

**Habitat Management
in the Yukon Winter Range
of the Little Rancheria Caribou Herd**

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J.Z. Adamczewski, R.F. Florkiewicz and V. Loewen

Director, Fish and Wildlife Branch

Chief, Habitat and Regional Management

Executive Summary

Woodland caribou (*Rangifer tarandus caribou*) ranges have shrunk substantially across North America due to the complex effects of human-caused habitat changes. As a result, COSEWIC¹ listed nearly all woodland caribou populations in Canada as either *Threatened* or of *Special Concern* in May 2002. The Little Rancheria Herd (LRH) of caribou, which numbered about 1,000 in 1999, has a lowland forested winter range with some merchantable pine and spruce stands just west of Watson Lake, Yukon. Timber harvest in this range has to date (2003) been limited but the potential for habitat fragmentation is high. In this report we develop a long-term approach to habitat management of the Yukon LRH winter range, based on the herd's habitat use and ecology, together with studies and management of woodland caribou elsewhere.

The direct and indirect effects of development on woodland caribou include:

- loss of fragile, slow-growing lichens, the
- primary caribou winter forage,
- avoidance of disturbed areas, particularly those with heavy traffic,
- increased hunter access and harvest,
- collisions with vehicles,
- increased access to remote caribou range for predators, primarily wolves, and
- improved habitat suitability for other
- ungulates like moose. Where these other prey sustain elevated wolf numbers, caribou numbers often decline.

Alberta studies showed that caribou were more likely to be killed by wolves in areas within 250 m of all recent cut-blocks and other developments, and that caribou used these areas much less than undisturbed forests. The development "footprint" was defined as the proportion of the land-base within such avoidance zones. Where the development footprint in a caribou range

was 50% or greater, the population was likely to be declining at 1–3% annually, even with little or no hunting. Threshold levels limiting the footprint in caribou range have been proposed as a management option for the Yukon. Management guidelines for caribou ranges in British Columbia and Ontario focus on protecting critical caribou habitat from development and access, and allow carefully managed development in less sensitive caribou range.

Three management zones in the Yukon LRH winter range were identified in the 1990s based first on reconnaissance surveys and later confirmed by radio-collar locations: a heavily used core, a surrounding extended range, and a migration corridor. Although just 3.6% of the land-base had been cut for timber by 2002, the development footprint in the LRH Yukon winter range was 16% overall, with 18% in the core, 18% in the extended range, and 5% in the migration zone.

Like most Yukon caribou herds, the LRH is hunted. The estimated annual harvest rate averaged 5% from 1992 to 2002. To enable continued hunting of this herd, and to allow for periodic range losses to fire, development in this winter range must be kept at levels well below the 50% footprint values linked to serious declines in Alberta.

The suggested management approach for the LRH Yukon winter range is based on British Columbia models, Alberta studies, and recent reports proposing thresholds for development footprint in caribou range. The main points of the approach are:

- withdraw the core winter range from further logging or development,
- establish a connected reserve network of high-quality habitat in the extended range and migration zone, and
- establish maximum development footprint values of 30% in the extended range and 25% in the migration zone.

¹ COSEWIC - Committee On the Status of Endangered Wildlife in Canada

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Status and management of woodland caribou in Canada and Yukon

Status of woodland caribou in Canada

The North American range of woodland caribou has shrunk substantially since settlement by Europeans (Bergerud 1974, Edmonds 1991). In May 2002, boreal eco-type populations were listed as *Threatened* by COSEWIC over a large National Ecological Area (NEA) that includes Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland. Caribou in the Southern Mountain NEA in British Columbia were also listed as *Threatened* (COSEWIC 2002); this NEA contains caribou of both northern and mountain eco-types, thus populations of both types were considered *Threatened*. At the same time, the northern eco-type caribou populations of Northwest Territories, Yukon, and northern British Columbia contained within the Northern Mountain NEA were listed by COSEWIC for the first time as being of *Special Concern*. The remaining jurisdictions in Canada do not have woodland caribou. What accounts for this widespread and growing decline across Canada? In simplest terms, woodland caribou live part or all of the year in large

tracts of old forest with abundant slow-growing lichens and relatively little use by other hoofed mammals. As these forest tracts are reduced in size, made more accessible to predators and hunters, and converted to younger stands attractive to other hoofed mammals, their capacity to support caribou erodes.

Status and management of woodland caribou in northern BC and Yukon

Ranges of the northern caribou eco-type in British Columbia have to date been less impacted (Seip and Cichowski 1996) than Alberta's caribou ranges (see Dzus 2001) because development has generally been on a much smaller scale. However, the range loss of northern British Columbia populations noted by Seip and Cichowski (1996) indicates that these northern forested lowland winter ranges are as vulnerable to development as caribou ranges further south. Woodland caribou in the Yukon are all of the northern type that is found in northern British Columbia, although the ecology of individual herds varies and a few herds have mostly alpine winter ranges (Farnell et al. 1996, R. Farnell, Yukon Environment, personal communication, 2000). Most Yukon woodland caribou herds were stable in 1996 and there were an estimated 30,000–35,000 in 23 herds (Yukon Renewable

Ecological typing and naming of woodland caribou has varied somewhat among jurisdictions and authors. We have used the following eco-types generally recognized by British Columbia biologists (Heard and Vagt 1998):

- **boreal caribou** are found in boreal forests with subdued topography, in small bands, with limited seasonal movements;
- **mountain caribou** are limited to high-elevation wet forests in some parts of southern and central British Columbia and Alberta;
- **northern caribou** are found in northern British Columbia, Alberta, Yukon and Northwest Territories, and usually have forested lowland winter ranges and alpine summer ranges. Some of these herds may winter in alpine areas.

COSEWIC designations consider these eco-types but are also based on geographic blocks called National Ecological Areas (NEAs). Some of these NEAs include more than one of the caribou ecotypes listed above.

Resources 1996). The seasonal movements and demographics of nearly all Yukon woodland caribou herds had been studied by 1996 (Yukon Renewable Resources 1996).

Most Yukon First Nations (FN) have a long-standing association with individual woodland caribou herds. For example, Kaska FN hunters from the communities of Watson Lake, Upper Liard, and Lower Post have known and hunted Little Rancheria Herd caribou for a long time (Sun-Comeau 2001). A recovery program has been in place for several years for the Ibex and Carcross herds, (known locally as the Southern Lakes herds) near Whitehorse. Six Yukon First Nations and the Yukon Government agreed to suspend hunting and co-operate on management of these small herds. Together, these examples illustrate the significance of Yukon woodland caribou herds to the communities in their regions.

Although most Yukon woodland caribou herds' winter ranges include little timber of commercial value, the Little Rancheria Herd (LRH) near Watson Lake (Fig. 1), ranges near the 60th parallel, where timber harvest and other development has been increasing. Both the Yukon and British Columbia portions of the LRH winter range contain stands of merchantable pine and spruce accessible from the Alaska Highway, and both FN and non-FN residents want the economic benefits of a regional timber industry. A desire has also been expressed by FN people in the region to manage the herd wisely and to continue to hunt these caribou. As of 2002, development associated with timber harvest had not impacted the LRH range nearly as heavily as most caribou ranges in Alberta and other provinces. With commercial timber occurring in scattered pockets throughout the region, however, the potential for habitat fragmentation is high. Biologists and land managers must work to reconcile the demands for timber and other resources in this caribou range with the well-documented vulnerability of woodland caribou to habitat fragmentation.

In this report, we develop a long-term approach for management of the Yukon LRH winter range. The approach is based on the herd's habitat use and ecology, and on research and management from other woodland caribou herds. A companion report (Florkiewicz et al. 2003) provides detailed information on this herd's habitat ecology. We begin by reviewing studies and management of woodland caribou in the provinces, and then focus on management of the LRH Yukon winter range.

Direct and indirect effects of development on woodland caribou

Habitat change has both direct and indirect effects on woodland caribou; these effects show the complexity of ecological relationships that can be altered by apparently small, simple disturbances on the land. Unlike large barren ground caribou populations such as the Porcupine herd that are more likely to be limited in numbers by range conditions (Russell et al. 1993), woodland caribou herds in the Yukon are primarily limited by predators, principally wolves (Yukon Renewable Resources 1996). Development effects linked to nutrition and energetics in barren-ground caribou (Wolfe et al. 2000) may affect also woodland caribou (Bradshaw et al. 1998) but the primary factor governing their numbers is adult and calf mortality rates, and these have been the main focus for disturbance studies in this subspecies.

The direct effects of habitat alteration on woodland caribou include:

Loss of terrestrial and arboreal lichens

Loss of arboreal lichens through timber harvest is self-evident; logging also reduces terrestrial lichens (Webb 1998) although the extent of the reduction depends on specific cutting practices (Stevenson et al. 2001). Wintering caribou rely heavily on abundant terrestrial lichens as forage (Farnell and McDonald 1990, Thomas et al. 1996).

Some woodland caribou rely more on arboreal lichens, particularly where deep snow limits access to terrestrial lichens (Rominger et al. 1994, Rominger et al. 1996).

Lichens are easily broken and slow growing; their regeneration following disturbance is measured in decades (Schaefer and Pruitt 1991, Webb 1998). Lichens compete poorly with faster growing grasses, forbs, and shrubs and tend to grow on low nutrient soils beneath relatively open-canopied forests. Regeneration of terrestrial lichens after fire is reasonably

well understood and proceeds in a predictable manner (Schaefer and Pruitt 1991) but lichen re-growth following timber harvest is less well understood and less predictable (Kranrod 1996, Webb 1998). Woodland caribou are well adapted to fire cycles in boreal forests over decades or centuries (Schaefer and Pruitt 1991) but timber harvest often does not replicate these cycles and temporal scales (McRae et al. 2001).

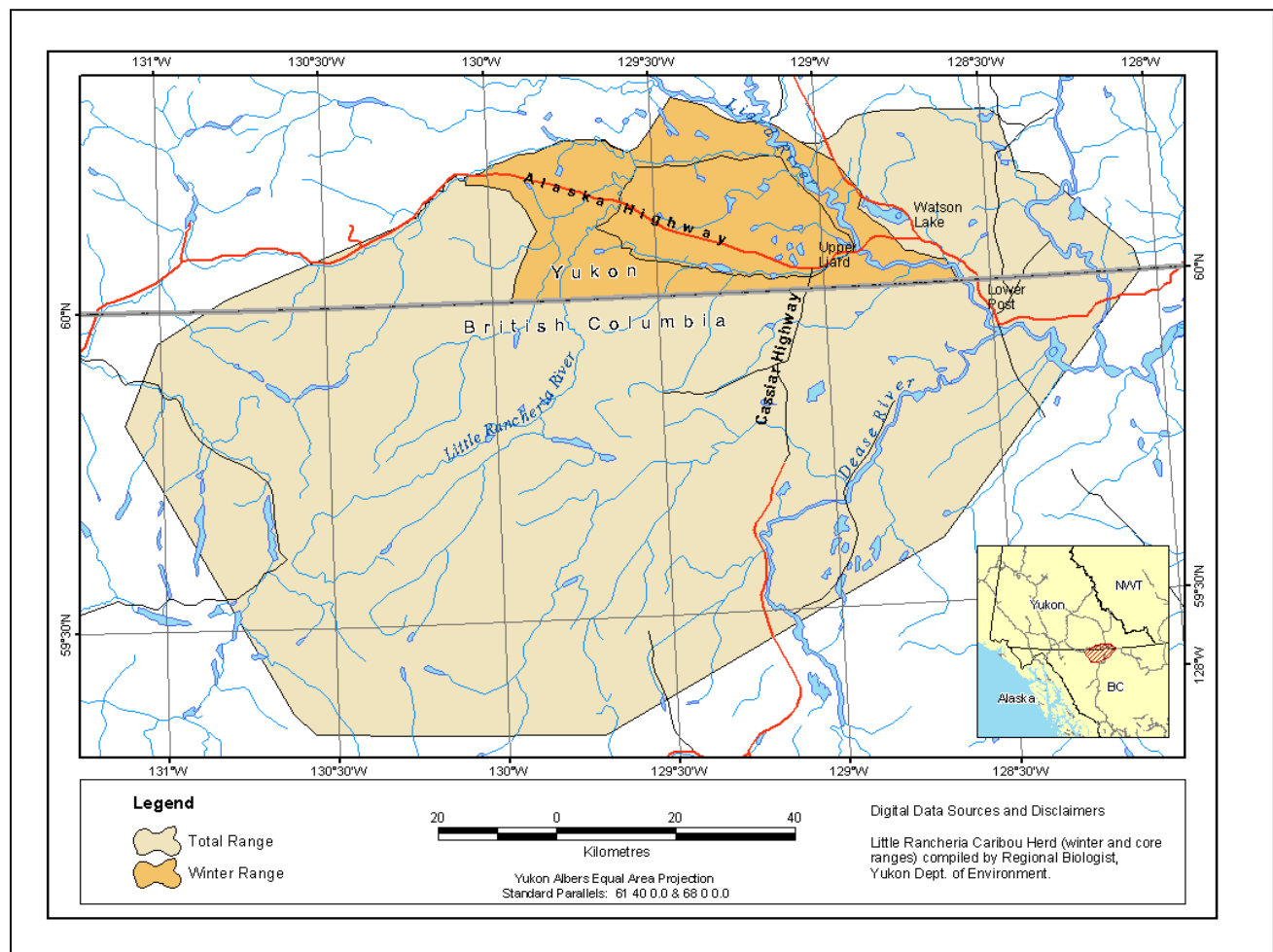


Figure 1. Year-round (beige) and Yukon winter range (orange) of the Little Rancheria Herd of woodland caribou in British Columbia and Yukon. Boundaries of the BC portion of the LRH winter range were under review in 2003 (M. Domazet, B.C. Min. Sustainable Resource Management, Smithers, personal communication 2003) (from Florkiewicz et al. 2003).

Loss of forest cover and avoidance of disturbed forests

The avoidance of clear-cuts, roads and seismic lines by woodland caribou has been demonstrated on a broad scale in Ontario (Cumming and Beange 1993, Cumming 1998, Cumming and Hyer 1998) and Saskatchewan (Rettie and Messier 1998, Rettie et al. 1998). In Newfoundland, Mercer et al. (1985) determined that animals “spaced away” from high disturbance, high use areas, especially road and rail corridors. In northern Alberta Dyer (1999) and Dyer et al. (2001) showed that boreal caribou avoided well-sites, seismic lines, and roads to distances of 250 m or more, creating “zones of avoidance”. Use of these areas was reduced to less than 50% of that in undisturbed sites. Nearly 48% of Dyer's study area fell within these zones, providing a graphic example of habitat deterioration. Oberg (2001) found similar reduced use patterns in a northern mountain herd in Alberta. In a different northern mountain herd in Alberta, Smith et al. (2000) showed that caribou avoided heavily logged areas by average distances of 1.2 km. With intensive and extensive oil and gas exploration and forestry throughout northern Alberta, Wynes (2000) reported declines for most northern Alberta caribou populations between 1991 and 1999.

The indirect effects of human activity on caribou include:

Increased hunter access and harvest

Increased hunter access and harvest following forestry and other development were identified as potentially the greatest threat to woodland caribou across their range (Bergerud 1979). Where predator populations are intact, woodland caribou cannot tolerate heavy hunting pressure (Bergerud 1980). Unrestricted caribou harvests that followed the construction of the Yukon's Robert Campbell Highway in the late 1960s contributed to a population decline of the Finlayson caribou herd that required a lengthy and expensive recovery

and management program to correct (R. Farnell, Yukon Environment, unpublished data). The need for roads is one of the key ways in which the influence of timber harvest differs from that of fire. The road access necessary for logging may precipitate the need for more intensive management of hunting, caribou, and other wildlife.

Collisions with vehicles

Caribou deaths from collisions with vehicles are an indirect effect of development recognized in Alberta (Edmonds and Hobson 1995). The Alaska Highway crosses several woodland caribou ranges in northern British Columbia and southern Yukon, and caribou deaths by collision are reported annually in these areas. The calcium chloride used to improve winter traction for vehicles is the primary attractant drawing caribou and other ungulates onto the road surface.

Increased predator access and higher predation risk

Caribou are at greater risk of wolf predation when near linear disturbances in northern Alberta (James 1999, James and Stuart-Smith 2000). These results may explain, in part, caribou avoidance of linear disturbances demonstrated by Dyer et al. (2001) and earlier studies. Roads, seismic lines, and other linear disturbances increase wolf access to preferred caribou winter habitats, reducing their value as refuges (James 1999, James and Stuart-Smith 2000). Wolves in northern Alberta traveled on seismic lines at speeds nearly 3 times greater than in undisturbed forests (James 1999). Where a fine balance exists between caribou recruitment and mortality, even small increases in predation rates can have large cumulative effects on a low-density woodland caribou herd.

Altered predator-prey balances leading to caribou declines

Reports from several provinces have shown that woodland caribou often decline where habitat change leads to an influx of other hoofed mammals like moose or deer. Greater wolf numbers and higher caribou mortality rates follow, with greater wolf numbers sustained by more than one prey species. In southeastern British Columbia, several small southern mountain caribou herds declined or disappeared when cut-blocks in previously undisturbed caribou habitat attracted more moose, followed by greater wolf numbers (Seip 1991, 1992; Seip and Cichowski 1996). Similar patterns were reported in Alberta (Edmonds and Bloomfield 1984). In northern Saskatchewan, Rettie et al. (1998) considered that regenerating clear-cuts increased habitat values for moose, elk, and deer. They concluded that woodland caribou populations in northern Saskatchewan would remain viable only where there was sufficient undisturbed habitat to provide refuge from predators. Individual herd histories and predator ecology vary across the Yukon (Farnell et al. 1996, Hayes et al. 2003), but in most provinces woodland caribou have generally persisted only where their winter ranges have seen little influx of other ungulates and little increased access for wolves.

The findings of Smith et al. (2000) and Oberg (2001) on the effects of development on mountain caribou in Alberta indicate that the forested winter ranges of these herds are as vulnerable to development as those of boreal populations, for which most research has been carried out.

Population ecology linked to development footprint

A caribou population's trend is linked to the degree of development in its range, based on limited data from Alberta (Bob Wynes, then Coordinator with Boreal Caribou Committee in Alberta, personal communication 2001, Anderson et al. 2002).

Alberta researchers proposed a means of quantifying cumulative environmental effects in caribou range by measuring the development "footprint", defined as the proportion of the land-base within 250 m of all recent cut-blocks, seismic lines, and other developments. Of the 6 Alberta caribou ranges reported on by Anderson et al. (2002), the smallest footprints were 38.6% and 45.3% of the land base; these populations were considered stable. The other 4 ranges had footprint values of 50% or greater, with the caribou estimated to be declining at 1–3% annually (Anderson et al. 2002). The most fragmented range had a 70% footprint, and showed a catastrophic caribou decline estimated at >10% per year. Komers (2002) concluded in a broader review of the relationship between cumulative habitat loss and animal abundance that "an abrupt change in responses occurs at around 50% of original habitat lost" for a variety of species and ecological systems.

In the Yukon, woodland caribou are considered predator-suppressed, meaning that caribou are kept by wolves, and to a lesser extent by bears, at densities lower than the range can support. Increased predator numbers or mobility following habitat change in caribou range are thus of special concern. Most woodland caribou herds are hunted in the Yukon, unlike Alberta. Recruitment in Yukon caribou herds normally balances natural mortality rates, but does not allow for much additional mortality from hunting. Sustainable hunter harvest rates from Yukon woodland caribou herds are therefore low (2–3% of the adult population per year; Yukon Renewable Resources 1996). Increased mortality rates in adults or calves resulting from habitat degradation would quickly eliminate these small sustainable hunter harvests. Alternatively, if hunting continued under such conditions, it could accelerate a decline. Altering the predator-prey balance in favour of wolves would be expected to increase mortality of calves, as has been

seen for several years in some of the most heavily developed caribou ranges in Alberta (J. B. Stelfox, Forem Technologies, Alberta, personal communication 2003). Recruitment in Yukon herds must offset both natural mortality of caribou and the additional mortality from hunting.

Natural habitat alterations, including fire

Natural disturbance patterns must be considered in managing development-caused caribou range degradation. While woodland caribou are adapted to boreal fire cycles over the long-term, over shorter periods they will periodically lose portions of their forested range to fire. Their ability to then shift to unburned portions of their range is essential over shorter intervals of decades. Woodland caribou in southern Manitoba made virtually no use of burned forests until at least 55–60 years after fire (Schaefer and Pruitt 1991). The Yukon's slower-growing forests likely mean that 70–80 years would elapse before burned winter ranges are again used by caribou. The Caribou Mountain population in Alberta had a relatively small development footprint (27.9%) but an additional 50% of the range had burned in recent years; this population has been estimated to be declining at 2.7% per year (Bob Wynes, then Coordinator with Boreal Caribou Committee in Alberta, personal communication 2001). This herd may be an example of the consequences of simultaneous, additive range loss from natural and human-caused sources.

Synthesis – woodland caribou and development

Woodland caribou range management presents a dilemma to forest and land managers. Intensive development inevitably results in some forest fragmentation and a shift from old forests to ones with younger age classes, but caribou conservation is best served by leaving large tracts of old forest intact. The direct effects of logging and other disturbances can be mapped and quantified (e.g. Dyer 1999), and

some groups of hunters can be regulated. However, altered predator-prey dynamics are difficult to quantify and even more difficult to manage. Forested caribou ranges must also be large enough to absorb periodic losses to natural disturbances such as fire. Woodland caribou management should be focused primarily at the landscape level, as the most serious effects result from the accumulation of many small habitat changes.

Management of woodland caribou ranges – examples from Ontario, Alberta and British Columbia

Managers in other jurisdictions in Canada have studied and managed woodland caribou ranges in an effort to balance the welfare of these populations with the economic benefits of development. We draw here on management approaches from Ontario, Alberta, and British Columbia due to the availability of research and recent guidelines from these provinces. We have focused particularly on the research in the 1990s and 2000s from Alberta, as this work offered a sound basis for developing thresholds for development in caribou range. Northern British Columbia has caribou herds of the same northern type as much of the Yukon, hence management of these ranges was also particularly relevant to the Yukon.

Ontario

In Ontario, woodland caribou historically ranged south to 46° N latitude but with spreading development their southern limit has retracted to near 50° N (Cumming 1998). As long ago as 1986, Darby and Duquette (1986) proposed mitigation of timber harvest that involved avoiding caribou winter ranges and leaving a 1 km no-cut buffer around wintering ranges and traditional migration routes. Timber harvest in peripheral portions of caribou winter range was to be considered only

where winter use was infrequent or where lichen biomass was low.

Relying on these and other reports (e.g. Racey et al. 1991; Cumming and Beange 1993; Cumming and Hyer 1998; Cumming 1992, 1998), Ontario adopted a landscape-focused approach to management of boreal caribou ranges. Management guidelines (Racey et al. 1999) include the following key points:

- Manage caribou on a very large spatial and temporal scale, spanning more than 1 Forest Management Unit over 80 or more years.
- Protect important winter habitat and calving areas through land use planning.
- Avoid traditional winter habitat, landforms, and soils with high capability to support winter habitat when planning access roads.

The objective when planning for development in caribou range in Ontario is to "maintain a continuous supply of suitable, mature, year-round habitat distributed both geographically and temporally across the landscape in such a manner as to ensure permanent range occupancy" (Racey et al. 1999). Under this system, a network of large (>100 km²) unbroken and connected patches of habitat is suggested to avoid the effects of habitat fragmentation, increased habitat suitability for moose and deer, and increased access for hunters and wolves (Racey et al. 1991, Racey et al. 1999). These guidelines are quite recent, however, and their success in managing for long-term caribou conservation is unknown.

Alberta

Recommendations from wildlife managers and biologists concerned with woodland caribou management in Alberta echo those from Ontario. For example, Hervieux et al. (1996) and Smith et al. (2000) suggested that timber harvest spare caribou core ranges and be limited in less critical parts of caribou ranges. In Alberta, efforts to manage for both timber and caribou culminate in negotiated agreements

between individual timber companies and provincial authorities where roles, responsibilities, and expectations are specified (Dzus 2001). While these agreements are focused on balancing caribou conservation with economic activities, "current land use guidelines have proved ineffective in terms of providing for long term caribou conservation" (Dzus 2001). In 2000, 12 of 18 areas in northern Alberta indicated declining caribou numbers even though resident hunting had ended many years earlier (Wynes 2000). Caribou range is limited to scattered remnants of its historic extent and the province's overall woodland caribou population is estimated at between 3,600 and 6,000 (Wynes 2000).

British Columbia

The most severely affected caribou in British Columbia, those of the mountain eco-type in the southeastern parts of the province (Seip 1991, 1992), do not occur in the Yukon. However, the problems faced by these herds are similar to those in other caribou ranges, and the management objectives (Stevenson et al. 2001) echo recommendations from other jurisdictions. Objectives included "(1) ensuring that large contiguous areas of habitat are maintained in a suitable condition for use by caribou, (2) providing linkage areas to ensure connectivity among caribou population centres, (3) controlling access and human activity – especially backcountry winter recreation – in caribou ranges, and (4) separating caribou from predation by avoiding the enhancement of moose, deer, and elk populations near caribou habitat."

Management for caribou herds of the northern eco-type in British Columbia is of particular relevance to the Yukon, which has populations of this type. Biologists' and managers' recommendations for management of these caribou ranges show a consistent pattern: protect the most critical or core ranges and allow limited timber harvest and access in areas of lesser importance to caribou. For caribou in

northern British Columbia, Stevenson and Hatler (1985) identified an objective of no industrial development and controlled access to key caribou ranges. More recently Cichowski and Banner (1993) provided for a range of management options for the Tweedsmuir-Entiako caribou herd, ranging from no timber harvest in critical caribou areas to modified timber harvest in most other zones. Within each of these zones, they further identified areas of high, medium, and low value to caribou. Armleder and Stevenson (1996) recommended that caribou core winter ranges be set aside as no-harvest and no-access areas in the event that management strategies did not meet caribou needs.

This zoned approach to management of caribou habitat has been incorporated into a succession of recent British Columbia Land and Resource Management Plans (LRMPs) developed through multi-stakeholder planning processes designed to achieve a broad range of land use goals. A review of caribou habitat management strategies from 9 LRMPs and 1 Regional Land Use Plan, covering most of the province, was written in 2001 (MacLean 2001).

The British Columbia plans show clearly that the incompatibility of intensive forestry and conservation of key caribou habitats is widely recognized in British Columbia. All but 1 of the LRMPs set aside the most critical caribou habitat as protected areas, and in each plan, protection of caribou habitat or of specific caribou herds was a primary reason for creating those protected areas. Most of these protected areas focus on winter range as the most important habitat; in some cases movement corridors are protected, and in a few cases year-round ranges are protected. Because all these plans are quite recent, their success in conserving caribou is not yet known.

Synthesis – management of caribou ranges in Ontario, Alberta and BC

Overall, the recommendations of biologists and managers for woodland

caribou in Ontario and British Columbia show a convergent pattern: manage on a large landscape-level scale over an extended time period, protect core ranges from development and access, and carefully manage development and access in areas less heavily used by caribou. Although some excellent research on woodland caribou and development has been carried out in Alberta in recent years, the entire land-base is committed for development, and the prospects for long term caribou conservation are poor (Dzus 2001).

Little Rancheria herd ecology and habitat use

Population ecology

Farnell and McDonald (1990) estimated the LRH to number $681 \pm 20\%$ caribou in March 1988. At that time Horseranch (HH) caribou appeared to occupy distinct ranges east of LRH range and were not found in the Yukon. In February 1999, Marshall (1999) estimated a total of 1800 caribou in an area which encompassed both the LRH and HH herds' winter ranges. Owing to the substantial overlap of the 2 herds, separate population estimates were not possible. Most information indicates that the LRH is the larger herd; 1,000 animals was the estimate for the LRH in 1999.

The LRH averaged 32 calves per 100 cows during October surveys in 1993, 1996, 1999, and 2000 (Table 1). Experience in the Yukon has shown that fall calf: cow ratios of 20 or fewer calves per 100 cows are indicative of declining herds, ratios of about 26 calves per 100 cows are needed for stable populations, and values exceeding 30 calves per 100 cows are indicative of increasing herds (R. Farnell, Yukon Environment, personal communication, 2001). These ratios assume a relatively constant natural mortality rate in adult caribou. The bull: cow ratios of the LRH were within the range considered normal in the Yukon (Yukon Renewable Resources 1996).

Table 1. October composition counts of the Little Rancheria caribou herd.

Year	Bulls	Cows	Calves	Total	Calf: cow ratio	Bull: cow ratio
1993*	107	254	66	427	26.0: 100	42.1: 100
1996★	87	153	44	284	28.8: 100	56.9: 100
1999★	87	260	115	462	44.2 :100	33.5: 100
2000★	134	290	87	511	30.0: 100	46.2: 100

*Yukon Environment, unpublished data

★ BC Environment, Lands and Parks, unpublished data.

Hunting and other mortality sources

LRH caribou are hunted in Yukon and British Columbia by First Nations (FN) hunters, primarily Kaska people, and by non-FN residents and non-residents. The numbers of caribou taken by FN hunters in British Columbia and Yukon are not well documented, but non-FN hunters in British Columbia and Yukon are required to report their kills. We estimated that the total annual harvest from the LRH averaged about 50

caribou per year from 1992 to 2002 (Table 2). This represents an annual harvest rate of 5% for the herd. The Yukon's caribou management guidelines suggest a maximum sustainable harvest rates of 2–3% of a herd's adults annually (Yukon Renewable Resources 1996). However, if the fall calf: cow ratios recorded in 1999 and 2000 are typical of the recent decade, then continued above-average calf survival could allow this harvest rate to be sustainable.

Table 2. Estimated average annual hunter kills of LRH caribou in British Columbia and Yukon, 1992– 2002.

Hunter group	Average annual kill, 1992– 2002	Source
British Columbia residents and non-residents	26	BC Environment, Lands and Parks, unpublished data, 2002
Yukon residents and non-residents	4	Yukon Environment, unpublished data, 2002
Yukon FN hunters	10 (estimated)	Farnell and McDonald 1990
British Columbia FN hunters	10 (estimated)	BC Environment, Lands and Parks, unpublished data, 2002
Total	50	

Conservation officers recorded the following numbers of caribou deaths due to vehicle collisions on the Alaska Highway near Watson Lake: 6 in 1999–2000, 1 in 2000–2001, 6 in 2001–2002, and 7 in 2002–2003. These counts may be incomplete as caribou struck by vehicles but not killed outright might die away from the road or be easy prey for wolves. In addition, Yukon residents killed 11 LRH bulls in late October 2001 when caribou returning to Yukon winter range near Watson Lake were locally known to be easy targets just off the Alaska Highway. The collision mortalities and higher-than-average Yukon resident hunter harvest in 2001 illustrate the negative influence of the Alaska Highway on LRH population trend. Recruitment and harvest rates of the LRH need to be closely monitored.

Seasonal range use

LRH caribou spend the summer and fall in alpine and subalpine ranges of the Cassiar Mountains, primarily in British Columbia (Fig. 1; Farnell and McDonald 1990; N. MacLean and R. Marshall, British Columbia Environment, Lands and Parks (BCELP), unpublished data). In early to mid-October, LRH caribou descend into a lowland forested winter range in the Liard River basin, spanning the border between Yukon and British Columbia. Caribou usually leave the Yukon portion of the winter range during early April but occasionally the southward movement continues into May. Calving in May is usually in the alpine.

Changes in LRH range use over time

The entire LRH range is within the traditional territory of the Kaska Nation. Interviews with Kaska elders indicate that the overall range boundaries and occupancy of the LRH range in 2000 (Fig. 1) were very similar to those remembered by older Kaska people from before 1942, when the Alaska Highway was built (Sun-Comeau 2001). This suggests that overall caribou occupancy of summer and winter ranges has varied relatively little for at least 6 decades.

Two significant changes in range use from the 1980s to the 1990s were apparent from the radio-collar data and the 1999 census-survey. First, there was limited winter range overlap between the LRH and Horseranch (HH) caribou herds in the late 1990's (N. MacLean and R. Marshall, BCELP, unpublished data). The 2 herds appeared to occupy separate summer-fall alpine ranges, but HH caribou, including a few with radio-collars, had made some use of LRH winter range. Caribou herds overlapping in winter range use but separating on summer-fall ranges are known in the Yukon-Northwest Territories border region near Nahanni National Park (JA, unpublished data). Because the British Columbia radio-collar study of LRH and HH caribou ended in 2001, distinguishing between caribou of the 2 herds will likely become more difficult, particularly in winter. Surveys and management may need to consider both herds simultaneously.

The second significant change in caribou range use was limited winter use of areas north and east of Watson Lake, based on local reports and observations by one of the authors (JA) in the late 1990s and early 2000s. A few radio-collar locations were also in that area (Fig. 2), but there were too few for detailed analysis. HH caribou likely accounted for most of these observations (N. MacLean, consulting biologist, personal communication, 2003). Another possible explanation may be the relatively limited snow cover in those years. Other Yukon herds use more peripheral winter range in years of low snow, with more concentrated use of core areas in deep-snow winters (RF's observations and R. Farnell, Yukon Environment, personal communication, 2002). Caribou did not use the areas east and north of Watson Lake in the early 1990s, based on author RF's experience. Local knowledge, including observations by JA on the ground, showed that there are a few open-canopied, lichen-rich stands east and north of Watson Lake, similar to caribou range west of Watson Lake.

Habitat use and habitat quality

Florkiewicz et al. (2003) provided a detailed assessment of LRH caribou habitat selection. Overall, their analyses of radio-collar data showed that caribou selected open-canopy habitat types rich in lichen cover and tended to avoid relatively closed-canopy habitat types, particularly those poor in lichen cover. This pattern was expected, given the reliance of LRH caribou on lichens as their primary forage in winter. However, the data also showed that caribou made substantial use of all other habitat types in their range, likely for rest, cover, and travel.

Using habitat type mapping in conjunction with caribou use patterns, each habitat polygon in the winter range was ranked as having high, medium or low value to caribou. In addition, each high and medium value polygon and each water corridor was buffered by 250 m to ensure that key areas were protected against mapping errors. The resulting map is presented as Figure 3, and represents our best understanding of the areas most important to the LRH in their Yukon winter range.

Forest cover and soils information were combined with the habitat quality rankings developed in the main Yukon LRH range to estimate likely habitat quality of areas east and north of the main Yukon LRH winter range (Fig. 4). These areas generally had less high-quality caribou habitat than the main LRH range, but some lichen-rich stands were identified and should be considered in forest management planning.

Management of LRH Yukon winter range and risk evaluation

Management status of the LRH winter range

Development in the LRH Yukon winter range has largely proceeded on a short-term, project-by-project basis, with no broader plan defining the limits of development. In 1996, in an attempt to take a broader

landscape approach to caribou habitat management, 3 caribou management zones were outlined (Fig. 2). These zones were based on a series of fixed-wing reconnaissance flights between 1990 and 1996 that delineated caribou locations and sign, on periodic summer field trips to evaluate ground cover not visible in winter, and on knowledge of local trappers and hunters (Florkiewicz et al. 2003).

Core winter range An elliptical area just west of the community of Upper Liard had a high density of caribou and caribou sign year after year, and was designated as the core winter range. Easily-observed features such as roads were used to delineate the core range wherever possible. The core had abundant open-canopy pine and pine-spruce stands with ground cover rich in lichens.

Migration corridor Early-winter reconnaissance surveys showed caribou consistently using the Little Rancheria River and Big Creek drainages to migrate from their alpine summer ranges in the Cassiar Mountains east and north into the Yukon portion of the lowland winter range (Fig. 2). Caribou also used more easterly portions of this migration corridor for foraging throughout the winter.

Extended winter range Areas known to be used by caribou throughout winter, but less heavily than the core, were identified as extended winter range. These areas mostly surrounded the core (Fig. 2). Summer reconnaissance also identified the presence of lichen-rich open-canopied pine and pine-spruce stands in the extended range.

One of the authors (RF) prepared detailed recommendations in 1996 for the 3 caribou management zones which were largely modeled after plans or recommendations from British Columbia for ecologically similar northern mountain herds (Appendix 1). In brief, these recommendations included:

- No timber harvest or roads in the core,
- Retain at least 80% of the old and mature forest in the migration corridor,

- Retain at least 50% of the old and mature forest in the extended range,
- Avoid lichen-rich forest stands of high value, and
- Limit logging to the summer when caribou are largely absent from the winter range.

Although never formally adopted as policy, the management zones and the recommended prescriptions were used in reviews of a succession of short-term (3–5-year) logging plans and other development proposals in the caribou range. As of summer 2003, development activity in the Yukon LRH range has been mostly timber harvest in clustered patch cuts (small clear-cuts). Timber harvest in the core range was restricted to morainal habitat types that were rarely used by caribou and were very close to the Alaska Highway. Some timber harvest also occurred within the Kaska Forest Resources Timber Harvest Agreement (THA – a long-term timber lease) in the southeast Yukon. The THA takes in a portion of the Liard basin and overlaps northern portions of the core and extended LRH range (Fig. 5).

Although this attempt at cooperative wildlife and timber management has had some success, there is no long-term commitment to the recommendations and most development review is still project-by-project. This approach does not dovetail well with the landscape-level and extended time scales needed for caribou habitat management. In November 2001, we estimated the development footprint in the Yukon LRH core winter range (all recent roads, cut-blocks and developed areas with a 250 m buffer) at 16% overall, 18% in the extended winter range, 18% in the core, and 5% in the migration corridor (Fig. 6). Yet just 3.6% of the forested land-base was cut for timber, providing a graphic example of the large development footprint that can arise from a few scattered cut-blocks and the roads linking them. In addition, the time scale for logging proposals by commercial permit (≤ 5 years) does not match the rates at

which disturbed areas return to use as caribou habitat. Together with the Alaska Highway and other developments, this small timber harvest has affected 16% of the LRH winter range, mostly within the last 10 years. A 10-year draft logging plan for the Kaska Forest Resources THA proposed in 2002, since withdrawn, would have increased the footprint in the extended range from 18% to 27%.

If continued, this short-term, project-by-project approach to development in LRH range could, within a few years, increase the development footprint to the levels seen in Alberta (38–70%). The risks to the LRH are considerable:

- A large population decline could occur before detection and corrective action could be taken. Census surveys are expensive and done infrequently, and rarely detect small changes in herd size (e.g. 5–10%), because population estimate errors of $\pm 20\%$ are common. Caribou numbers also vary naturally over time, and this variability could mask changes resulting from habitat degradation. Slow declines of 1–3% per year, as seen in Alberta, would be difficult to detect in the short term without intensive monitoring.
- Recruitment for the LRH, a hunted herd, must be robust enough to offset both natural mortality and hunting mortality. If habitat degradation leads to a 1–3% annual rate of decline, current hunting could add a further 5% mortality and accelerate a decline.
- If habitat management is changed only when the herd has been clearly affected (i.e. a large drop in herd size), the accumulated roads, cut-blocks, and especially altered predator-prey balances would be very difficult to reverse. Even an expensive recovery program including a ban on hunting, as in the Southern Lakes caribou recovery program near Whitehorse, might not be able to reverse a decline caused by increased wolf predation. Predator management would be very costly and controversial. Pro-active caribou range

management would be far more cost-effective.

- If the cumulative losses of winter range to fire and habitat fragmentation are excessive, a remnant winter range might not support the current caribou numbers and could concentrate caribou so that spacing out from predators is compromised.

We suggest that a short-term, project-by-project approach to habitat management means a high risk to the long-term viability of the LRH.

Although forest fire management is not the main focus of this report, a fire management policy is also needed for the LRH winter range. In other caribou winter ranges, the Yukon Fish and Wildlife Branch has advocated a conditional approach to fire management. Where fires are likely to be small and relatively little of the range has burned in recent decades, the preferred approach is to let the fires burn as part of the normal forest turnover. Where much of the range has burned recently or the fire is likely to be large-scale, fire suppression may be preferred. We suggest that this approach is also appropriate for the LRH Yukon winter range. The eastern portion of the LRH Yukon winter range tends to burn in small, frequent fires, while the western portion tends to burn in larger landscape-scale fires (AEM 1998).

Proposed approach to LRH caribou range management

A report commissioned by the Environment Directorate of the Department of Indian Affairs and Northern Development (DIAND) in Whitehorse endorsed the concept of managing cumulative environmental impacts in caribou range by placing a limit on the human-caused footprint (Anderson et al. 2002). A similar approach for thresholds of development for key wildlife species, including caribou, was proposed by AXYS Environmental Consulting (2002) in another report prepared for the Environment Directorate. From a strict caribou conservation perspective, the

safest approach to management of the LRH range would be a ban on further logging and other development. However, we recognize the economic value of road-accessible pine and spruce stands near Watson Lake. We concur with Anderson et al. (2002) and AXYS Environmental Consulting (2002) that thresholds limiting the development footprint are an appropriate way to manage development in the LRH range, coupled with specific recommendations for the three management zones. It would always be preferable to have more data, but there are compelling reasons to keep the footprint in the LRH range closer to the current 16% than to the 50% clearly linked to protracted caribou declines in Alberta:

- The Canada-wide status of woodland caribou as *Threatened* or *Special Concern* (COSEWIC 2002) is clear. Simple caution means that development should stop well short of a 50% footprint linked to declines.
- If development leads to increased wolf predation on caribou, sustainable hunting could quickly disappear, or continued hunting might accelerate a decline caused by the increased wolf predation.
- Periodically fire makes portions of the range unsuitable for caribou for at least 70–80 years. LRH caribou need the option of shifting to alternative ranges not compromised by human-caused habitat fragmentation.
- If severe habitat fragmentation occurs, it will be difficult to reverse. Waiting until there is clear evidence of development-caused caribou habitat degradation is a risky approach for the LRH, as early effects may be difficult to detect.

We suggest an approach to development in LRH range that combines (1) an updated version of preliminary recommendations from 1996, based on BC models, with (2) development footprint limits proposed by Anderson et al. (2002) and AXYS Environmental Consulting (2002), based on Alberta studies. Recommendations are specific to the 3 management zones first

delineated in 1996 and confirmed through subsequent studies (Florkiewicz et al. 2003).

Core winter range

- Remove the core winter range identified in Figure 2 from consideration for timber harvest, road construction, or other development. The core should be seen as a contiguous block of critical habitat for the Little Rancheria Herd.

Extended winter range and migration corridor

- Reserve a well-connected network of high-quality caribou habitat from consideration for timber harvest or other development in the extended winter range (Fig. 7). The maximum development footprint in non-reserve parts of the extended range should not at any time exceed 30%, and should not exceed 25% in the migration corridor.
- Cut-blocks that return to use as caribou habitat (70–80 years) in the extended range and migration corridor may be removed from the development footprint. Roads may be removed from the footprint once they can no longer function as access corridors for predators or hunters; this is less a function of elapsed years than an inspection showing that the roads can no longer be travelled by all-terrain vehicles.
- Minimize the fragmentation, time of disturbance, and improved access for predators and hunters. Where timber harvest in portions of the extended and migration ranges outside the reserve network is considered, the objective should be to remove wood from individual areas within a short period of time (3–5 years), followed by rapid and complete road reclamation. Aggregated cut-blocks in a few areas are preferable to many scattered cut-blocks, which maximise fragmentation.
- Permit development activity in the extended range and migration corridor between June 1 and Sept. 30, when caribou are largely absent from the Yukon winter range. Winter access may be considered under exceptional circumstances.

- Avoid severe site preparation techniques like broadcast burning and disc trenching, due to their effects on lichen ground cover and lichen re-growth.
- At the stand level, avoid timber harvest in lichen-rich areas; where lichen-rich pockets occur, retain these for faster lichen re-growth after timber harvest.
- Establish a monitoring program of caribou composition surveys, census-surveys and, where possible, assessment of changing habitat use patterns over time.

It is difficult to predict the conservation risks of this development approach to Little Rancheria Herd caribou. The precedents from British Columbia for similar approaches to northern mountain caribou herds are all recent and their long-term success is unknown. The reserve network and removal of the core winter range from further development should safeguard the most important caribou habitat, although the core will always have some developed areas associated with the Alaska Highway and municipal regions near Watson Lake and Upper Liard. The development footprint associated with the moderate option proposed here would increase over 2001 levels, but should remain within limits that allow the herd to remain within its natural range in numbers.

In the Little Rancheria caribou winter range, Yukon land managers have the opportunity to manage pro-actively and forestall the kind of declines and disappearances so common to woodland caribou in southern Canada. The current total disturbance in LRH range is still relatively limited and the herd is healthy. However, the footprint has been growing steadily over the last 10 years and the opportunity to manage this caribou herd wisely may not last long.

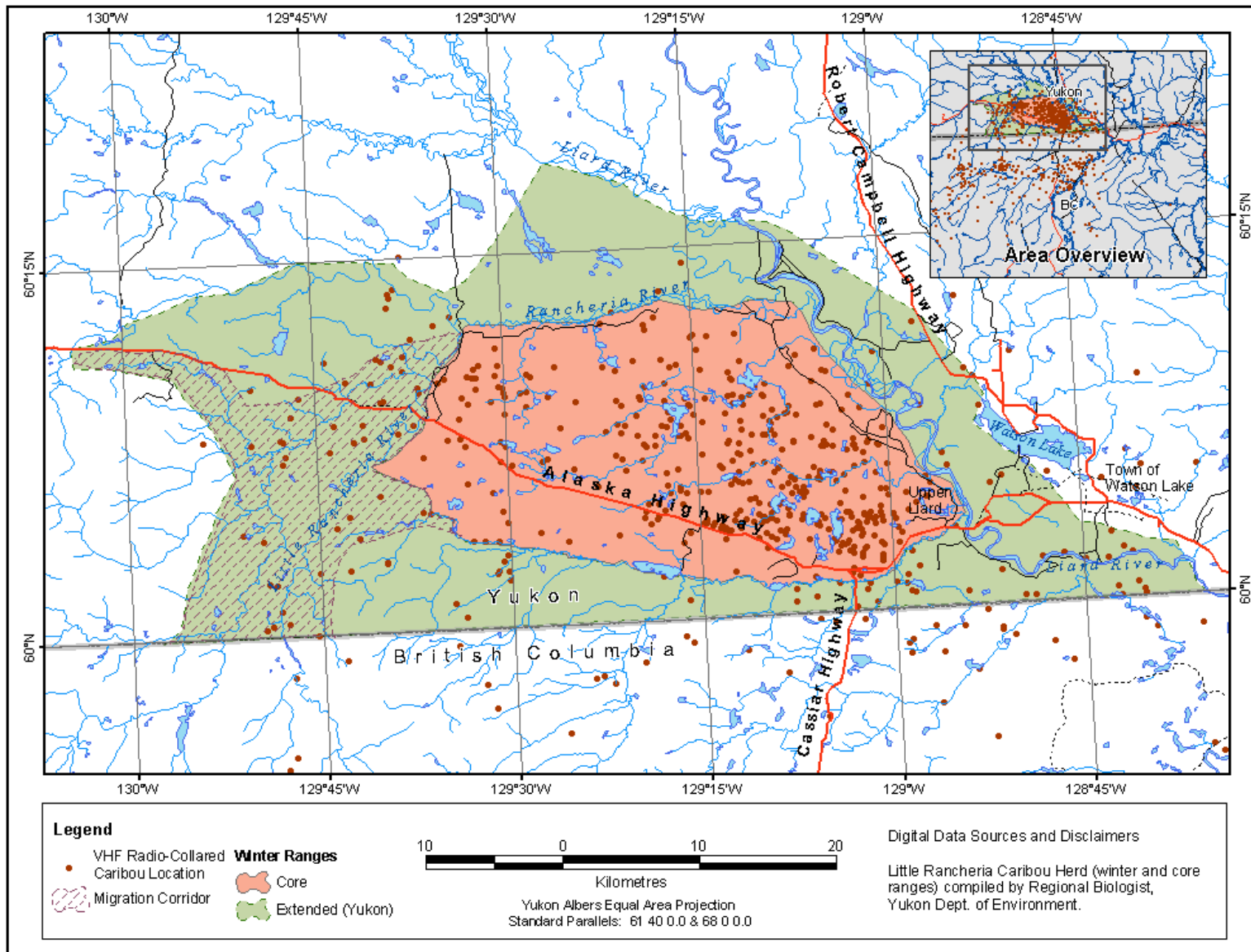


Figure 2. Distribution of radio-collared caribou locations in winter in three management

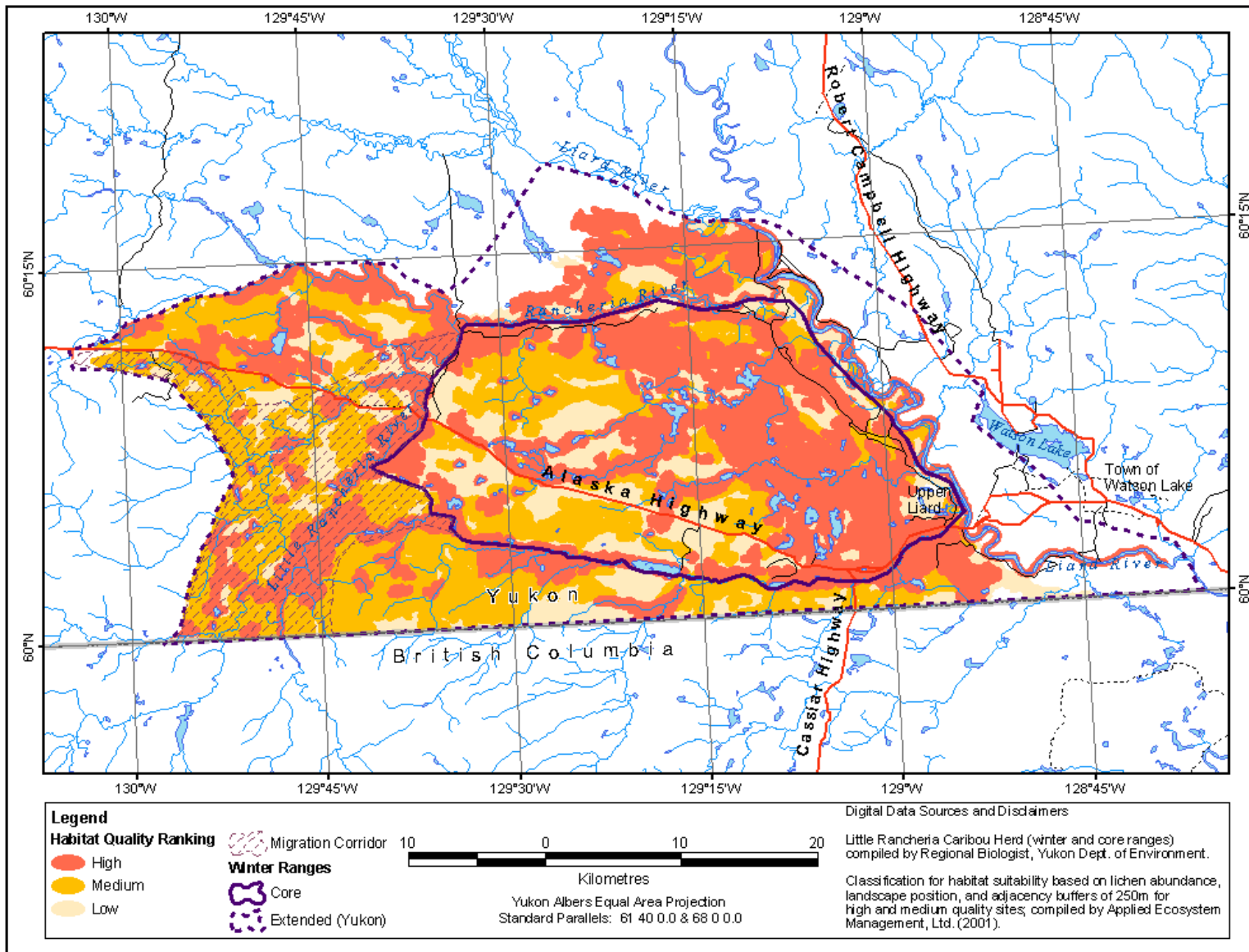


Figure 3. Habitat quality map for the Yukon Little Rancheria Herd winter range (from Florkiewicz et al. 2003).

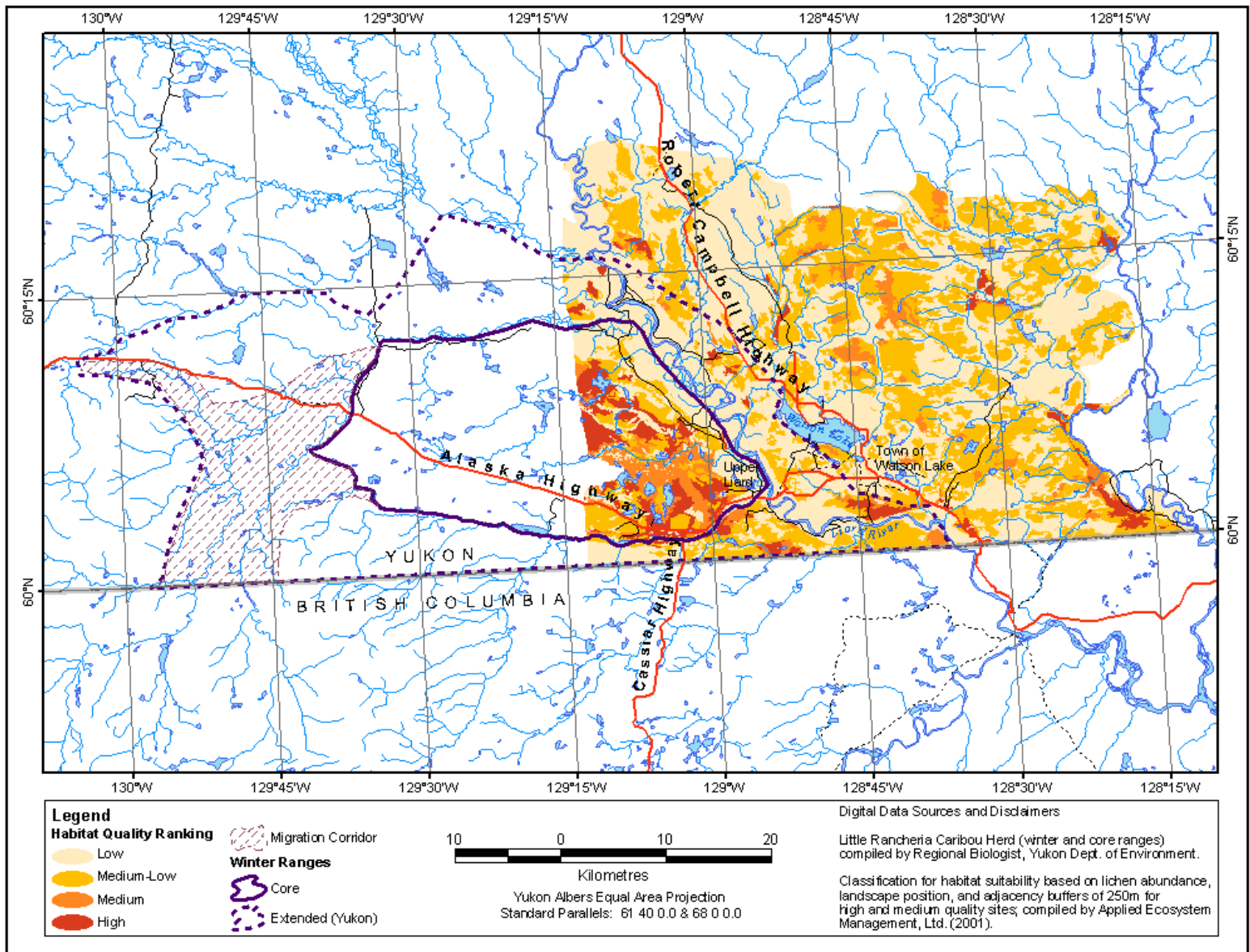


Figure 4. Predicted habitat quality in areas north and west of the main Yukon winter range of the Little Rancheria Herd.

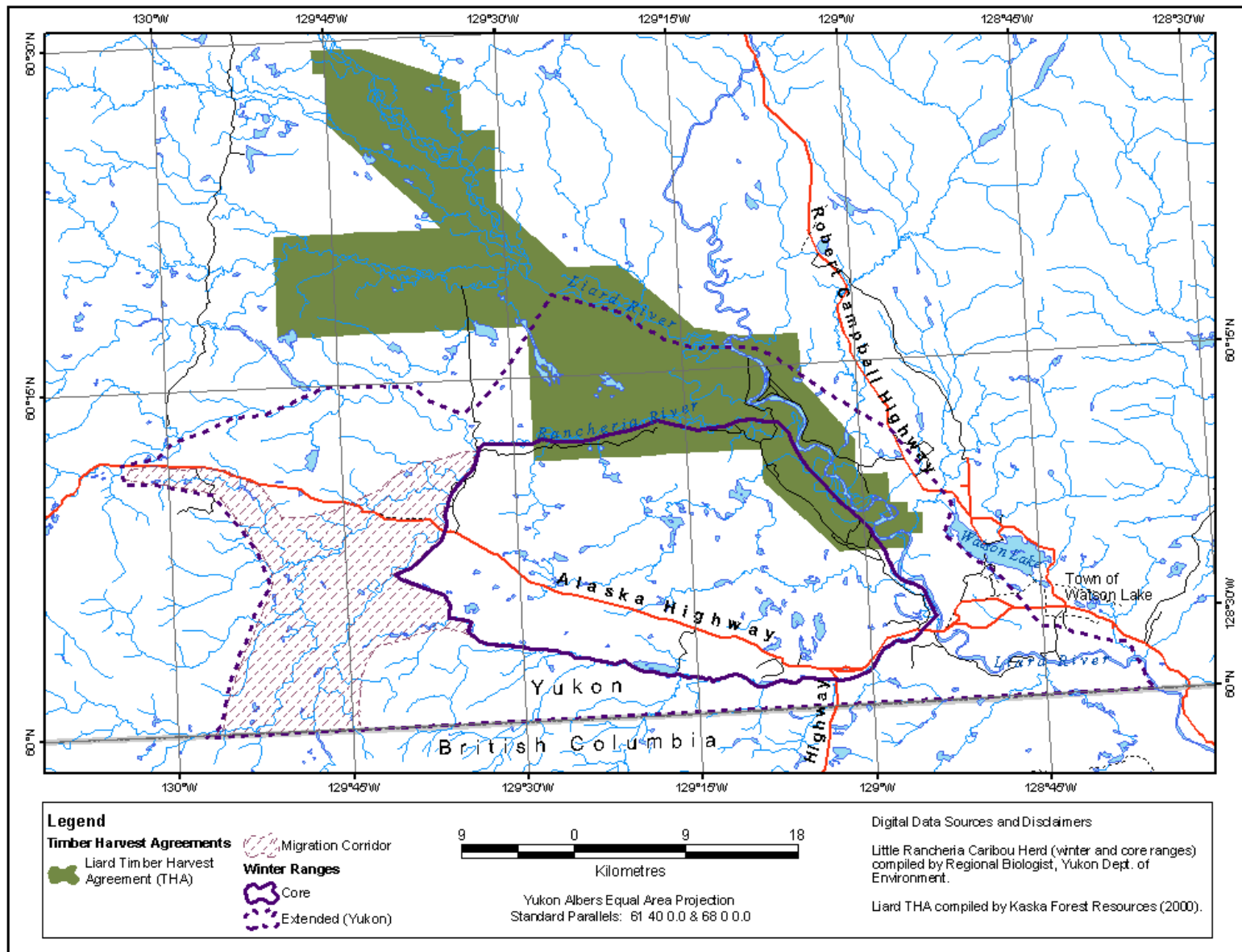


Figure 5. Overlap of Liard Timber Harvest Agreement (THA) with Yukon winter range of the Little Rancheria Herd.

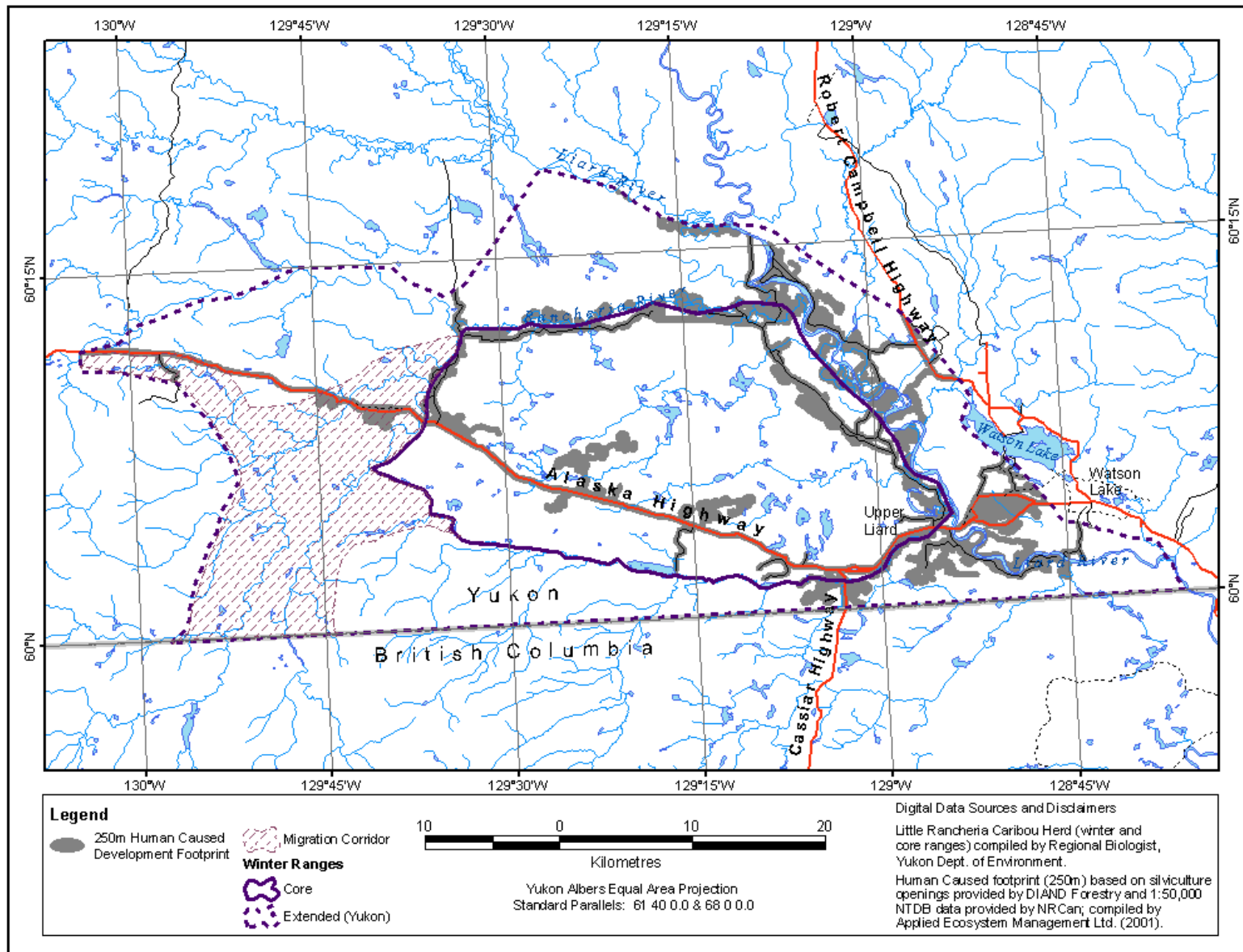


Figure 6. Development footprint (all developed areas plus a 250m buffer) in November 2001 in the Yukon winter range of the Little Rancheria Herd.

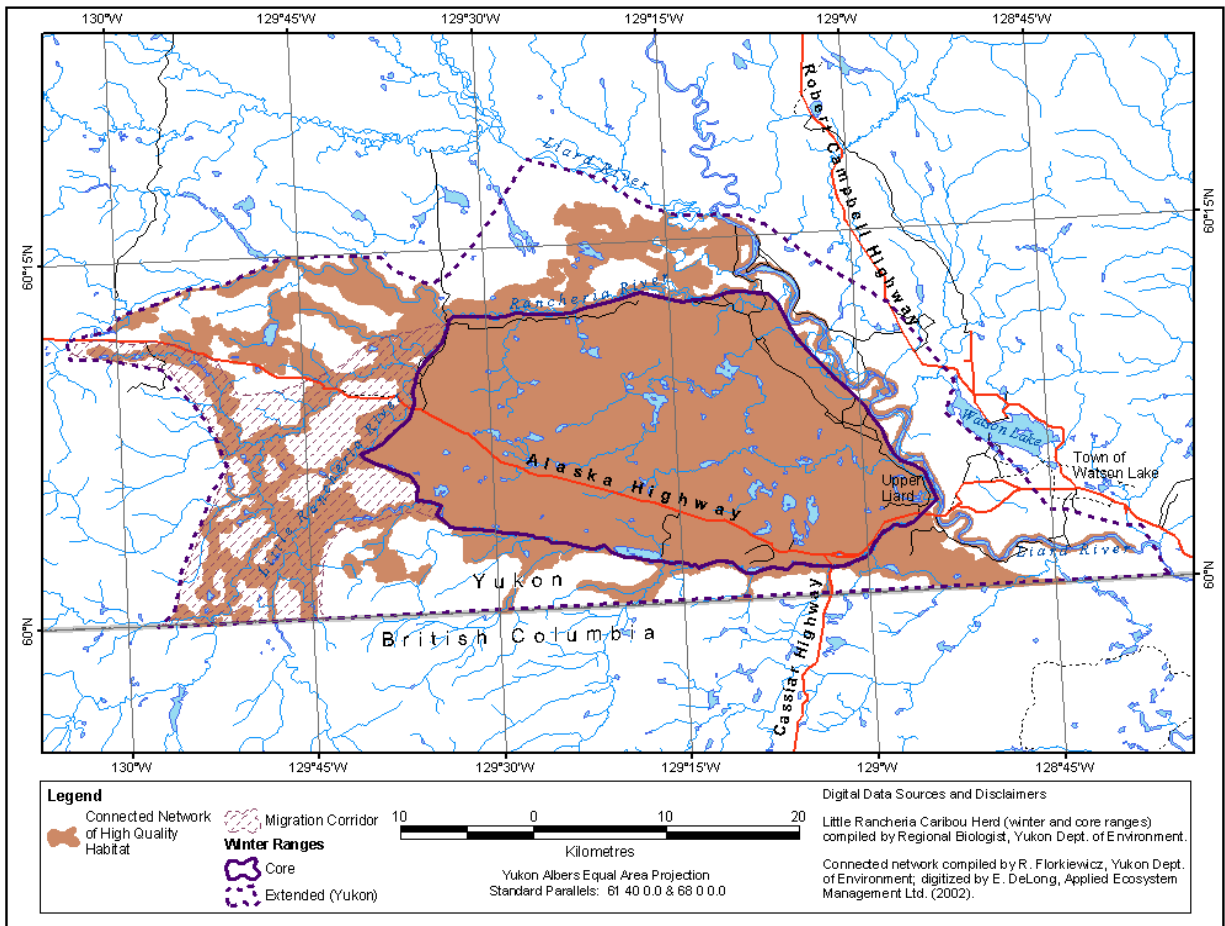


Figure 7. Core winter range and surrounding connected network of high-quality habitat in the Yukon winter range of the Little Rancheria Herd.

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Appendix 1. Management recommendations for Little Rancheria Caribou winter range and forestry, 1996

Rob Florkiewicz, Yukon Renewable Resources, Watson Lake, Yukon, 1996

There are relatively discrete subsections of the caribou winter range that lend themselves to distinct management regimes. These subsections or Caribou Management Zones (CMZs) are:
The core winter range, movement corridors between seasonal ranges and peripheral winter range.

CMZ 1: The core winter range:

1: The core winter range should be maintained by a “no timber harvest” policy.

Caribou use of this core winter range is well known and annually consistent. However, within the winter range, caribou make variable use of specific areas or even specific forest cover polygons. This pattern is typical in the winter feeding patterns of caribou. The core winter range zone is a complex of open wetlands, open black spruce, open pine, and mixed upland pine/spruce forest types. They are the primary forage producing habitats within the caribou ranges. Characteristic surface substrate are organic (spruce and wetter forest cover types) or glaciofluvial (pine and mixed pine forest cover types). An association between lichen cover and the glaciofluvial substrate was observed here and was also documented by Cichowski and Banner (1990). They are indicative of high value caribou habitats. Additional features of the winter range are lakes, ponds, and stream courses are used by caribou as loafing areas, as escape or travel routes, and as a source of fresh water (as slush).

Forest cover types used by caribou within the core range appear to be slow growing, likely nutrient and/or moisture limited, or are underlain by organic soils influenced by permafrost. Forest cover types typically used by caribou are of little commercial value as sawlogs. They also are likely to exhibit a longer natural rotation or renewal interval because of relatively lower fuel loading.

2: Institute a no road objective for the core winter range.

The core winter range is largely circled by a road network of the Alaska Highway and the Rancheria loop road. Currently, many of the preferred loafing areas within the core range are isolated and therefore protected from easy access. Access development will lead to increased exposure of caribou and likely increased mortality as either human harvest or predation. Access management and road development should be restricted within this area with a “no road objective” to protect feeding areas and movement corridors within the core winter range.

3: Permit limited timber harvest on a case by case basis where access and forage producing forest cover types are not compromised.

Upland Pine forest cover types within the core range are situated adjacent to important forest cover types for caribou, but do not appear to support use by caribou as either cover or forage. They are closely associated with morainal substrates and typically have an understory of alder and feather moss. Where these stands grow on level plateaus (with 0– 5% slope) they tend to

support high stem density and canopy cover. Timber volumes of 200m³/ha or more (NAP forest management: Florkiewicz, unpublished plot data) also appear to be characteristic.

A second class of pine stand on morainal substrate has greater slope (5–15%). Consequently, the value of these stands as caribou habitat and as sawlog timber is also more variable. Timber volume and stand cover density are less consistent and plot data suggest timber volumes to be well below 200m³/ha. (KFR Rancheria east, Ron Lutz Rancheria west permit, Florkiewicz unpublished data). The canopy and ground cover are more variable with increasing amounts of lichen and more open canopy classes relative to level morainal sites.

4: Upland pine stands can be accessed by crossing travel corridors where they are narrow and of limited use as winter feeding habitat.

Level morainal pine stands are distributed adjacent to the Alaska Highway and along the Rancheria loop road. These stands within the core winter range are summer accessible but appear to have only limited distribution but are adjacent to critical foraging habitats or travel corridors. Some travel corridors within the core winter range are small and do not appear to support substantial amounts of foraging activity. In specified cases, reviewed on a case by case basis, small travel corridors may be crossed where impacts can be identified as minor. Crossing should only occur during summer when corridors are not in use. Access to winter traffic should be vigorously de-activated immediately following the timber harvest season. Wider caribou travel corridors with typical winter habitat mosaics should not be either exposed or crossed by access roads or timber harvest activities. At least two such blocks have been identified within the core range and should be maintained as permanent reserves.

5: Permit 2 pass logging system, 33% permanent buffer retention and relaxed block sizes on upland Pine benches (level morainal sites).

Timber harvest should attempt to mimic natural fire regimes typical of morainal pine benches. The uniformity in vegetative structure and age classes could be maintained by relaxing block size standards in the current timber harvest guidelines **for these selected stand types**. These could result in larger openings, a larger proportion of the timber harvested in a shorter time period, and shorter occupation of the land base for timber harvesting activities.

Upland morainal pine strands are relatively discrete and the perimeters are easily defined. However, because of adjacency to core lowland habitat types, a substantial buffer will be required. It is proposed that one third (33%) of the timber be identified as permanent reserves located on the margins of any and all upland morainal sites selected for timber harvest. This will ensure the isolation of timber harvest activity and access from core lowland foraging habitats and movement corridors. The balance 67% would be harvested on a 2 pass design with the second pass removed subsequent to green up, largely to protect other values within these timber types.

6: It is recommended that short term demand for sawlogs concentrate on highway accessible timber stands pending additional information on the relative value of the forest land base in other caribou management zones.

CMZ 2 Migration and movement corridors:

Interim Management Objectives.

7: Target 80% retention of mature forest, 4–5 pass harvest schedule, cutblocks that are 5 ha or less in area, and timber harvest when caribou are absent (summer or selected winter periods).

The Little Rancheria caribou move between summer ranges in northern British Columbia to winter ranges either in British Columbia or the Rancheria area in the Yukon. Local information also suggests caribou may remain within the Yukon winter range during summer.

Assessment of movement patterns spans only one season therefore detailed knowledge of corridors and forest cover types used in migration is limited. Continued monitoring of caribou movements in and out of the range will be essential to providing an assessment of the impact of timber harvest in this zone. Consequently, timber harvest should be directed toward road accessible stands outside of movement corridors in the interim. The above harvest objectives recognize that activity will begin conservatively.

The above objectives attempt to minimize the impact to caribou in any one season. Small cutblocks will ensure that barriers are not created by interim timber harvest. Also the objective will be to mimic approximate natural opening sizes to minimize potential exposure of caribou to natural and human caused mortality factors.

8: Protect floodplain and immediately adjacent benches in drainage used as movement corridors.

The current study has confirmed movement corridors associated with the floodplain of Big Creek and the Little Rancheria River. The floodplain and the adjacent upland benches should be included in protected corridors as they were consistently used by caribou moving to and from the core winter range.

Seasonal caribou movement appears closely associated with lowland drainage, watersheds, and topographic features within both the core winter range and migration corridors. Specific habitats include river and creek floodplain, open black spruce, lowland mixed spruce/pine, and upland morainal pine sites (5–15% slope).

9: Institute a 500m no harvest buffer on both sides of the Alaska Highway between Upper Liard and the Lower Rancheria River Bridge.

The Alaska Highway right of way influenced the movement of caribou during the return migration. Caribou followed timbered margin of the highway with very little sign of crossing. Caribou moved through recent cutblocks and gravel quarries (directly across and also around the periphery) within the right of way. Traversing features such as these would result in increased exposure and increase the potential mortality to caribou.

A 500m buffer along the Alaska Highway will ensure the integrity of movement corridors along the highway and unhindered movement of caribou to and from this winter range. This corridor

could also assist in meeting visual quality and landscape management objectives for the Alaska Highway.

10: A network of wide corridors connecting the winter range and associated lowlands should be identified and set aside as permanent reserve prior to any timber harvest activity.

Migration and movement corridors are key components of winter range. Caribou are sensitive to dramatic reductions in mature forests and travel corridors (Bloomfield 1980) and consequently generic timber harvest prescriptions for travel routes are considered difficult (Cumming 1992). More effort in identification of movement corridors is required and although specific routes have been observed, other movements through broad belts of forested land is known. Any timber harvest activity within the movement corridors should be extremely conservative.

CMZ 3: Peripheral winter range:

11: A timber retention standard of 50% permanent mature timber should be maintained. Timber harvest as multi-pass (3–5) systems and small cutblocks to mimic natural openings.

This zone encompasses areas within the delineated range boundary but lie outside the core range and migration corridors. Caribou habitat and caribou sightings occur within this zone but they appear to be less abundant. Upland pine and upland mixed pine/spruce forest cover types appear more prominent in the peripheral ranges relative to the other two zones. The range boundaries are largely established because of habitat components and proximity to caribou range.

Timber harvest activity within the peripheral ranges should be relatively conservative but less restrictive than core areas. Open upland pine sites, lowland black spruce, and potential caribou movement corridors should be identified and protected with permanent reserves. As with other caribou ranges, timber harvest activity should be restricted to summer.

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