially offset by it's high digestibility. It is thought that small portions of evergreen vegetation are consumed to supplement the lichen diet (Person et al 1980a).

Lichen Ecology

Terrestrial Lichen Ecology

Throughout the winter, caribou in the Itcha-Ilgachuz area crater for terrestrial lichens as a primary means of sustenance (78% of feeding site types according to Cichowski, 1989). Due to their extremely slow growth rates, terrestrial lichens compete poorly with vascular plants and are therefore most often found on poor soils and in harsh climates that are not conducive to vascular colonization (Hale 1983). Mature lodgepole pine forests with relatively open canopies (30% canopy closure or less) and cold, dry climates are prime sites for such lichen colonization (Clement, 1987). A number of studies have been done, quantifying lichen species upon which caribou forage, habitat types preferred by lichen species, successional stages of different terrestrial lichen species and the effects of logging and fire on these lichens (Cichowski 1989 &1993, Clement 1987, Brulisauer and Pitt 1992, Hooper and Pitt in prep., Miege 1995, Enns 1990).

Terrestrial lichen abundance in three biogeoclimatic units, SBPSmc (Moist cold, Southern Sub-Boreal Spruce, Chilcotin Variant), SBPSxc (Very dry, Cold, Southern Sub-Boreal Spruce Sub-zone, Entiako River Variant) and MSxv (Very dry, Very cold Montane Spruce Sub-zone) have been mapped for the Itchas-Ilgachuz area in region 5 (Clement, 1987). The MSxv is located at higher altitudes and is the dominant habitat type of the area. As far as caribou foraging grounds are concerned SBPSmc appears to have very little value, since this region consists mostly of steep, dry, rocky slopes where only stunted pine and rock lichen are able to grow. The Dry Lichen and the Lichen-Moss associations of the SBPSxc and the MSxv provide caribou with prime winter habitat (Clement 1987). Fescue-lichen meadows in the MSxv are also of importance in the early winter and possibly in times of low snow accumulation (Cichowski 1993).

In preliminary field experimentation, Enns (1990) observed that caribou seem to be selecting first for *Cladina* and secondarily for *Cladonia* and *Stereocaulon*. *Stereocaulon* species are less often consumed by caribou of the Itchas-Ilgachuz ranges, but are often abundant in the intermediary stage (ca. 150 years) between the periods where first *Cladonia* and then *Cladina* lichens dominate. It has been suggested that the severe climate following both fire and logging is responsible for the delay in the production of lichens and conifers in the Itchas-Ilgachuz Mountains. Recently, logged and burned stands appeared to shelter few lichen communities, and those that survived were protected from exposure by slash or other herbaceous vegetative cover (Enns 1990).

There is still uncertainty over what forest stand ages are best able to provide the caribou of the Itchas and Ilgachuz Mountains with adequate winter forage and when the relevant lichens are most abundant. Although caribou eat a wide variety of terrestrial lichens, *Cladina* and *Cladonia* species seem to be the favorites (Cichowski 1989). Since forest conditions vary from one location to the next across the country, it is necessary to study the areas of specific importance to each caribou population. For example, it has been noted in other research that after about 120 years lichen productivity tends to decline with the invasion of mosses and other bryophytes, however this data was collected in Ontario, under different forest conditions and may not be relevant in the forests surrounding the Itchas and Ilgachuz Mountains (Racey et al 1991).

In 1991 Brulisauer and Pitt initiated a study in the Chezacut area (Itchas-Ilgachuz caribou winter range) with two objectives: to determine the succession stages of terrestrial lichens in stands of lodgepole pine and, to explore the changes in stand dynamics over these succession periods. It was found that after fire, preferred terrestrial lichen species such as *Cladina* recovered slowly, not increasing significantly until the stand reached approximately 150 years. This species was not observed to reach an upper threshold at a certain age limit but continued to increase with the age of the stand. The study found that *Cladina* thrive in areas with poor, xeric soil conditions, relatively open canopies of old growth where light was plentiful and tree density was low. *Cladonia* and *Stereocaulon spp.* appeared earlier after disturbance and reached peak abundance at stand ages of 120 and 150 years respectively, thereafter declining as moss cover and competing *Cladina* species increased (Brulisauer & Pitt 1992).

A more recent paper by Hooper and Pitt (in prep.) analyzes further field data collected from the Itchas-Ilgachuz caribou winter range by Brulisauer in 1992. Three hypotheses were examined: Kershaw's canopy closure hypothesis that lichen abundance declines with stand age, Strange's tree seedling inhibition hypothesis that over time thick mats of terrestrial lichens develop thus inhibiting seedling establishment, and Rowe's forest-lichen climax community hypothesis which states that forests rich in lichens are self-perpetuating climax communities. Results of this paper indicate that lichen-forests in the Chezacut study area are indeed self-perpetuating climax communities. Terrestrial lichen cover was positively correlated with stand age, canopy cover, and was negatively correlated with bryophyte cover and vascular plants. Old age lodgepole pine forests (260-300 years) are likely of greatest winter importance to the caribou due to a high

percent ground cover of preferred *Cladina* species, and suitable growing conditions for arboreal lichens (especially near riparian areas) . Forest stands aged about 145 years are also important sources of *Cladonia* and *Stereocaulon* lichens (Hooper and Pitt in prep.).

Arboreal Lichen Ecology

Arboreal lichens are an important food source for caribou, especially in the late winter when cratering in the snow pack is most difficult. Conventional logging practices have severe effects on arboreal lichens, destroying the substrate on which they grow and possibly delaying recovery for more than 80 years (Detrick 1984). *Bryoria* species are the most common and preferred tree lichen in the Itchas - Ilgachuz caribou diet. They are found and fed upon primarily in Pine/Spruce forests and forested wetlands (22% winter feeding sites according to Cichowski 1993).

Bryoria develops slowly in the first 150 years after a disturbance, and then increases in abundance to peak in stands of about 250 years old. Self pruning of the lower branches of older lodgepole pine trees is apparently the cause for the decline in *Bryoria* abundance after reaching this peak (Brulisauer & Pitt 1992, Hooper & Pitt in prep.). The study by Brulisauer and Pitt (1992) in the Itchas-Ilgachuz ranges indicates that high levels of light and humidity are ideal for the growth of this arboreal lichen but since these two factors are usually negatively correlated, *Bryoria sp.* tend to grow best in environments where both factors are at intermediate levels.

Baker (1985) also found that light and humidity seem to be the most important factors for the growth of arboreal lichens, specifically *Bryoria.* The amount of arboreal lichen in each tree available to the caribou was measured from ground level to 3m in height. He found that *Bryoria* was a relatively shade tolerant arboreal lichen and seemed to increase in abundance with stand age and stand density, growing best on north facing slopes where the most moisture was retained and forest stands were densest. In general, *Bryoria* lichens are found most abundantly in mature forests over 200 years old. Spruce trees often found around riparian areas seem to be the best hosts for arboreal lichens, since they more often retain their lower branches as they age, providing abundant substrate within reach of the caribou (Baker 1985).

Stand Management and the Impacts of Logging on Lichens

When conservation is not an option, lichen management can be approached in a number of ways. The surrounding forest can be manipulated to improve growing conditions in the remaining areas, an attempt can be made to artificially enhance the lichen population, or some of the original stand can be retained to allow natural propagation to occur. Although follow up monitoring is necessary, preliminary results indicate that few lichens survive logging, except where shelter or residual trees occur. There also seems to be more terrestrial competition by vascular plants in areas that have been burned than in clear-cut blocks that have not been burned (Enns 1990). There are many different factors

and requirements that must be taken into account when managing areas for terrestrial and arboreal lichen communities.

Following conventional clear-cut logging practices, all arboreal lichens in the immediate area are eliminated. In order for arboreal lichens to establish themselves in the new young growth, studies indicate that lichen abundance must be high in adjacent mature timber, and it must be within 300-400m of the young stand (Stevenson 1988). It has also been shown that *Bryoria sp.* are relatively effective at dispersal to young forests (10-15 year old stands) due to their light weight and breakable nature, aiding in wind dispersal. This indicates that selection logging may be successful to maintain arboreal colonies in remaining mature timber and regenerating second growth (Stevenson 1988). Management of second growth stands to enhance lichen abundance would require additional study into the effects of factors such as: canopy closure and the density of lichen loads in adjacent mature timber stands that is necessary to ensure propagation.

There is very little information on the long term success of artificial enhancement or "cultivation" of terrestrial lichens. A number of terrestrial lichen enhancement trails were initiated by Enns (1990) in the Itcha-Ilgachuz area to attempt understanding of the response of these organisms to forest management practices. Of all the transplant treatments the method of kicking aside the duff and dropping a colony of terrestrial lichen into the trough created (kick and stomp method) seemed to be most effective as long as there was adequate protection from the suns rays. This is only an initial evaluation since over-wintering of colonies had not yet been assessed (Enns 1990).

Until very recently, not much was known about the effects of canopy openings on lichen communities or the response of terrestrial lichens to operational logging. An interm report by Enns (1992) stated that her results to date supported the hypothesis that terrestrial lichens survive clear cutting better than was previously anticipated, but that it does have marked affects on lichen abundance. There is an immediate, negative response to the change in canopy cover, at which time most terrestrial lichens are burned and overexposed. Even though surviving colonies are usually associated with debris, the recommendation that debris remain on site should be carefully considered since the long term affects of debris loading and canopy openings are as yet undetermined (Enns 1992).

Such interm reports prompted more in-depth research into silvicultural systems that could maximize lichen survival as a winter food source for caribou. In 1994 three treatments were tested in a pilot block of 40 hectares; group selection, group retention and retention of islands (Figure 6a-6c). The group selection treatment retained 70% of the volume (group openings of 20m diameter), while the group and island retention treatments each retained 30% (with groups of about 15-20m in diameter and islands from 1-3 ha.). In each of the treatments, the green volume maintained was chosen in such a way as to "maintain and re-establish arboreal lichen, and maintain environmental conditions necessary for terrestrial lichen," (Silvicultural Systems Research Draft 1995, p.2). All treatments were done on a winter snow pack, harvesting only the stems with a low ground pressure single-grip harvester. It should be noted that winter logging in caribou winter

range may disturb the animals, however such trade-offs must be taken into account when attempting to maintain the terrestrial lichen communities.

Initial surveys of the treatment areas in the pilot block indicated high levels of success (Harold Armleder, pers. comm.). The large island remnants of 1 hectare (30%) show high degrees of lichen survival in the islands but poor survival in the openings. This has positive implications for re-colonization, while maintaining adequate lichen biomass and thermal cover. The 30% retention in small islands of 10-15 trees offers more shading throughout the block, however there may be more damage to residual trees. Finally, the 70% group selection treatment looks most promising, but may be modified to 50% retention to meet harvest demands and requirements (Harold Armleder, pers. comm.). Five replicate blocks were harvested in the winter of 1995 using this suggested 50% partial retention method. With this system (Figure 6d), 50 % of the timber would be removed using a harvester (no drag technique) approximately every 70 years (140 year rotation).

Lichen surveys of the existing and proposed silvicultural system research blocks were undertaken by Miege (1995). He concluded that areas of critical lichen habitat for caribou, especially in the Itchas-Ilgachuz caribou range should be set aside as no-harvest zones. Peripheral areas of caribou winter use should be winter logged to leave a standing volume of 70% in order to achieve habitat management objectives (Miege 1995). The openings in this 30% harvest area should be as small as possible to minimize drying effects on terrestrial lichens and maximizing substrate available for arboreal lichens. This selective harvest technique will hopefully increase terrestrial lichen survival, and reduce the amount of time required for the lichens to reestablish themselves to the levels required to sustain the caribou population over the winter.

Mortality Factors

It is still uncertain whether the most consistent factor influencing the growth of caribou numbers is predation, hunter harvest or winter starvation due to decreased amount of suitable habitat. However, at this point in time it is more widely believed that predation plays a large role in the direct mortality of caribou in British Columbia, including the Itchas-Ilgachuz-Rainbow population (Bergerud and Elliot 1986, Jim Young pers. comm. 1996). The predation hypothesis is supported by examination of dead calves found on calving grounds (Miller and Gunn 1985) and the radio-tracking of young calves(Page 1985).

Predation

Wolves generally den and hunt near the tree line in central British Columbia (Bergerud 1974b). To minimize wolf predation when young are vulnerable female caribou migrate to common alpine calving grounds, distancing themselves from wolves and conspecifics.

It has been suggested that this spacing behavior and philopatry (returning to the same area to calve) result in a regulating, density dependent type of predation (Bergerud 1990). Caribou anti-predator spacing strategy increases the predator searching time and decreases the rate in which wolves encounter cows and their calves (Bergerud 1984). This behavior stresses the importance of protecting calving grounds since a reduction of range in which to space out would effectively increase the density of caribou when the calves are young and weak, enhancing search time for predators and causing a decline of the caribou population.

Caribou have behavioral adaptations for predator avoidance which are made apparent through the type of calving and winter habitat that they select. Generally, their chosen winter range is abundant in caribou winter forage, has a low moose suitability and therefore maintains a relatively low wolf population (Racey et al 1991, Seip 1991). Close monitoring of predators and prey is required, as well as tightly controlled harvests of prey species.

Decreased Amount of Suitable Habitat

Clear-cut harvesting of mature Lodgepole pine forests reduces or eliminates the winter forage available to caribou. The decrease in suitable winter habitat that results from timber harvest reduces the area in which the animals can space out, effectively increasing both their density and the risk of encountering predators. Increased amount of edge caused by silvicultural practices, often supports a larger moose population which in turn supports larger numbers of wolves that may prey on caribou. The increased access via logging roads created by timber harvest indirectly impacts the herd by making the caribou more susceptible to hunting and poaching.

Forest fires also decrease the amount of winter habitat available to caribou, destroying the winter food supply and the thermal cover in the area. Overly mature pine forests are particularly susceptible to fire due to build up of dry matter on the ground and numerous dead falls created when the stand undergoes self-thinning. Areas infested or killed by mountain pine beetle are also particularly dry, and if not taken by fire, they are most often removed by logging companies to reduce the impacts of further beetle attack.

Hunting

Human harvest of the Itchas-Ilgachuz-Rainbow population is restricted in number, sex region and time of year by BC Environment. Management units 5-6, 5-10 and 5-11 are closed to caribou hunters. The overall average caribou harvest for region 5 over the last 10 years has been about 30 kills per year, decreasing from 54 kills in 1991 to 27 kills in 1994 (table 1). The number of kills by non-resident hunters is significantly higher than for resident hunters in MU5-12. There is also limited entry hunting for cows in MU5-12. A maximum of 25 cows can be harvested between September 1 and October 15. The amount of caribou taken through poaching is unknown, however the curiosity and

seasonal congregation of the species make caribou especially vulnerable where there is good road access.

Human Caused Disturbances

There is very little information on the response of caribou to directly human related disturbances. Simpson (1987) concluded that caribou avoided areas of intense snowmobile use due to both the presence of human scent and the mobility of snowmobiles. A few machines can be avoided, however large numbers of them send multiple sound stimuli accompanied with human scents, initiating a panicked flight response and causing the animals to abandon the area. Excessive snowmobiling in caribou winter ranges decreases the amount of area available to the animals, affecting reproduction and survival (Simpson 1987). As with loss of habitat due to forestry practices and fire, this decrease in available range increases the concentration of the caribou, making them more vulnerable to natural predators (Simpson 1987, Bergerud 1990).

Human disturbance in the form of access roads undoubtedly has great affects on caribou. Increased poaching, habitat loss due to forestry and urbanization, increased access to hunters, and increased use for recreational purposes all directly or indirectly have negative impacts on caribou populations. In Alaska, the distribution of calving caribou was reportedly altered by a road system, indicating that caribou may be most sensitive to human disturbances during the calving period in early summer (Dau and Cameron 1986).

Population Size and Trend

Two aerial count population surveys were completed in the Itchas-Ilgachuz mountains in 1994. A post calving population of 1618 caribou was estimated in late June 1994 and an autumn rut survey in late October of the same year estimated the population to be 1369 caribou (Young in prep.). There was no survey of the Rainbow mountains, but the herd there is believed to number about 150 individuals (Jim Young pers. comm.). The entire Itchas-Ilgachuz-Rainbow population is presently estimated to be about 1500 individuals and is stable (Young in prep.). Autumn rut surveys and post calving surveys have been completed most years since 1978 (with a large gap in rut surveys from 1988-1993) and the population in the Itchas-Ilgachuz Mountains has remained relatively stable since 1982 (tables 2 & 3).

The rutting season occurs from October to November, primarily in alpine and sub-alpine habitat in the Itcha-Ilgachuz-Rainbow Mountains (Cichowski 1989). Bulls are polygamous during this season and a successful male may maintain a harem of 12-15 cows (Cowan 1973). The breeding season is short, from one to two weeks, and if the cow does not conceive she can experience a second heat. Studies have shown pregnancy rates as high as 97% for mature females caribou, (Seip & Cichowski 1996, in press). A

pregnancy rate of 97% among mature collared cows of the Itcha-Ilgachuz herd was determined by measuring plasma progesterone levels in the winter. This pregnancy rate is one of the highest in the province, likely because many of the other studies used methods which included non-parous 2 year olds that would have been classed as yearlings (Seip and Cichowski 1996, in press).

The reproductive rate of caribou is comparatively low. Other cervids such as moose and elk are often mature as yearlings, but female caribou do not reach sexual maturity until 28 months or later and do not conceive until their second or often third year (Bergerud 1978a). Caribou give birth to single young (rarely twins) and lay down to calve in open alpine areas, rejoining the herd after a few short hours.

Caribou mortality can be due to accidents, birth defects, social interactions (i.e. trampling), drowning, disease, starvation, wind chill, desertion and predation. Although adult mortality is often low, calf mortality can be as high as 90% if there is a high number of wolf and grizzly bear in the area (Seip & Cichowski in press). It is believed that predation is the primary cause of mortality in both adults and young, and that wind chill and desertion also play a large role in calf mortality (Bergerud 1978a). A healthy adult bull to cow ratio of 35/100 is optimal, however the most recent study shows the ratio of the Itchas-Ilgachuz population to be at 25:100 (Young in prep.). This bull/cow ratio is slightly lower than the 1985-1987 period when Cichowski measured cow pregnancy rates. Further studies of plasma progesterone levels may reflect effects that decreased bull numbers have on pregnancy rates in the population.

Neo-natal survival for the Itchas-Ilgachuz-Rainbow population in late June is about 42% (Seip and Cichowski in prep.). This decline of over 40% of the calves is likely due to predation but other factors such as stillbirths, emaciation, accidents and congenital defects also contribute to some degree (Jim Young pers. comm.). Studies show that only about 16% of the calves in this population survive their first year of life (Seip and Cichowski in prep.). Caribou have an average life span of 4.5 years and may live as long as 13 years in the wild. Annual female adult mortality for the Itchas-Ilgachuz-Rainbow population is reported to be about 15% (Seip and Cichowski in prep.).

Legal Protection

Cariboo-Chilcotin Land Use Plan

In 1994 the Cariboo-Chilcotin Land-Use Plan was released to guide the application of the Forest Practices code of BC in three established zones, depending on the intensity of use. Within these three zones there are a total of 7 separate sub-units overlapping the range of the Western Caribou herd (Figure 7).

- The New Itchas-Ilgachuz Protected area of 109,000 ha. was designated specifically for the western caribou herd, (hatched section 8 in CCLUP).

- Enhanced Development Zone was designated primarily for forest productivity and is composed of the Baezaeko (E-1) area.
- Special Resource Development Zone was designated for modified forestry practices to ensure the maintenance of ecosystem, recreation and tourism values. The SRDZ includes the Itchas-Ilgachuz (F) and Upper Blackwater (P) areas. The 305,925 ha. Itchas-Ilgachuz SRDZ surrounds the New Itchas-Ilgachuz protected area.
- The Integrated Management Zone consists of three Sub Zone units, the Kluskus (I-A), Chezacut (I-C) and Anahim Lake (I-B) areas, which will be for integrated resource use.

According to the CCLUP, 64% of the Itchas-Ilgachuz SRDZ polygon consists of key caribou habitat. Each polygon has been assigned a target for the proportion of the forested land base available for conventional harvest and for modified, more sensitive practices. Road and forest development in the B1 polygon of the SRDZ in the Itchas-Ilgachuz area has been deferred until further studies regarding caribou habitat and population needs have been completed. In the meantime, alternate wood supplies are being identified to accommodate this strategy. The land use plan requires that: 1) an assessment of the caribou herd be completed in the next 4 years, and that 2) adequate tools and information are gathered to develop integrated management approaches for caribou habitat (CCLUP 1995).

Western Caribou Working Committee (WCWC)

The Western Caribou Working Committee produced a series of options that provided a range of protection for the Itchas-Ilgachuz caribou herd. Each option had a risk rating attached to it as to whether the existing population would be maintained. The CCLUP modified the moderate risk option (Figure 8) that was proposed by the Western Caribou Working Committee. A portion of the area that the Western Caribou Working Committee had proposed for no harvest was made into a park by the CCLUP and the remainder was split between the no harvest category (65%) and the modified harvest category (35%). The area identified as restricted harvest (by the WCWC) was placed in the modified harvest category designated within the Cariboo-Chilcotin Land-Use Plan and was made available for harvest immediately. No logging will be carried out in the deferred area north of Punkutlaenkut Creek until it has been deemed compatible with caribou habitat requirements.

At the present time biologists of the region are assessing whether the targets of the Cariboo-Chilcotin land use plan can be met without causing excessive increased risk to the western caribou herd. This same process is also being investigated for the smaller Eastern caribou herd of the Quesnel Highland.

Forest Practices Code

The forest practices code requires sustainable use of the forests, which includes conserving biological diversity, soil, water, fish, wildlife, scenic diversity and other forest resources. There is currently a maximum cut block size in the Cariboo region of 60 ha. The forestry companies have an obligation to propose a silviculture system that takes into consideration any wildlife present that may require canopy retention in order to maintain the population (Forest Practices Code 1995).

BC Wildlife Act and Regulations

In order to carry a firearm and hunt wildlife in British Columbia, non-natives must possess a firearm license and a valid hunting license for the species being hunted. Caribou can be harvested from Sept. 1 to Oct. 15 in MU5-12.

- Each hunter is limited to one mature bull, bearing at least 5 points.
- There must be a compulsory report within 10 days of the kill in which the hunter submits an incisor tooth of the animal, the date, location and sex of the kill and personal information (BC Hunting and Trapping Synopsis 1995).
- There is also a short season of limited entry hunting for caribou cows in MU5-12.

This is the first year that inspections of the harvested caribou were not compulsory since 1979, and it has been recommended that the compulsory inspection be reintroduced for 1996 year (pers. comm. John Youds, Jim Young 1996).

Anahim Round Table - CORE Pilot Project

The Commission on Resources and Environment (CORE) has initiated pilot projects across the province to test a "shared decision-making" approach to resolving local and sub-regional resource management conflicts. In this approach, individuals that may be affected by decisions on local issues work together with groups that have the authority to make these decisions in order to seek an outcome that accommodates everyone involved. The Anahim Round Table was established not as another level of government, but as a shared decision-making forum for open public discussion. In 1994 a Resource Management plan was agreed upon, and is scheduled to be reviewed in 1999 (Anahim Round Table Resource Management Plan 1994).

A number of the resource management issues identified and prioritized by the Anahim round table involve or address concerns of importance to the Itchas-Ilgachuz-Rainbow caribou population.

- It was agreed that as far as access management goes, unused industrial access roads would be closed to prevent continued use of industrial roads as an uncontrolled access network.
- Any adverse affects of new access roads should be minimized to offer maximum protection of other resource uses, ecosystems and values.
- Key old growth values should be recognized, such as unique species representation, preservation and conservation.

- Human related (mechanized) access will be managed so as to protect wildlife values.
- Caribou winter range and calving grounds should be sustained in the Beeftrain-Sager-Corkscrew, Charlotte Lake, Upper McClinchy, Kappan and Trumpeter Mountain areas (Anahim Round Table Resource Management Plan 1994).

Potential Management Options

The management objective for the Itchas-Ilgachuz-Rainbow caribou population is to ensure that a landscape containing year round caribou habitat is suitable and sustained within the targets of the CCLUP. In Ontario this type of objective is to be met by the design of a Caribou Habitat Mosaic where caribou habitat is managed to large temporal and spatial scales. In this mosaic, the currently used winter habitat exists as part of mature (40-100 years) or old (80-140 years) even aged stands (within 20 years) of forest land usually greater than 100 square kilometers (Racey et al 1991). In accordance with Bergerud's studies on predation and alternate prey species, it is recommended that the creation of moose travel corridors, moose leave blocks and edge be limited to minimize any drastic increase in the wolf population due to abundance of alternate prey. Areas not critical for caribou, but suitable for moose may be managed to increase habitat values for moose.

The land inhabited by the Western Caribou herd must me carefully managed at both the landscape and stand levels.

Landscape Management Priorities

- migration corridor, winter range and calving grounds are of primary concern
- no harvest areas should be established central to the winter range where use by caribou is high and habitat is suitable and has high capability
- harvest over large continuous areas
- no harvest areas should be where there is minimal access developed (ie. snow mobiles, permanent roads, recreational activities)

Stand Management Priorities

- moderately long rotations to maintain terrestrial and arboreal lichen communities
- harvesting should mimic the natural disturbance patterns of the area
- modified clear-cut or selection silvicultural systems

A)Clear cutting option

Minimize edge by increasing cut size to up to 250 ha. and harvesting in a manner that mimics natural forest fires as much as possible. This should minimize the increase in moose population and thereby minimize the increase in the wolf population and it's impact on caribou. Large timber blocks may be harvested so that they can regenerate as

future winter habitat in 150 years or more. These large cut-blocks will also help to minimize the number of secondary access roads and thus the problems associated with increased access. Disadvantages of this system: lichen may take more than 150 years to fully regenerate after a clear-cut/slash burn, negative impacts on biodiversity, aesthetics and public opinion.

B) Group Selection Treatment

Large areas of forest harvested with 50%-70% green retention. The openings (20m radius) in these areas will be as small as possible to minimize drying effects on terrestrial lichens, maximize substrate available for arboreal lichens and to allow recolonization of lichens to second growth. Winter log areas to minimize impacts on terrestrial lichens under the snow pack. This approach will reduce the overall impact on lichen abundance and the recovery time to establish lichens to pre-harvest levels. Very small openings with poor soil conditions will likely create less than optimal moose habitat, and thereby not increase the moose and wolf populations significantly. Disadvantages to this system: expense to logging companies may be increased, studies have not been completed on the impacts of large amounts of edge created around numerous small openings and there may be damage to residual trees.

Other Recommendations

- encourage lichen regeneration where possible or necessary
- manage temporary roads by ditching, scarification or planting
- maintain a travel corridor at least 2 km wide in order to avoid creating a barrier between calving habitat and winter habitat. Corridor should follow natural features such as rivers, lakes, ridges, eskers etc. The wider the corridor, the more spacing is possible and the less chance of predator encounters
- identify areas with high potential for future winter caribou habitat
- longer lived roads (greater than 5 years) should avoid areas of current and potential winter habitat
- limit snowmobile access to caribou winter habitat
- restrict back country expeditions into alpine calving habitat during the early summer (May, June and July)

Summary

The Itchas-Ilgachuz-Rainbow population has been identified as a high priority management area for woodland caribou. Using the information in this and other such reports management options such as the two posed here should be evaluated for their effects on the caribou population and on the timber supply and implemented. Undisturbed mountainous habitat is essential for calving success of these caribou, however, since the majority of the calving grounds are located inside the Itchas-Ilgachuz protected area (as designated by the CCLUP 1994) winter habitat and travel corridors are of prime management concerns. Large areas of mature pine forests that are abundant in

terrestrial and arboreal lichens are essential for caribou winter survival but are also in high demand for timber harvest. Extensive undisturbed tracts of the core habitats critical to caribou and travel corridors between herds and migratory ranges must be maintained to ensure the survival of the Itchas-Ilgachuz-Rainbow population. In order to satisfy the requirements of the caribou and the timber industry, these core areas must be identified and alternative silviculture techniques adopted.

Acknowledgments

I would like to thank Jim Young, John Youds and Harold Armleder for their direction and comments.

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Table 1: Summary of hunting statistics for caribou (*Rangifer tarandus caribou*) in management units 5-12 and 5-15 for the years 1986-1994 in the Cariboo.

RATIO 1: Kills/Hunter
RATIO 2: Kills/Hunter Day
YEAR RANGE: 86/94
MONTH RANGE: 01/12

M.U.		Data Source	Hunter Res.	Animals Killed Male	Female	Juv.	Total	Number Hunters	Number Days	Ratio 1	Ratio 2
512											
	86	CI	R	8			8	70	396	.11	.02
		CI	N	1			1	6	59	.17	.02
		Total		9			9	76	455	.12	.02
	87	CI	R	26	4		30	69	497	.43	.06
		CI	N	4			4	4	15	1.00	.27
		Total		30	4		34	73	512	.47	.07
	88	CI	R	23			23	66	361	.35	.06
		CI	N	2			2	5	38	.40	.05
		Total		25			25	71	399	.35	.06
	89	CI	R	23	1		24	79	476	.30	.05
		CI	N	5			5	12	54	.42	.09
		Total		28	1		29	91	530	.32	.05
	90	CI	R	17	2		19	69	331	.28	.06
		CI	N	4			4	5	17	.80	.24
		Total		21	2		23	74	348	.31	.07
	91	CI	R	42	2		44	86	496	.51	.09
		CI	N	7			7	12	78	.58	.09
		Total		49	2		51	98	574	.52	.09
	92	CI	R	31	3		34	99	534	.34	.06
		CI	N	6			6	11	72	.55	.08
		Total		37	3		40	110	606	.36	.07
	93	CI	R	25	3		28	74	425	.38	.07
		CI	N	6			6	11	67	.55	.09
		Total		31	3		34	85	492	.40	.07
	94	CI	R	18	3		21	83	444	.25	.05
		CI	N	6			6	12	61	.50	.10
		Total		24	3		27	95	505	.28	.05
	Total	CI	R	213	18		231	695	3960	.33	.06
		CI	N	41			41	78	461	.53	.09
		Total		254	18		272	773	4421	.35	.06
515											
	86	CI	R	2			2	22	111	.09	.02
		CI	N	3			3	17	140	.18	.02
		Total		5			5	39	251	.13	.02
	87	CI	R	4			4	19	73	.21	.05
		CI	N	3			3	14	81	.21	.04
		Total		7			7	33	154	.21	.05

..U.		Data Source	Hunter Res.	Animals Killed Male	Female	Juv.	Total	Number Hunters	Number Days	Ratio 1	Ratio 2
	88	CI	R	2			2	21	68	.10	.03
		CI	N	2			2	7	48	.29	.04
		Total		4			4	28	116	.14	.03
	89	CI	R	1			1	25	130	.04	.01
		CI	N	3			3	6	41	.50	.07
		Total		4			4	31	171	.13	.02
	90	CI	R	2			2	21	80	.10	.03
		CI	N	1			1	2	12	.50	.08
		Total		3			3	23	92	.13	.03
	91	CI	R	2			2	21	87	.10	.02
		CI	N	1			1	1	5	1.00	.20
		Total		3			3	22	92	.14	.03
	92	CI	R					12	37		
		CI	N					2	4		
		Total						14	41		
	93	CI	R					6	36		
		CI	N					6	33		
		Total						12	69		
	94	CI	R					8	48		
		CI	N					4	21		
		Total						12	69		
	Total	CI	R	13			13	155	670	.08	.02
		CI	N	13			13	59	385	.22	.03
		Total		26			26	214	1055	.12	.02
tal											
	86	CI	R	10			10	97	532	.10	.02
		CI	N	4			4	23	199	.17	.02
		Total		14			14	120	731	.12	.02
	87	CI	R	30	4		34	96	629	.35	.05
		CI	N	7			7	18	96	.39	.07
		Total		37	4		41	114	725	.36	.06
	88	CI	R	25			25	89	433	.28	.06
		CI	N	4			4	12	86	.33	.05
		Total		29			29	101	519	.29	.06
	89	CI	R	24	1		25	109	633	.23	.04
		CI	N	8			8	18	95	.44	.08
		Total		32	1		33	127	728	.26	.05
	90	CI	R	19	2		21	96	451	.22	.05
		CI	N	5			5	7	29	.71	.17
		Total		24	2		26	103	480	.25	.05
	91	CI	R	44	2		46	107	583	.43	.08
		CI	N	8			8	13	83	.62	.10
		Total		52	2		54	120	666	.45	.08
	92	CI	R	31	3		34	111	571	.31	.06
		CI	N	6			6	14	78	.43	.08
		Total		37	3		40	125	649	.32	.06
	93	CI	R	25	3		28	80	461	.35	.06
		CI	N	6			6	17	100	.35	.06
		Total		31	3		34	97	561	.35	.06
	94	CI	R	18	3		21	91	492	.23	.04
		CI	N	6			6	16	82	.38	.07
		Total		24	3		27	107	574	.25	.05
	Total	CI	R	226	18		244	876	4785	.28	.05
		CI	N	54			54	138	848	.39	.06
		Total		280	18		298	1014	5633	.29	.05

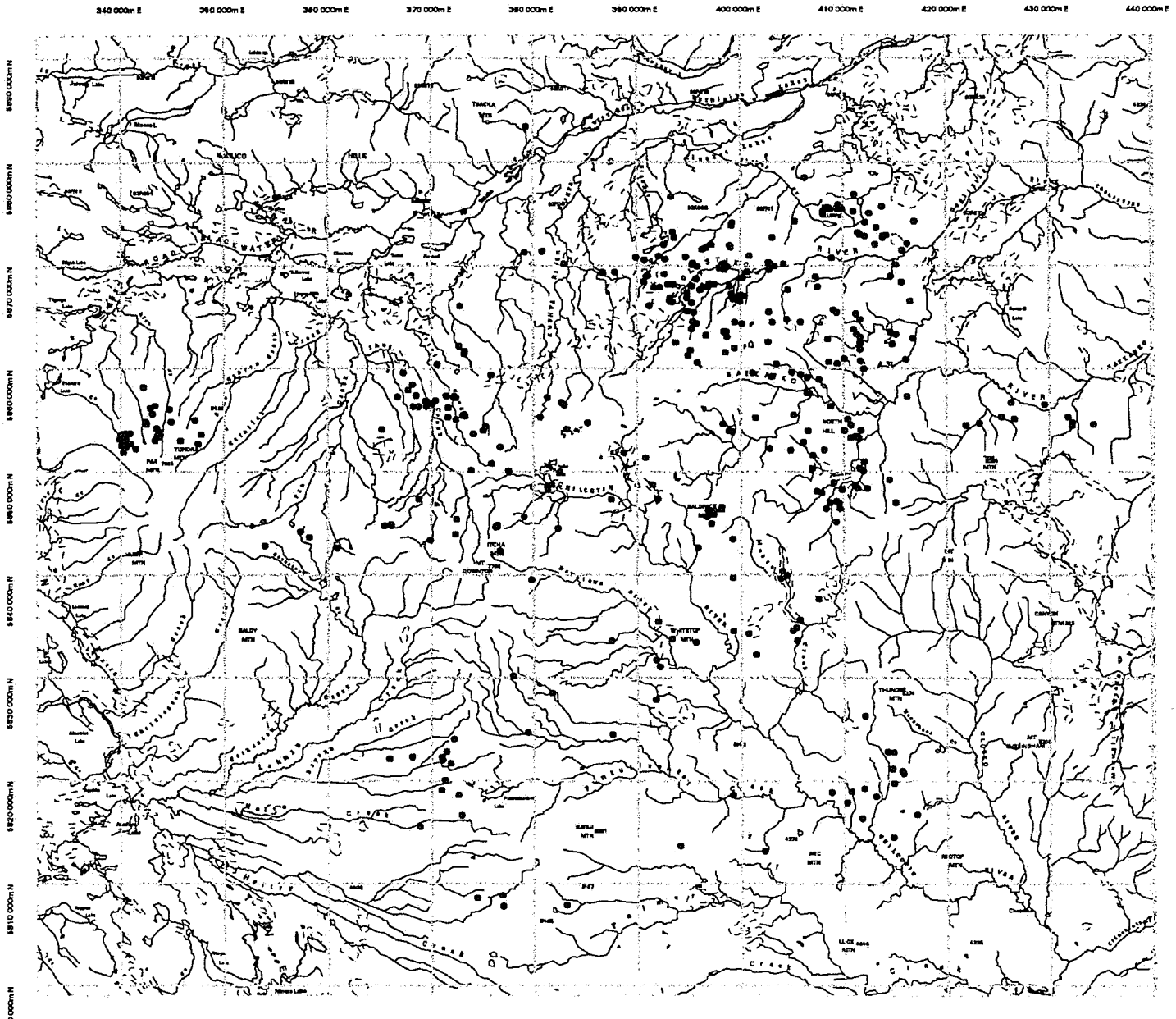
Table 2. Results for autumn rut caribou population surveys in the Itchas-Ilgachuz mountains from 1978-1994 (incomplete).

Day/Month	Year	Total Obs	Cows	Calves	Bulls	Unclass.	Bulls/100 Cows
2/Nov	1978	353	190	117	46		24
27/Nov	1979	513	36	10	82	385	N/A
4/Nov	1981	475	14	62	58	341	N/A
15/Oct	1983	351			64	287	N/A
25/Oct	1984	334	227	40	67		30
18/Oct	1985	263	187	46	30		16
10/Oct	1986	484	342	85	57		17
21/Oct	1987	626	478	71	77		16
17/Oct	1994	440	331	63	46		14

Table 3. Results for summer post calving caribou population surveys in the Itchas-Ilgachuz mountains from 1978-1994 (incomplete).

Day/Month	Year	Total Obs.	Cows	Calves	Bulls	Yeralings	Unclass	Calves/100 Cows
1/Jun	1978	110	13	5			92	N/A
8/Jun	1979	262	45	45			172	N/A
16/Jun	1982	711	395	197	119			50
22/Jun	1983	710		186			524	N/A
7/Jul	1984	775		187	107		481	N/A
18/Jun	1985	991	678	258	55			38
25/Jun	1986	951	625	269	57			43
18/Jun	1987	942	604	260	78			43
26/Jun	1988	670	461	161	48			35
23/Jul	1989	1175	672	314	132		44	47
27/Jun	1990	1215	682	330	183	4	16	48
12/Jul	1991	1408		298	16		1094	N/A
17/Jun	1992	1194	569	317	219	48	41	56
21/Jun	1994	1136	618	293	123	102		47

Figure 1: Telemetry locations for October 1995 - April 1996 for the Itchas - Ilgachuz herd



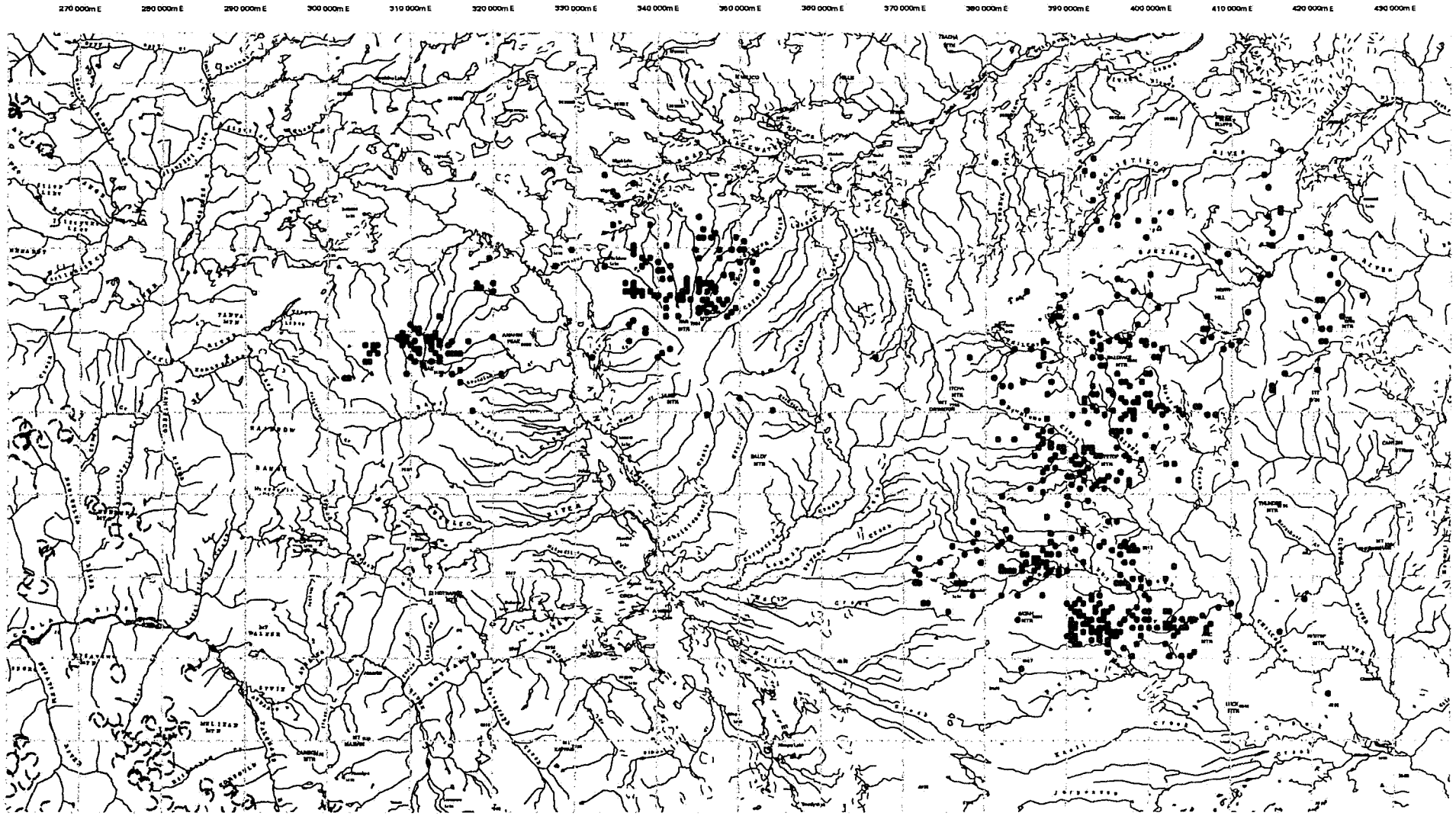
Scale 1:600 000 - Échelle 1/600 000

Kilometres 10 0 10 20 30 40 50 Kilomètres

Ministry of Environment, Wildlife section

Projection Universal Transvers Mercator, zone 10

Figure 2: Locations of female radio-collared Itchas-Ilgachuz-Rainbow caribou from November - April, 1985 - 1988 (Deborah Cichowski, 1989).



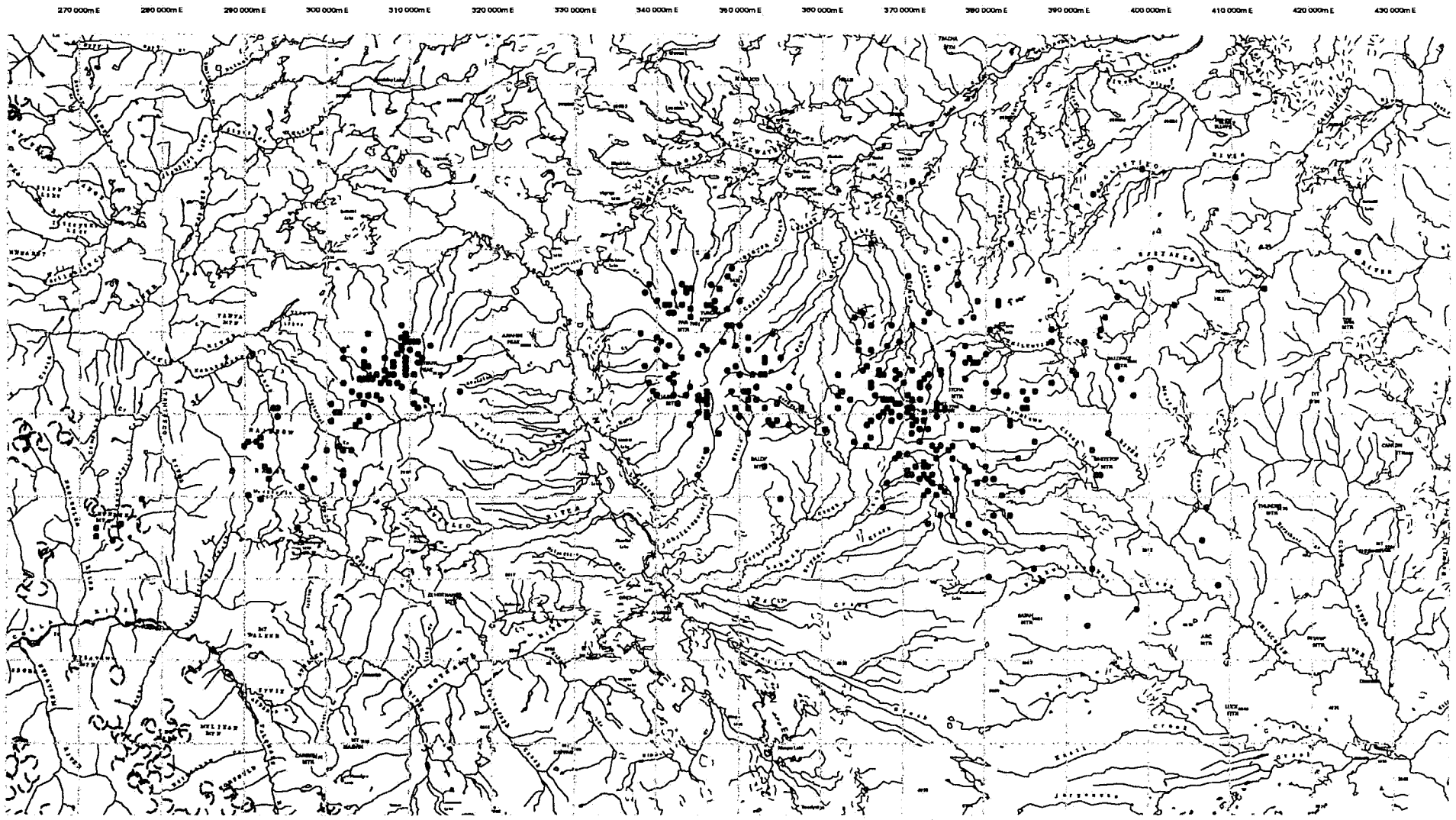
Scale 1:700 000 - Échelle 1/700 000

Kilometres 10 0 10 20 30 40 50 Kilomètres

Ministry of Environment, Wildlife section

Projection Universal Transverse Mercator, zone 10

Figure 3: Locations of female radio-collared Itchas-Ilgachuz-Rainbow caribou from May - October, 1985 - 1987 (Deborah Cichowski, 1989).



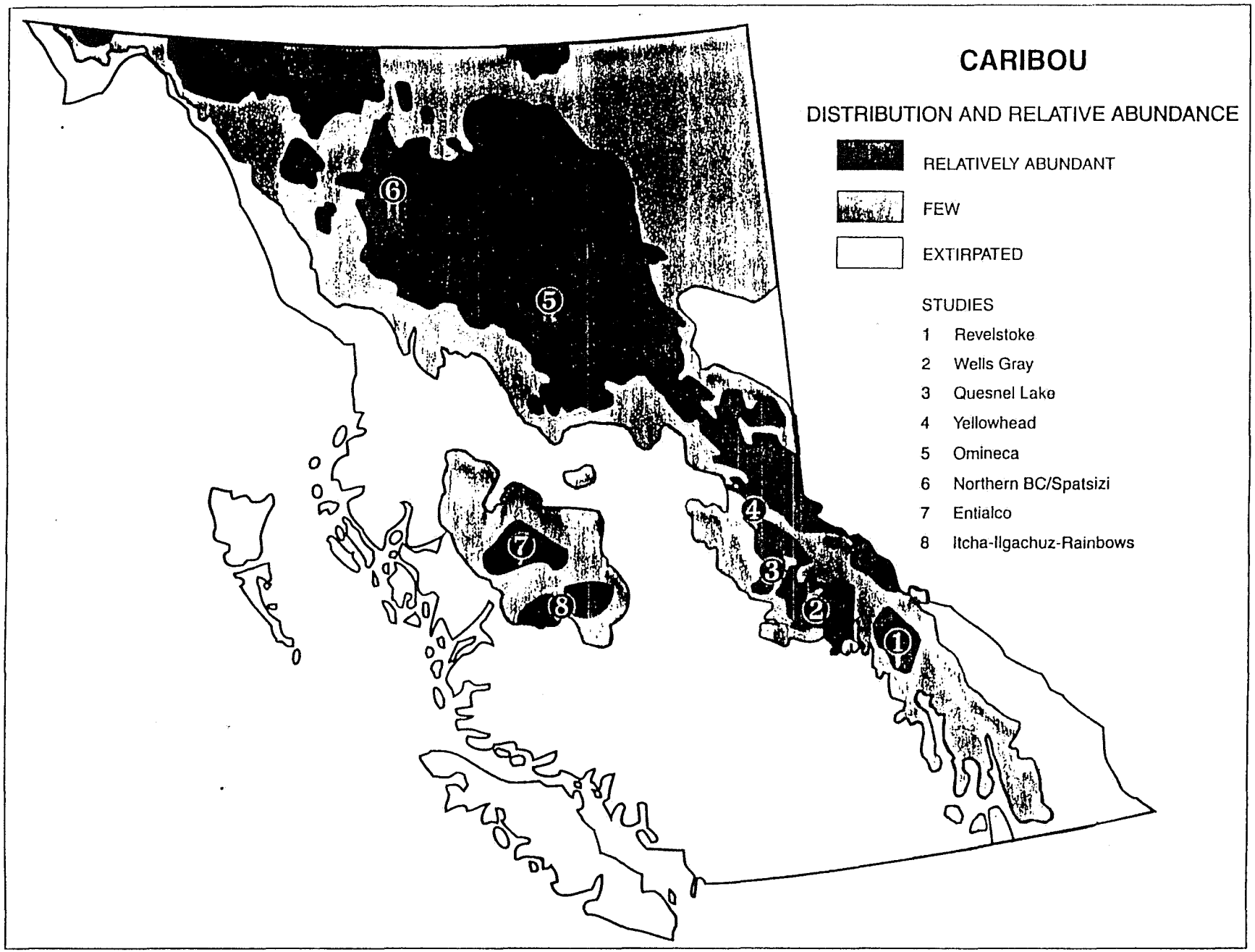


Figure 4. Distribution and relative abundance of caribou throughout British Columbia (from Seip & Cichowski, 1996).

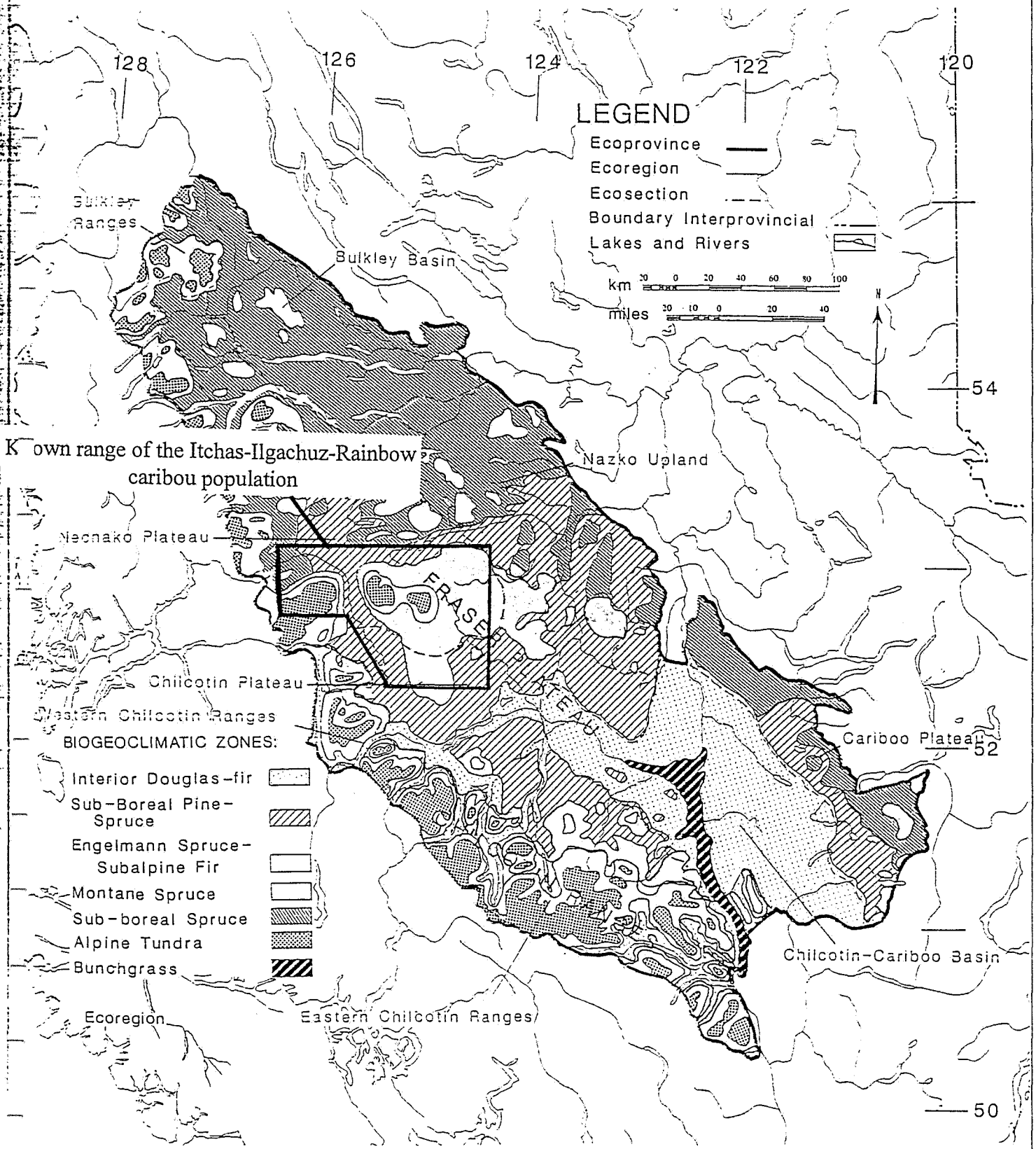
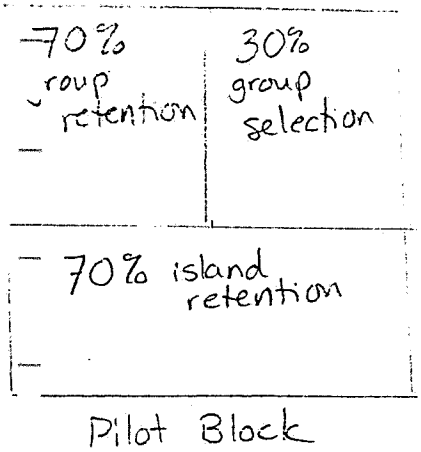
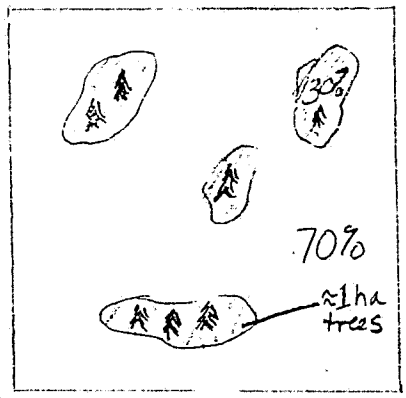
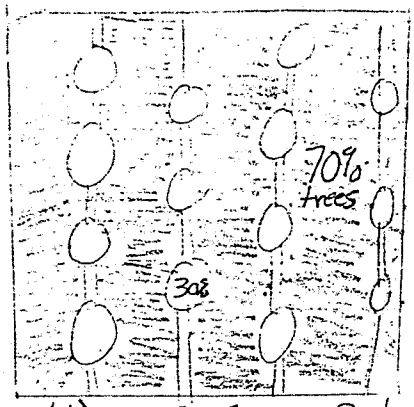


Figure 5. Biogeoclimatic zones of the Fraser Plateau Ecoprovince, for the Itchas-Ilgachuz-Rainbow caribou populated area (from Campbell et al, 1990).

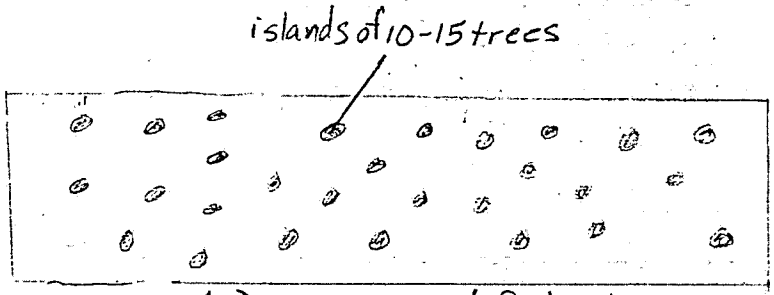




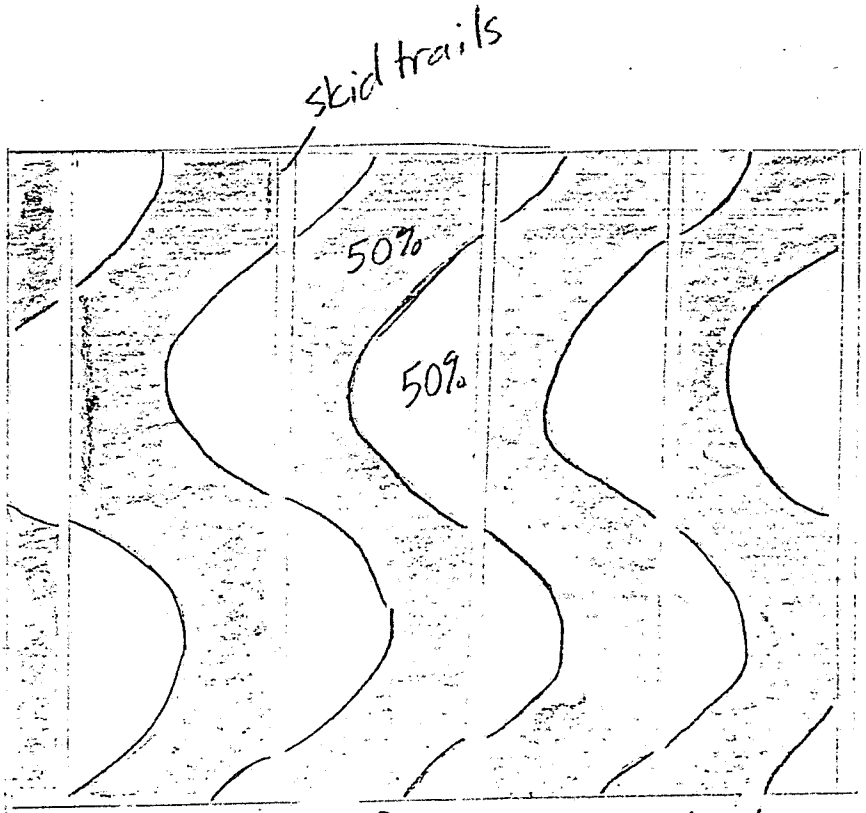
6a) 30% Group Selection



6b) 70% Group Retention



6c) 70% Island Retention



6d) 50% Partial Retention Method

Figure 6: Alternative Silviculture Systems for Even-Aged Lodgepole Pine Stands in the Msxv in order to maximize lichen survival.

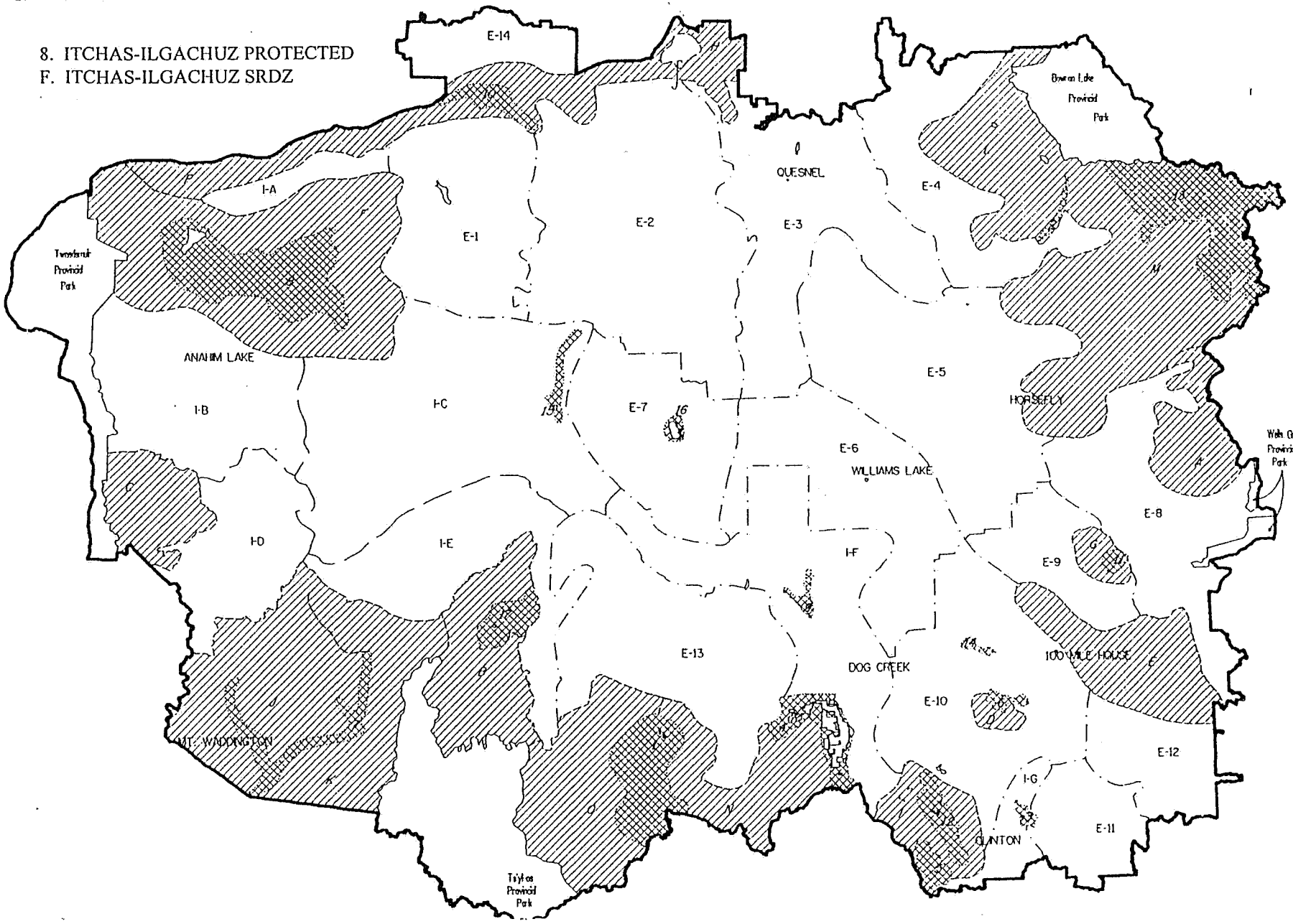


Figure 7. Cariboo-Chilcotin Land-Use Plan [illegible]cted as a[illegible]ecia[illegible] ourq[illegible]
development zones (from CCLUP, 1995).

Figure 8: Moderate risk option: Itchas-Ilgachuz approved integrated management areas as specified by the Western Caribou Working Committee in conjunction with the Cariboo Chilcotin Land Use Plan