

Snowmobile - Mountain Caribou Interactions: Perceptions and Trends in Caribou Displacement

June 2008

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Disclaimer

This report was initially prepared in early 2003, so data and interview results are current to 2002 or 2003. Affiliations of individuals mentioned in this report are also current to 2003; agency and club affiliations have changed in some cases, and ministries have been renamed. The report was revised in 2008, at which time more recent literature was reviewed and included.

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Summary

Mountain Caribou and snowmobilers share much of the same terrain in late winter within the Interior Wet Belt of east-central and southeastern British Columbia, northern Idaho and northeastern Washington. The rarity of Mountain Caribou and the expansion in both numbers and capability of snowmobiles have raised concerns that snowmobile activity may have negative effects on caribou, such as physiological impacts, increased exposure to dangerous terrain, and displacement or range abandonment. This report examines two types of information, with the goal of increasing our knowledge on the potential relationships between snowmobiling and caribou. It (1) summarizes the observations of a sample of snowmobilers, wildlife managers and others with experiences relevant to the topic, and (2) examines late-winter caribou survey data in relation to mapping of snowmobile-use areas, to determine whether there has been any decrease over time in the proportion of surveyed caribou groups occurring within snowmobiling areas. Data are current to when this report was initially prepared (2003) but literature available to early 2008 has been reviewed during editing.

Interviews with people having direct experience with caribou and snowmobiles indicated that perceptions of the potential effects on caribou vary widely. This was no doubt partially due to the variety of ways in which caribou respond to snowmobile presence, but is probably due in part to observations being filtered by each individual's background or beliefs, and also reflects observations spanning the spectrum of spatial and temporal scales. There is not necessarily a tight link between observations involving a single caribou and patterns exhibited by populations. In addition, part of the variety of responses was related to disagreement over basic ecological information, such as how many caribou occurred in given locations, or what types of habitat are important to caribou. Several key points were evident from the responses:

1. Reduced caribou activity in parts of their range occurred during the period when snowmobile use began or increased. In no instance does snowmobile use appear to have been the only land-use factor that changed during this period, but even if snowmobiling was largely responsible, it would be essentially impossible to clearly identify after the fact whether this was the case.
2. On a shorter time frame, respondents cited examples both of caribou becoming peripheral to snowmobile-use areas and of remaining in areas with heavy snowmobile use. This likely reflects reality in some cases and lack of agreement on population status in other cases.
3. Direct snowmobile-caribou encounters are common in some areas and very unusual in others. In general, the most obvious flight responses seem to be where encounters are unexpected. If the minor physical responses reported in several areas having predictable snowmobile activity are typical, this may be due to habituation, benign snowmobiler behavior, earlier displacement of less-tolerant caribou, or differences in terrain that reduce the ability of caribou in some locations to easily shift locations while still remaining in good habitat. Based on the responses, it can be hypothesized that pioneering snowmobile use in an area disturbs caribou, with increases in activity initially making snowmobile presence more predictable to remaining caribou (resulting in less stress), but with further increases ultimately causing significant shifts in caribou activity. This hypothesis is untested.
4. All information from respondents related to visible caribou responses; research into physiological effects has been conducted separately.

5. With enforcement, there can be high compliance in closure areas. However, it is not clear whether closures provide adequate separation between snowmobiles and key habitat, nor whether restricted use in some areas pushes some snowmobilers into areas that would otherwise not be used.
6. Snowmobile tracks are sometimes used by predators, possibly presenting a threat for Mountain Caribou on low-elevation early-winter ranges, or for other ecotypes of caribou that remain at low elevations throughout the winter. Predator access to high-elevation late-winter ranges via snowmobile tracks appears more likely to have an effect on Mountain Caribou if snow is simultaneously firm enough at high elevations to allow predators to effectively move off of tracks in pursuit of caribou, yet soft enough at mid elevations to have prevented predators from reaching high elevations without the packed trails.

Data from survey records were analyzed for eight local populations. For seven of these, the trend in percentage of surveyed caribou groups falling within snowmobile-use areas over time was very weakly to moderately strongly negative ($R^2 = 0.02$ to 0.52 , $P = 0.02$ to 0.85), when considering individual years. The remaining one showed a positive trend ($R^2 = 0.48$, $P = 0.30$). When comparing all data through 1997 to all data from 1998 onward, the 1998-onward period was associated with a lower proportion of caribou locations falling within snowmobiling areas for 6 of the 8 local populations ($P = 0.02$ to 0.23) and for all local populations combined ($P = 0.14$ or 0.0002 , depending on whether the unit of measure is the local population or the survey record, respectively). The greatest and third-greatest proportional decreases in caribou presence within snowmobile-use areas occurred in local populations that initially had the greatest overlap with snowmobiles. In addition, the only local populations in which the proportion of caribou activity occurring within snowmobile areas appeared to be stable to increasing between the comparison periods had low statistical significance ($P = 0.45$ and 0.76), and had the lowest apparent overlap between caribou and snowmobiles. Thus, despite weaknesses in the data available for conducting the analysis, there was relatively strong evidence at the scale of local populations that caribou generally shifted away from areas of snowmobile use, particularly where snowmobile use covered extensive portions of the local population's range.

Research priorities arising from the observations of respondents and the data analysis are outlined. In addition to more effectively communicating and gaining acceptance of baseline information among all agency personnel and resource users having a stake in management decisions, research needs include gaining an understanding of: (1) the physiological and demographic effects of caribou displacement, (2) factors contributing to differences in how caribou react to snowmobiles and in potential habituation, (3) predator hunting efficiency in relation to snowmobile tracks, (4) recolonization of habitat, and (5) within-season caribou movements.

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1. Introduction

1.1 Mountain Caribou Ecology

Mountain caribou are a rare ecotype of woodland caribou occurring in the Interior Wet Belt of east-central and southeast British Columbia, extreme northern Idaho, and the northeast corner of Washington. This ecotype is red-listed provincially, on the American endangered species list and, along with southern herds of the northern ecotype, listed as nationally threatened by the Committee on the Status of Endangered Wildlife in Canada. A recent assessment suggests that the metapopulation may function as 18 subpopulations (Wittmer et al. 2005) but at the time this report was prepared, Mountain Caribou were described as occurring within 13 local populations (Simpson et al. 1997; Figure 1). These range from 0 to 700 animals each and total about 1900 caribou (Hatter 2006). Habitat use and seasonal movements vary among local populations, but all Mountain Caribou forage on arboreal hair lichen in open, high-elevation stands during late winter.



Figure 1. Mountain caribou local populations in British Columbia as of 2003. 1 = South Selkirk, 2 = South Purcell, 3 = Central Selkirk, 4 = Monashee, 5 = Revelstoke, 6 = Central Rockies, 7a = Wells Gray North, 7b = Wells Gray South, 8 = North Cariboo Mountains, 9 = Barkerville, 10 = George Mountain, 11 = Narrow Lake, 12 = Hart Ranges. See Wittmer et al. 2005 for updated subpopulations.

The duration of the late-winter season varies between years and herds, but typically spans mid-January through April (Stevenson et al. 2001). Habitat used in late winter is almost always dominated by stands of subalpine fir and Engelmann spruce (and in the south sometimes by whitebark pine), though with considerable variability in stand structure. This includes regularly spaced but open-canopied forest in the upper Engelmann Spruce – Subalpine Fir biogeoclimatic zone (ESSF), open or clumpy stands in the woodland and parkland subzones, respectively, of the ESSF, and non-forested alpine areas used primarily for resting. Elevations used in this season vary geographically and relative to snow conditions, but activity sites are typically at 1500 to 2200 m, usually near the tops of plateaus, ridges and mountains. Topography used by caribou varies from flat to moderately steep, but gentle terrain is strongly preferred, probably for ease of movement, ease of access to all sides of lichen-bearing trees, and avoidance of avalanche-prone sites on steeper ground.

1.2 Potential Effects of Snowmobiling

Late-winter Mountain Caribou habitat overlaps with terrain preferred by many snowmobilers (Seip et al. 2007: Figure 6). Expanses of non-forest or open forest on gentle ground along ridgetops interspersed with steep, open slopes provide enjoyable riding with broad vistas. While limited use of such areas probably began shortly after the initiation of recreational snowmobiling, access through mid elevations has in the past been highly challenging in most locations, due to steep terrain, deep snow, and the difficulty of traveling through forest. However, ongoing technological improvements (lighter machines, more powerful engines, improved tracks, and wider skis) have coincided with more extensive road networks at mid to upper elevations, creation and grooming of trails specifically for snowmobiles, construction of backcountry cabins, improved riding expertise, and increasing numbers of snowmobile owners. This has dramatically increased the number of snowmobile user-days and the extent of riding at high elevations. The upward trend in snowmobile activity has been underway for several decades, but the late 1990's apparently saw a particularly marked rate of increase. A number of towns in British Columbia are now known and marketed as destination snowmobile centers, and winter tourism traffic has become a significant part of those towns' economies. The level of activity by resident snowmobilers has paralleled this.

Increases in the number of users at designated riding areas and the extent of dispersed travel into previously inaccessible or unused locations has focused attention on the potential interactions between caribou and snowmobiles. Trends in numbers, locations and movements of Mountain Caribou can be complex and open to various interpretations. However, there is either empirical or circumstantial evidence that snowmobile activity sometimes has one or more of the following effects:

1. Displaces caribou from preferred habitats, leading to less food intake and increased energy use (Simpson and Terry 2000, Powell 2004), and also greater mortality risk due to movement into steeper, more avalanche-prone terrain (Simpson and Terry 2000).
2. Causes avoidance or abandonment of late-winter ranges where snowmobiling occurs (Simpson 1987, Hooge et al. 2001, Lewis and McLellan 2007 [but see one exception], Seip et al. 2007).
3. Allows predators to access late-winter habitat via packed snowmobile trails (Simpson and Terry 2000).

4. Increases the level of glucocorticoids, which are indicative of stress (Freeman 2008). Such concerns are based in part on evidence from disturbance studies involving caribou or reindeer. Short-term displacement of reindeer or caribou from direct snowmobile approaches has been reported by Simpson (1987), Tyler (1991), Mahoney et al. (2001) and Powell (2004). Minor reductions in foraging and resting by caribou due to the presence of guided groups of skiers and snowshoers was recorded by Duchesne et al. (2000). Jet and helicopter overpasses caused startle reactions and running, respectively, among caribou (Harrington and Veitch 1991). Oilfield traffic (Murphy and Curatolo 1987) and noise (Bradshaw et al. 1997, 1998) have been determined to have negative energetic effects on caribou, and Dyer et al. (2001) reported that caribou avoided sites disturbed by oil and gas exploration or extraction. Vistnes and Nellemann (2001) noted significant avoidance by semi-domesticated reindeer during calving of areas within 4 km of resort areas used for snowmobiling and skiing. Nellemann et al. (2000) reported similar results for wild reindeer in winter near a cross-country skiing resort, despite the lack of forage available in areas to which they were apparently displaced. Freeman (2008) reported elevated levels of fecal glucocorticoids among caribou up to 10 km distant from snowmobile-use areas, in comparison to animals not exposed to snowmobile noise.

1.3 Purpose

Lewis and McLellan (2007) and Seip et al. (2007) have recently analyzed localized displacement responses of Mountain Caribou to snowmobiling, but no range-wide assessment has been completed, nor have stakeholder perceptions of the issue been summarized at a broad geographic scale. The purpose of this report is to:

1. Collect and summarize a sample of the experiences and observations of snowmobilers, wildlife managers and others related to Mountain Caribou – snowmobile interactions.
2. Determine, where data permit, whether there have been any changes in the proportion of Mountain Caribou inside versus outside of snowmobile-use areas over time (i.e. whether there is evidence for long-term shifts in caribou distribution at the subpopulation scale associated with snowmobile activity).
3. Recommend direction for further research.

This report was not intended to provide definitive answers on the negative physiological or demographic effects, if any, experienced by caribou due to snowmobiling. Research on direct measures of stress experienced by caribou has recently been completed (Freeman 2008). Likewise, the potential negative effects on caribou of heli-skiing, snowcat skiing, backcountry skiing, snowboarding and snowshoeing, passenger vehicles, all-terrain vehicles, industrial activity, and research are not addressed here.

2. Approach and Methods

2.1 Observational Record

To obtain input from people with a range of experiences relating to Mountain Caribou, phone interviews were conducted with recreational (11) and commercial (1) snowmobilers, caribou researchers (13), resource and recreation managers (20) and other backcountry resource users (3). A standard list of questions was used as a rough guide to the interviews (Appendix 1). In some cases, interviewees were contacted because of their experience relevant to a specific topic, so were not asked the entire list of questions. The list of interviewees was not exhaustive; many people with potentially relevant input were not or could not be contacted. However, those contacted were from throughout the range of Mountain Caribou and covered a broad spectrum of backgrounds, experiences and opinions. Most importantly, input was considered as an amalgamation of observations, rather than a “vote” of what most people believed to be the true answer to a question. Government employees with relevant experience were identified because of their positions. Among snowmobilers, some contacts were directors whose names appeared on the BC Snowmobile Federation website or were people recommended by provincial-level representatives, while others were suggested by fellow snowmobilers. For both resource managers and snowmobilers, the focus was primarily on people with direct field observations rather than higher-level managers or provincial representatives. Responses are reported using only a number and general background descriptor (“researcher or resource manager”, “recreational or commercial snowmobiler”, or “other backcountry observer”) to designate each respondent.

2.2 Analysis of Trends in Distribution

For 8 of the 13 local populations of Mountain Caribou, the percentage of caribou survey locations falling within snowmobile-use areas was recorded for each year in which survey data were available to determine whether, over time, a diminishing percentage of caribou remained in areas where snowmobiling occurred. This approach was based on that of Hooge et al. (2001). It is generally assumed that there were increasing levels of snowmobile activity over the course of the analysis period (about the early 1990s to 2002 for most local populations). Detailed, site-specific information is not available to establish the validity of this assumption in all areas, but the analysis would only be invalidated if snowmobile activity had actually declined markedly or stopped altogether over that period.

Survey data were used, rather than late-winter telemetry locations, because survey results include the maximum number of individuals and groups. Telemetry data are more likely to be unrepresentative as it is based on only a small number of individuals that may repeatedly use a limited number of areas. In addition, it is possible that radio collared caribou, as a result of being aurally netted and handled, might react differently to disturbance than other caribou would. Using survey data minimized any effect this might have had.

Snowmobile-use areas were identified in 2002 or 2003. They were defined as all sites having more than sporadic use by very low numbers of people, so the use areas considered in this analysis could receive anything from “low” to “very high” levels of snowmobiling. Mapping approaches are described for each

local population below. Snowmobiling probably began in some use areas over the course of the survey data period. However, this would be expected to only minimally affect the results, because those areas would still have experienced an increase in use over time (from nil to some). There do not appear to be any areas considered in the analysis where snowmobile use stopped midway through the survey data period.

Survey data were obtained from regional staff of the former Ministry of Water, Land and Air Protection (MWLAP) and consultants, as described for each local population below. The following rules were used in determining which survey data to use.

1. The unit of measure was an animal or track location, rather than the actual number of animals per location. This accounted for the likelihood that individuals in a group did not independently make decisions as to their location (i.e. if 10 caribou were together in a given location, this likely represented a single selection choice by the group, rather than being the result of 10 independent choices to be in exactly that spot). This approach also allowed the use of track-only data, for which the number of animals actually present was unknown.
2. Track-only sightings from surveys were included only if they were mapped or had coordinates recorded. Some tracks were only recorded by general location, so were excluded.
3. Any data falling within provincial parks were excluded from the analysis, unless those mapping snowmobile use areas explicitly considered whether or not snowmobiling occurred in the park. This approach was based on the uncertain and varying levels of use within parks, including considerable trespass snowmobiling in "non-snowmobiling" areas in some parks, reductions in the areas or duration where snowmobiling was permitted in other cases, and incomplete mapping elsewhere. Thus, survey data from Wells Gray, Cariboo Mountains, Bowron Lake, and Purcell Wilderness Conservancy parks were not used. Data from Sugarbowl-Grizzly Den, West Twin and Goat Range parks were included because of the availability of snowmobile mapping for those parks, and the apparent continuation of use in them since recently being designated as parks. In addition, Stag Leap and West Arm parks were included in the analysis as non-snowmobiling areas because they were specifically mapped as such.
4. With the exceptions noted above, all available survey records through 2002 were considered, even when there was only partial coverage within a local population's range in any given year. This decision was made for several reasons:
 - accurate and complete flight-line mapping was seldom available to indicate the total extent of any survey, so screening would have been impossible in many cases;
 - using data only from censuses covering entire local populations would have severely curtailed the amount of information available;
 - survey boundaries often did not conform to local population boundaries (for example, some Robson Valley surveys covered parts of the Hart Ranges, North Cariboo Mountains, Wells Gray South and Central Rockies local populations).

Where reasonably complete survey data were available, the proportion of survey data within snowmobile-use areas was plotted for each year to allow inter-annual comparisons. Trends, correlation coefficients and trend significance probability values were determined assuming linear relationships and using *Excel*

software. In addition, an “early” period was compared to a “later” period. General indications from interviews were that one of the major points in the expansion of snowmobile usage occurred at about 1997 or 1998, coinciding with improved technology. Thus, survey data from 1997 and earlier were combined and compared to data from 1998 through the date of data analysis (2002 or 2003). The results were portrayed graphically (percentages) and using a chi-square test (raw numbers; done with *Excel*) based on each local population and all local populations combined. Use of the chi-square test would assume each group of caribou within a local population acted independently and was one-tailed because previous literature indicated the possibility only of no or negative effects on caribou, not positive effects. However, if groups of caribou within an individual local population acted somewhat in concert with other groups of that local population, then the appropriate unit of measure would be the local population. In the event that this was the case, the simple binomial probability (Sokal and Rohlf 1981) that the observed number of local populations exhibiting a decrease in use of snowmobile areas was simply a product of chance events was determined using *Excel*, assuming that random changes in distribution would be equally likely to be increases or decreases. In comparisons of ≤ 1997 to ≥ 1998 , both complete and partial survey data were used, whereas comparisons across individual years included only surveys that were reasonably complete.

Where it was questionable whether a mapped survey location fell in or out of a snowmobile-use area, the raw UTM coordinates were determined and marked directly on the snowmobile-use maps to make more accurate determinations.

Of the 13 local populations, five were not analyzed for the following reasons:

1. Disturbance issues within the Revelstoke local population were already being more intensively studied locally at the time of writing.
2. The level of snowmobile use in the Central Rockies is not clear but appears to be very low and almost entirely in areas without late-winter caribou activity.
3. The Monashee local population had few surveys, each containing very few data points, and snowmobile mapping did not appear to be available for this area.
4. The George Mountain local population also had very few data points, and its range falls almost entirely within a single snowmobile-use polygon.
5. Conversely, no identified snowmobile areas overlap with the range of the Narrow Lake local population.

For the remaining eight local populations, the survey and snowmobiling information were as follows.

1. *South Selkirk*. For the Idaho and Washington portions of this herd’s range, snowmobile mapping was provided at 1:250,000 (T. Layser, U.S. Forest Service, Priest River, Idaho, unpublished map). The Pack River snowmobile closure area in Idaho was established in 1995. However, trespass snowmobiling has continued in caribou habitat within the closure area at a level comparable to that occurring in other areas mapped as “low use” zones (T. Layser, personal communication). Therefore, it was considered a snowmobile-use area even after 1995. For the British Columbia portion, 1:225,000 snowmobile mapping provided by the former Ministry of Sustainable Resource Management (MSRM) in Nelson was modified by members of the Kokanee Country

Snowmobile Club (M. East, Creston). Survey data for both sides were available in a spreadsheet for 1991-1996, 1998-2000, and 2002 (W. Wakkinen, Idaho Department of Fish and Game, Bonners Ferry, Idaho, unpublished data).

2. *South Purcell*. A draft map of riding areas provided by the Cranbrook Snowmobile Club was too broad for use in this analysis. Instead, I used draft snowmobile-use mapping provided by MSRM, Cranbrook, at 1:50,000 scale for most of the portion of the Rocky Mountain forest district having late-winter caribou activity. Mapping for the portion of this herd's range falling within the Kootenay Lake district was obtained in the same manner as the BC portion of the South Selkirks. Survey data were originally collected by the author (Kinley 2002, T. Kinley, Sylvan Consulting Ltd., unpublished data). Data from the Purcell Wilderness Conservancy were excluded.
3. *Central Selkirk*. Mapping of snowmobile areas and major access routes within the Central Selkirks was conducted for a separate project, and was provided in electronic form (D. Hamilton, Nanuq Environmental Consulting, Nelson, unpublished map), as were survey data (1996, 1997, 1999, 2002).
4. *Wells Gray South*. Snowmobile mapping was from several sources. For three areas (Miledge-Chappell, Clemina and Allan creeks), snowmobile-use areas were assumed to correspond to areas legally open to snowmobiles and mapped on 1:20,000 orthophotos for each site. Use beyond these legal bounds does occur but the sites are patrolled, the level of trespass use is believed to be minimal, and locations of trespass are not readily mapped (A. Schmidt, former Ministry of Forests [MOF], Clearwater, personal communication). Similarly, for the Raft Mountain area, snowmobile-use areas were assumed to be those identified as trails on a snowmobile brochure (Ministry of Forests n.d.). For the remainder of the Wells Gray South range (outside of Wells Gray Park, which was deleted from analysis), snowmobile-use areas were mapped at 1:250,000 by the local MOF recreation officer and snowmobile patroller (A. Schmidt, MOF, Clearwater, unpublished map). Survey data for 1974, 1977, 1979, 1988, 1990, 1995, 1997, 1998 and 1999 were hand-plotted at 1:250,000 (J. Surgenor, MWLAP, Kamloops, unpublished map), and 2002 locations were recorded in a spreadsheet of coordinates. In addition, a limited amount of data from the north end of this range was taken from files for the 2000 Robson Valley survey (D. Seip, MOF, Prince George).
5. *Wells Gray North*. All survey locations (1993-2002) were included in spreadsheets and maps provided by J. Young, MWLAP, Williams Lake. Mapping of currently used snowmobile areas produced through local land-use planning processes was provided by J. Ballentine, MSRM, Williams Lake. Survey data from Cariboo Mountains and Wells Gray parks were deleted.
6. *Barkerville*. Survey and snowmobile data were from the same sources as for Wells Gray North.
7. *North Cariboo Mountains*. Snowmobile mapping was done at 1:250,000 scale by the author under the direction of five members of the Prince George Snowmobile Club, and MSRM, MOF and MWLAP staff in Prince George. Survey data came from 1:250,000 hand-drawn maps provided by G. Watts, MWLAP, Prince George for 1987 and 1990, the Robson Valley survey for 1995 (Terry 1995), a summary report map for 1999 (Watts 1999), a combination of spreadsheets from J. Young, MWLAP, Williams Lake (area near Bowron Lake park) and D. Seip, MOF, Prince George (Robson Valley) for 2000 and 2001, and a spreadsheet from D. Seip covering the entire range for 2002. The 1992 survey done by MWLAP, Prince George was not used, as

8. *Hart Ranges*. Snowmobile mapping was as done for the North Cariboo Mountains. Survey data came from 1:250,000 hand-drawn maps provided by G. Watts, MWLAP, Prince George for 1987, 1990 and 1992 (partial mapping only for 1992), the southern Robson Valley survey for 1991 (Bindernagel et al. 1991), a summary report map for 1999 (Watts 1999), and spreadsheets provided by D. Seip, MOF, Prince George for 2001 (Robson Valley area only) and 2002 (entire range).

3. Results and Discussion

3.1 Issues Arising from Responses

3.1.1 Differing Perceptions and Issues of Scale

Information provided by each interviewee is collated in Appendix 2. While respondents appeared to provide straightforward and open responses to the questions, and generally had direct experience, a strong caveat should be placed on the interpretation of these observations. It is clear that perceptions of snowmobile effects on caribou vary dramatically, from there being no significant issue through to snowmobile activity representing a major conservation challenge. This variability may be the result of several factors.

1. Different people have undoubtedly observed different responses by caribou. Everything from “they ran away and kept running” to “they paid no attention to us and kept feeding” were reported for similar encounter situations, suggesting that differences in caribou personality, chance events, previous encounters, habituation, landscape position, or other unknown factors may have a major bearing.
2. Respondents are likely to have unintentionally filtered their observations to some extent through their own backgrounds and beliefs. For example, the observation that caribou are often in timbered areas just downslope of the forest-alpine transition when snowmobiles are present just above them was cited both as evidence that caribou are not measurably affected by snowmobiles and as evidence that caribou are displaced out of the open, gentle areas and into the steeper, timbered slopes.
3. Most importantly, it is possible to consider the issue over a range of spatial and temporal scales, and this can profoundly influence impressions of caribou-snowmobile interactions. To illustrate this, Figure 2 shows an arbitrary number of scales and situations in which the question “How do caribou react to snowmobiles?” can be considered. This indicates that there may be dozens or hundreds of different but correct answers. An example of the effect of scale is that one person may see a caribou flee for several kilometres from an approaching snowmobile and conclude that snowmobiling has a major effect, while a second person may observe in the same area that caribou continue to be regularly encountered after 10 years of snowmobile use, and conclude that there is therefore minimal effect. Both sides of the above situation, as well as the reverse (decreasing caribou

numbers yet apparent lack of reaction by individual caribou) were reported by interviewees. In reality there may be no conflict between apparently disparate observations; a series of one-time events may or may not lead directly to a parallel pattern at the scale of a mountain range or local population (Vistnes and Nellemann 2008). A band of caribou with some members that have been obviously stressed might continue to use a busy ridge indefinitely. Conversely, caribou that appear to individually react little to snowmobiles might eventually shift their activity to areas without machines.

Annual Exposure and Type of Stimulus		Population and Spatial Scale Considered								
		Individual Caribou			Small Group			Local Population		
		Site	Ridge System	Mtn Range	Site	Ridge System	Mtn Range	Site	Ridge System	Mtn Range
Single or irregular exposure	Stop at a distance									
	Close approach									
	Get off machine									
	"Play" activity									
Regular exposure at moderate levels	Stop at a distance									
	Close approach									
	Get off machine									
	"Play" activity									
Regular exposure at high to very high levels	Stop at a distance									
	Close approach									
	Get off machine									
	"Play" activity									

Figure 2. Matrix illustrating part of the range of scales at which "caribou-snowmobile interaction" could be observed or defined. Other dimensions representing such factors as weather, availability of alternative foraging areas, the number of years over which caribou have been exposed to snowmobiling, individual differences in caribou, random events, or method of measuring reactions also exist.

3.1.2 Lack of Agreement on Baseline Information

Some items of basic, essentially irrefutable information linked to a defined space and time were widely agreed upon. An example of this is the fact that Yanks Peak supported caribou during late winter in the middle of the last century but no longer does. However, there were several other situations where reasonably definitive information existed or could easily be obtained, yet there was considerable confusion or disagreement regarding it. This mostly dealt with numbers of caribou within defined drainages or ridges. For example, impressions of the number of caribou typically found on Frisby Ridge

in late winter differed between some snowmobilers (many caribou, numbers relatively unchanged) and some resource managers (few caribou, numbers declining). Similarly, some respondents felt that only a handful of caribou remain in Allan Creek, totaling far fewer than in nearby Mileage Creek which itself had far fewer than in the recent past, while others felt that caribou were relatively common in both drainages. Such discrepancies could be attributed to major within-season caribou movements (i.e. resource managers may base their population estimates on survey results from a single day in March while snowmobilers may make observations throughout the winter, so resource managers may not be aware of caribou use in some sites). Another possibility is that large portions of the population are missed during survey flights. However, given the regularity of telemetry flights associated with visual observations in most locations and the use of sightability correction factors during surveys based on visibility of collared animals, neither explanation seems satisfactory. A simpler interpretation is that survey results and population trends are not widely known or accepted in some cases.

Confusion over numbers may relate to the apparent belief by some respondents that wintering bands of caribou are cohesive and relatively static. If there is an observation of eight caribou in a single group one week, two groups of four caribou 2 km away another week, and a group of six caribou a third week, the differences in group structure may be assumed to indicate that different animals were seen each time, whereas observations based on telemetry suggest that group structure changes regularly. This may have led to overestimation of caribou numbers and the assumption that resource managers lack information. There is little chance of reaching agreement on potential cause-and-effect relationship relating to changes in caribou numbers without uniform acceptance of what those numbers are.

Another issue is that not all respondents appeared to be aware that caribou often use treeless sites adjacent to upper subalpine forest on a daily basis. Opinions will undoubtedly differ as to whether disruptions to the resting and vigilance activities typical of the open alpine are critical in comparison to the foraging that occurs in treed locations, but a prerequisite to that discussion is that all parties operate from the same knowledge base.

3.2 General Summary of Responses

1. During the period in which snowmobile activity has increased in extent and intensity, Mountain Caribou have clearly abandoned or been extirpated from some areas formerly used, and declined in number within some areas that are still occupied. Despite this, at broad scales (mountain ranges, subpopulations, decades), there do not appear to be any cases where snowmobiling is the only factor that has changed, even where it appears to have been the factor that changed the most during the period of caribou decline. Habitat loss, fragmentation, other recreational activities and predation are among the variables that confound the interpretation of evidence potentially suggesting that snowmobiling has caused range abandonment. Even if snowmobiling had been solely responsible for range abandonment, it would be virtually impossible at this point for observational reports to provide anything more than circumstantial evidence, so lack of clarity does not necessarily indicate lack of effect.

2. Some reports are consistent with the possibility that caribou tend to become peripheral to areas with concentrated snowmobile use, either by moving from one mountain to another or by shifting slightly downslope into more heavily timbered areas, possibly to sub-optimal habitat (for examples, see comments by respondents 2, 6, 17, 20, 36, 37, 38, 42, 44 and 46 in Appendix 2). Considering only the moderate spatial and temporal scales, snowmobile use does sometimes appear to have been the major environmental factor that has changed over time as these apparent shifts have occurred, although broader-scale effects from other sources would also have been present. In contrast, some respondents provided examples where they believe that caribou have not been displaced despite ongoing heavy snowmobile use (see responses 23, 27, 32, 35 in Appendix 2). The locations cited as examples of co-existence were cited by others as examples of displacement, so clearly there is a significant difference in level of information, perceptions, or scales being considered among respondents.
3. Direct encounters between caribou and snowmobiles are much more common in some areas than others. Depending on location, responses of experienced riders indicated everything from almost daily sightings to having never seen a caribou. At the scale of individual encounters, there is evidence to suggest both strong negative responses (running for significant distances) and very minimal response (moving little if at all, approaching snowmobiles, using snowmobile trails extensively). However, direct encounters reported to cause fleeing reactions (respondents 4, 21 and 35 in Appendix 2; also author's personal observation) seem to have been where encounters were unusual, such as occurring early in season, in low snowmobile-use area, or as surprise encounters. Sites where there were reported to be minimal visible responses by individual caribou (Frisby Ridge, Miledge and Chappell creeks, and especially Allan Creek) all have heavy, regular snowmobile use on designated routes with apparently few closure violations. If these observations are correct, they may be interpreted in several ways. The most obvious explanation is that caribou are capable of habituation when snowmobile activity is predictable and builds slowly over time, as has been suggested for Frisby Ridge (Lewis and McLellan 2007). Mahoney et al. (2001) suggested that caribou in Newfoundland may be tolerant of snowmobiles due to their exposure to highway traffic. Alternatively, this pattern could suggest that caribou within a local population vary in their tolerance level, so less tolerant individuals quickly abandon areas of heavy use and those able to habituate remain. In support of such variation, both Mahoney et al. (2001) and Powell (2004) found maternal groups to differ from others in displacement patterns, suggesting possible within-herd differences. Sex- and age-related differences commonly confound studies of caribou responses to human activities (Vistnes and Nellemann 2008). Another possible explanation for varying caribou responses is that rider behavior may have differed, both at the time of the reported encounter and over the course of past encounters between snowmobilers and caribou. A number of respondents noted the continuation or resumption of normal caribou activity when snowmobilers were careful to stop or move away from the animals or otherwise avoid stressing them (see responses 10, 23, 27, 32 and 35 in Appendix 2). A fourth possibility arises from the fact that the places having the best evidence of habituation (northern North Thompson valley, parts of the Revelstoke area) are also in regions with rugged terrain nearby, whereas the area where the strongest case has been made for widespread abandonment of ranges (Barkerville and Wells Gray North) is typified by rolling terrain.

Perhaps the presence of rugged terrain either offers refuges that caribou feel are inaccessible to snowmobiles, or perhaps caribou in such areas cannot easily move to adjacent suitable habitat without covering significant distances, topographic impediments and patches of non-habitat (alpine, rock), so are less prone to abandon traditional habitat patches even when snowmobiles are present. Another consideration is that some areas with very heavy snowmobiling that formerly supported caribou no longer do. Thus, there may be situations in which increasing snowmobile use leads to range shifts and other situations where it does not. Based on the responses, it can be hypothesized that there are threshold values as snowmobile use increases, with (1) pioneering snowmobile use disturbing caribou, followed by (2) a threshold in snowmobile activity level at which the machines are seen as normal and predictable to remaining caribou (resulting in less stress), then (3) ultimately an upper threshold at which snowmobile use is high enough to cause significant shifts in caribou activity. In support of the concept of animals not simply becoming habituated to snowmobile use as levels reach high levels, Creel et al. (2002) found positive relationships between numbers of snowmobiles and levels of a stress hormone among wolves and elk, even after the animals had a history of exposure to high snowmobile numbers. However, the hypothesis outlined above remains untested.

4. Regardless of reasons for the apparent low response by caribou in some designated sites, there is limited information to indicate whether non-visible effects may be experienced by caribou there, such as measures of stress, reproduction and body condition. These factors have been investigated for other ungulates, such as heart rate for bighorn sheep (MacArthur et al. 1979) and stress hormones for elk (Creel et al. 2002). Research on Mountain Caribou indicated increased levels of stress hormones in caribou up to 10 km from areas used for snowmobiling, although potential demographic correlates of this were not investigated. Two researchers noted that the site within their respective local population study areas having the highest snowmobile use also experienced abnormally high mortality among collared animals, but no causal link was evident.
5. Designated riding areas having high levels of snowmobile use and enforcement or patrols of closed areas appear to have relatively few violations, even when the majority of snowmobilers are not local and therefore potentially less aware of regulations. However, there is some concern that the scale at which closures seek to separate caribou and snowmobiles is not adequate (i.e. that perhaps key caribou habitat needs to be separated from snowmobiles by kilometres rather than tens or hundreds of metres). Several respondents also suggested that the presence of designated, high-use areas pushes those who do not wish to be regulated or use crowded areas to pioneer new areas, where they may have significant effects on caribou.
6. It is generally agreed that wolves do sometimes follow snowmobile tracks at low elevations and are thereby presumably able to hunt ungulates more efficiently there (responses 5, 9, 12, 13, 38 and 40 in Appendix 2). There are also observations of wolves killing caribou in late-winter habitats at high elevations without the benefit of snowmobile trails (responses 13, 21, 30 and 39 in Appendix 2). The latter presumably occurs mainly when the snowpack is unusually consolidated, given the

expected advantage caribou hold over wolves in deep, unconsolidated snow (Telfer and Kelsall 1984; see also responses 18 and 27 in Appendix 2). What is in question is:

- (a) whether there is enough use of snowmobile tracks when caribou are at low elevations (early winter) to provide predators with significantly improved access to caribou in that season; and
- (b) how frequently wolves (or potentially cougars, wolverines or, in April, bears) access late-winter habitats via snowmobile tracks when conditions would otherwise have discouraged such access (i.e. how often trails create a bridge from valley bottoms to consolidated snowpacks on caribou late-winter ranges over otherwise uncrossable snow at mid elevations, or more generally encourage predators to move into late-winter ranges at times when snow conditions allow successful hunting of caribou there).

3.3 Analysis of Survey Data

3.3.1 Reliability of Data

Track-only survey locations were not mapped or given grid coordinates in some cases, causing some loss of data, and locations of animal groups sighted were sometimes mapped with low precision. For most local populations, snowmobiling areas were mapped from memory and the original mapping was sometimes plotted at scales as coarse as 1:250,000, so this mapping likely had only moderate accuracy. There was also no information on the precise timing of snowmobile presence in relation to survey dates; it is likely that some established snowmobile-use areas were unused at the time of the survey or for several weeks beforehand in some years. These types of errors undoubtedly caused situations in which survey locations that in reality were outside of snowmobile-use area were mapped as being within them, and vice-versa. In addition, the scale and quality of snowmobile mapping and the mental images of what constituted enough snowmobile use to justify inclusion on a map probably varied between areas and even within local populations. For example, mapping of snowmobile use for the BC side of the South Selkirks covered the majority of the mountain range, whereas on the American side it appeared to include only sites with relatively high levels of use. Finally, areas surveyed within a local population sometimes shifted over time, possibly leading to either more or less of the survey being within snowmobile-use areas over time.

Despite this, none of the issues identified above would be expected to cause a directional bias that would create the appearance of caribou shifting away from snowmobiling areas over time, if no shift had actually occurred. That is, over the eight local populations investigated and the 1007 individual survey locations, it would be expected that errors in mapping or plotting or the effect of shifts in survey routes would go in both directions and would essentially “average out”. The one exception is the potentially confounding effect from other recreational activities. In cases where heli-skiing, snowcat skiing or backcountry skiing overlapping with snowmobiling, it could be argued that any potential effect on caribou behavior might have little or nothing to do with snowmobiling. However, it appeared at least as common that other winter recreation activities occurred adjacent to snowmobiling, rather than directly on the same land. In such cases, the other activities could potentially make caribou less likely to avoid snowmobiling areas because other available habitat would be subject to disturbance as well. Therefore, there is no indication that the occurrence of other activities would cause a false impression of

snowmobiling affecting caribou when considered at a broad scale. Overall, multiple random errors should have decreased the power of any analysis to detect changes, rather than causing an effect to be evident if in reality there was no effect.

3.3.2 Trends in Caribou Locations

The percentage of survey locations falling within snowmobile-use areas, by local population, is shown in Figure 3 for years in which there were complete or reasonably complete surveys. For 7 of the 8 local populations, linear regression trends showed a very weak to moderately strong negative correlation with time (i.e. a decreasing proportion of survey records fell within snowmobiling areas over time). The remaining local population (North Cariboo Mountains) showed a moderate relationship in the opposite direction. Generally, statistical significance was low. In combining all data up to 1997 and comparing them to all data from 1998 onward (Figure 4), a similar pattern was evident: six of the local populations showed apparent moderate to large decreases between up-to-1997 and 1998-and-later, one showed a very small increase (Central Selkirk), and one showed a moderate increase (North Cariboo Mountains), again with generally low significance. The combined data showed a significant decline from 26.0 to 16.5% of caribou survey records being in snowmobile-use areas. Using each survey location as an independent replicate, there was a significantly lower percentage of locations within snowmobile areas from 1998 onward for all local populations combined ($\chi^2 = 13.8$, 1 df, $P = 0.0002$; Figure 4). Alternatively, using the eight local populations as independent replicates, the probability of 6 of 8 showing the observed decrease if in fact no relationship existed would be 14% (binomial test $P = 0.14$). The three local populations with the most significant relationships (lowest P values) were South Selkirk, Wells Gray North and Barkerville (Figure 4).

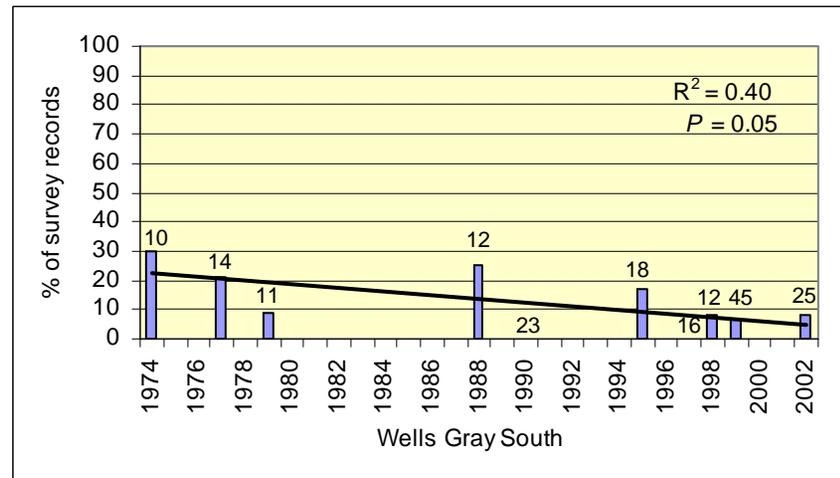
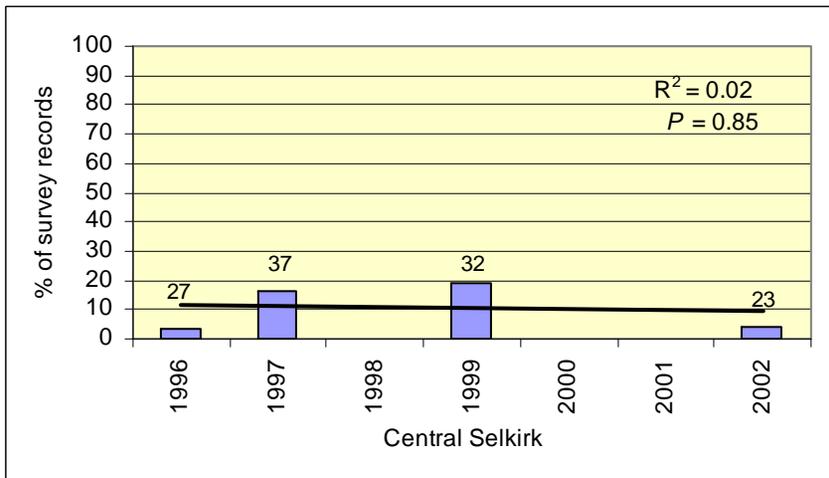
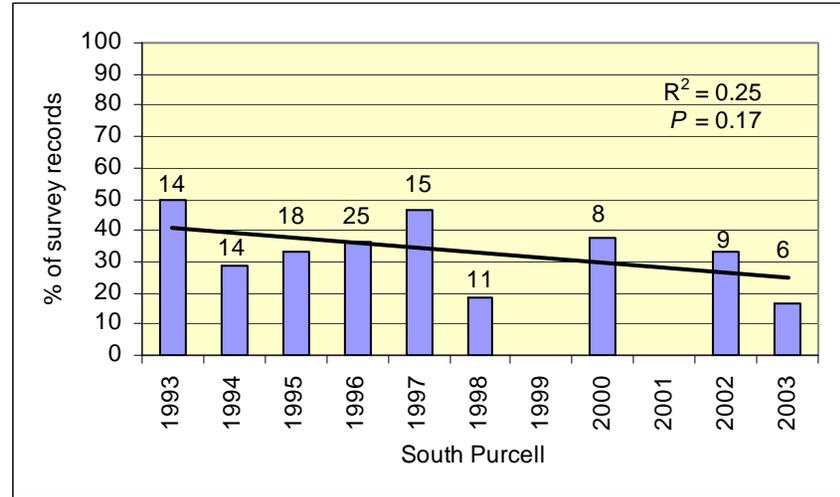
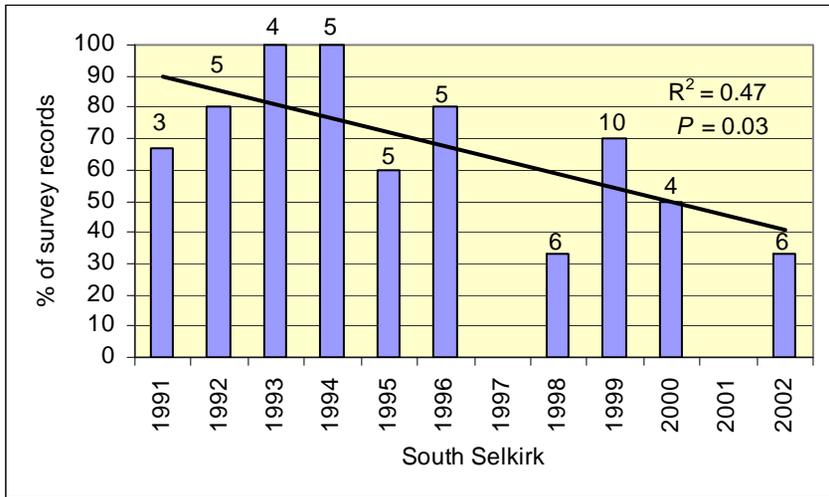


Figure 3 (continued on following page).

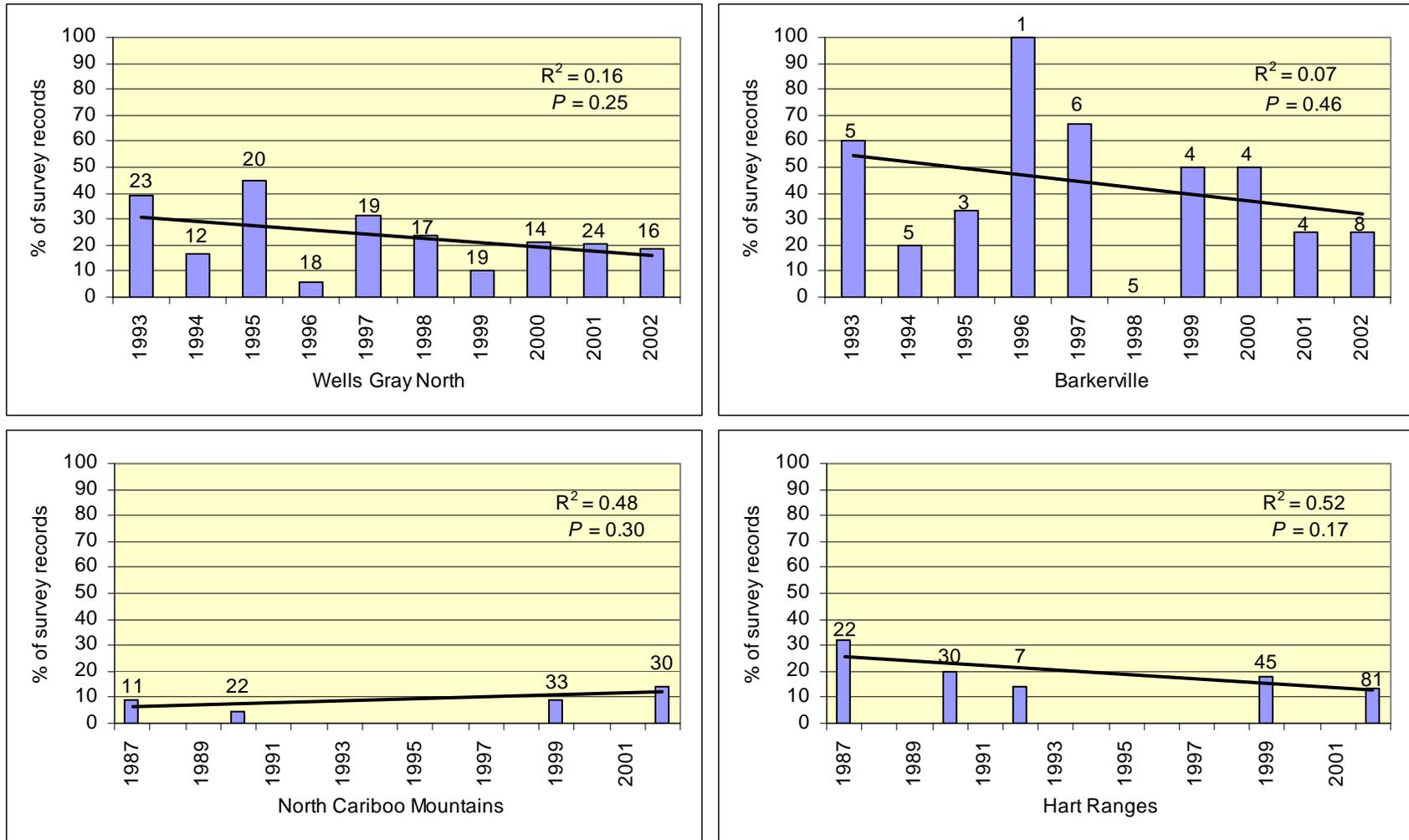


Figure 3. Percentage of caribou survey locations (groups of animals) occurring in snowmobile-use areas during each survey year for eight local populations of Mountain Caribou, southeastern and east-central British Columbia, 1974-2003. Sample size shown above each bar. Trend line assumes linear relationship. *P*-value refers to significance of trend line. Mapping of snowmobile-use areas may have been more conservative in some local populations than others.

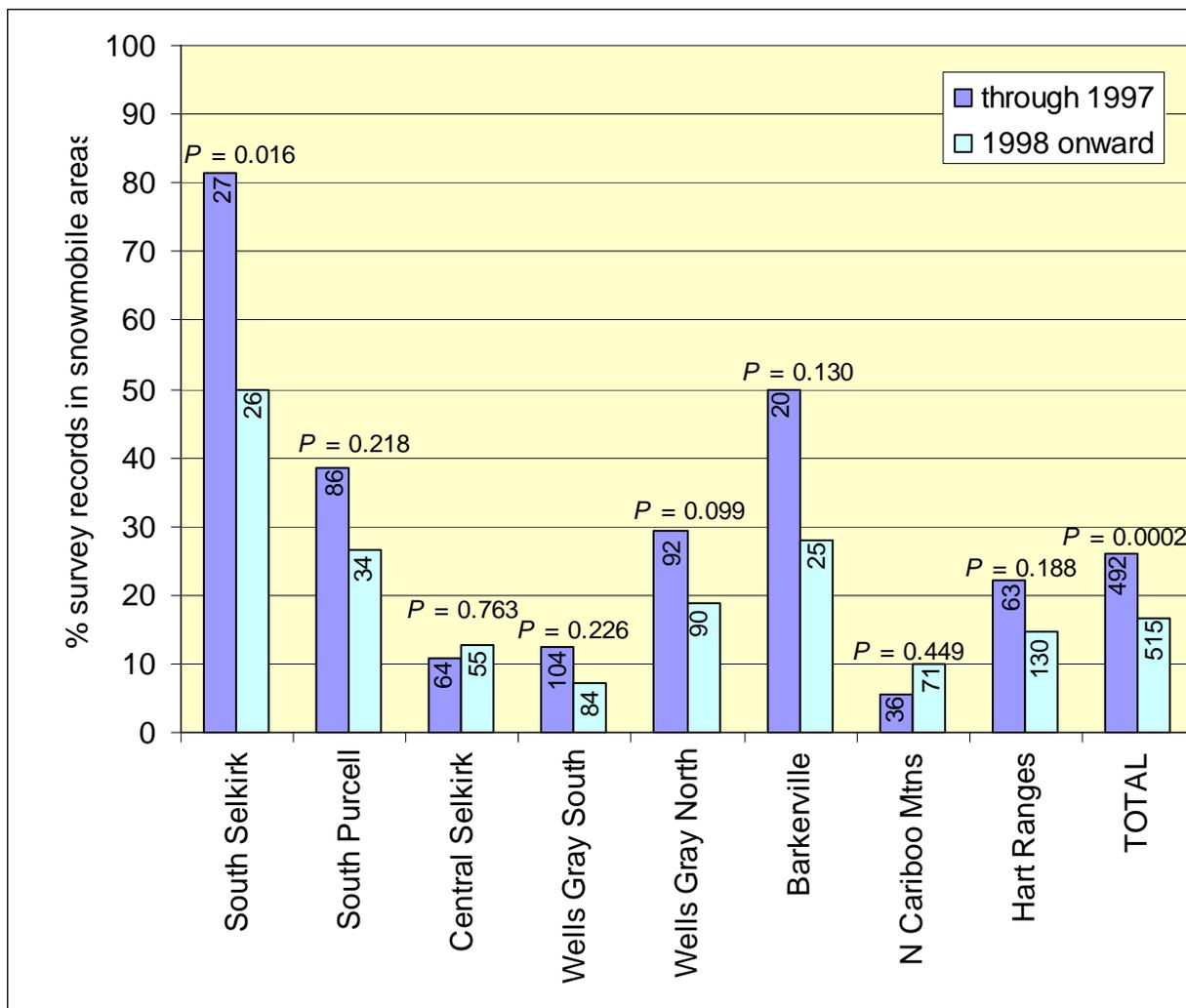


Figure 4. Percentage of caribou survey locations (groups of animals) occurring in snowmobile-use areas up to 1997 in comparison to 1998 onward for eight local populations of Mountain Caribou, southeastern and east-central British Columbia, 1974-2003. Sample sizes for ≤ 1997 and ≥ 1998 respectively are noted on each bar. Probabilities refer to one-tailed chi-square alpha values. Mapping of snowmobile-use areas may have been more conservative in some local populations than others.

Despite weaknesses in data causing this analysis to have a low power to detect changes in caribou distribution, as discussed above, there was a relatively strong indication that caribou use of snowmobiling areas declined over time. This was more evident when comparing the period through 1997 to the period from 1998 onward than when comparing each year individually, due to major inter-year variation. Because the standards used to define and map snowmobile-use areas undoubtedly differed somewhat between local populations, any interpretation involving comparisons among herds of the degree of snowmobile use must be done cautiously. However, it is notable that the two herds with the greatest proportion of caribou occurring within snowmobile-use areas up to 1997 (South Selkirk and Barkerville) showed the greatest absolute declines in caribou activity within snowmobile areas from 1998 onward, and ranked third and first respectively in proportional declines. The only two herds to show indications of

increasing caribou concentration within snowmobile-use areas (Central Selkirk and North Cariboo Mountains) were those with the lowest proportion of caribou occurring within snowmobile-use areas up to 1997. Considering all eight local populations, the percentage change in use of snowmobile areas was negatively correlated to the percentage of caribou occurring within snowmobiling areas through 1997 (Figure 5). Thus, the balance of evidence suggests that late-winter caribou distribution shifted away from areas used by snowmobiles from the period up to 1997 to the period from 1998 onward.

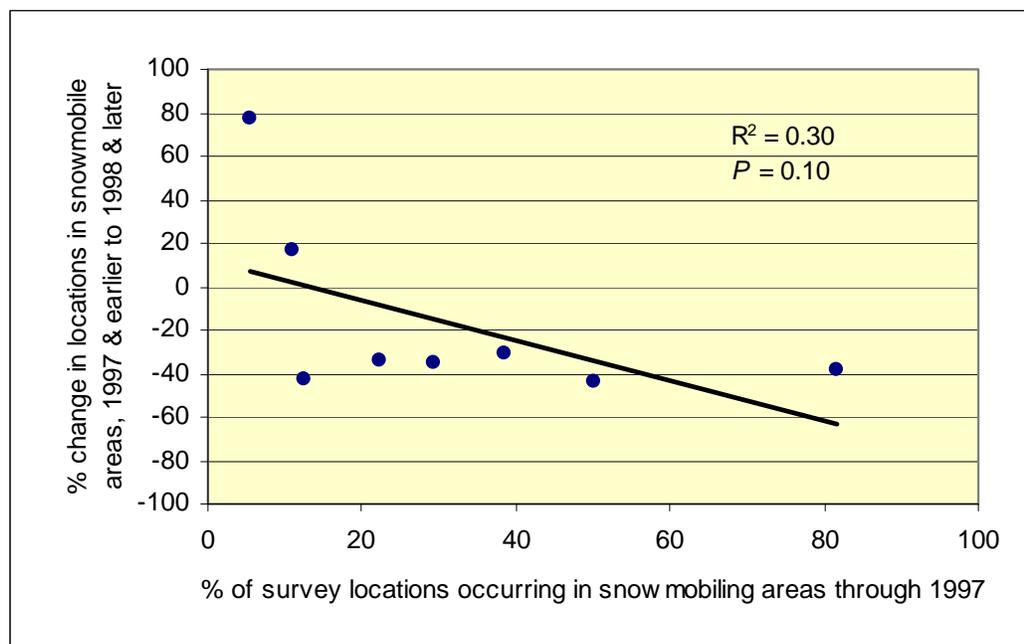


Figure 5. Percentage change in caribou survey locations (groups of animals) occurring within snowmobiling areas from the period through 1997 to the period from 1998 onward, in relation to the percentage of survey locations that occurred in snowmobiling areas through 1997 for eight local populations of Mountain Caribou, southeastern and east-central British Columbia, 1974-2003. Trend line assumes linear relationship. *P*-value refers to significance of trend line.

It is conceivable that some other factor not measured was responsible for the general decrease in use of snowmobile areas over time. For example, snowmobile areas may typically be found where there is good road access, which in turn could be correlated to areas having forest harvesting, mineral exploration, backcountry skiing, or some other impact, and these other factors might have had a negative influence on caribou habitat selection or caused localized increases in predation. However, in order for this alternative explanation to be accepted, such influences would have had to operate relatively consistently across the eight local populations investigated and occur within snowmobile-use areas but not in locations adjacent to them. Overall, the evidence is consistent with snowmobile activity being generally associated with gradual caribou displacement.

3.4 Research Questions

The data analysis and interview responses lead to several research questions, listed below in approximate priority. It is also apparent that there is commonly a need for better transmittal of data among ministries, regions or districts and between researchers, managers, agencies and the public, or alternatively, better acceptance and trust of data that are available.

1. *Demographic Effects.* Future management would be best guided by understanding whether demographic effects are associated with exposure to snowmobile activity. Given the small bands of caribou remaining, their mobility and the presence of other confounding ecological variables, it will be very difficult to determine whether displacement from preferred areas results in poorer body condition, decreased calf production, or increased mortality risk. In the absence of such data, elevated stress hormone levels among caribou exposed to snowmobiles suggest the possibility of demographic responses in some cases. Additional measurement of stress hormones across a variety of disturbance and habituation situations may indicate the range of physiological effects, with expected demographic responses estimated from that.
2. *Habituation.* Evidence from at least one specific ridge may be consistent with behavioral habituation (Lewis and McLellan 2007). Long-term monitoring of the presence of stress hormones in feces, as described above, may indicate whether physiological habituation eventually occurs. Until physiological or demographic analyses provide more definitive results, repeated analyses of caribou-distribution data at various spatial scales may indicate whether behavioral habituation commonly occurs or whether the apparent lack of response at finer scales simply reflects the situation commonly reported elsewhere in which broader scale displacement occurs despite some individuals remaining near the point of disturbance (Vistnes and Nellemann 2008). These analyses should include refined mapping of snowmobile-use areas, including within parks, and using the revised subpopulation delineation (Wittmer et al. 2005). In well-defined sites where there is evidence for little initial response or eventual habituation, and where good ecological and recreational information is available, logistic regression techniques could indicate contributing factors and direct guideline development. These factors might include the predictability of snowmobile activity, snowmobiler responses when caribou are seen, area covered by snowmobiles, presence of refuges within the bounds of snowmobile use, amount of adjacent suitable habitat (i.e. number of options for exhibiting displacement), other disturbance factors (heli-skiing, research activities, backcountry skiing and snowboarding, snowcat skiing, summer activities such as ATV use, hiking and horseback riding, vehicular traffic), and level of snowmobile activity. Behavioral habituation and types of snowmobiler activity that are least likely to elicit a visible response by caribou could potentially be investigated through direct observations also, but it is difficult to translate individual responses to population effects.
3. *Predation.* There should be sufficient telemetry and mortality data from most local populations to provide initial indications of whether the presence of packed snowmobile trails influences mortality risk in early winter where caribou activity occurs in valley bottoms in that season. Determining whether packed trails linking valley bottoms to late-winter habitats in the upper subalpine facilitate

predator access might be accomplished by measuring snow weight-bearing capacity across elevations, locations, weeks and years. This would determine how frequently there is snow supportive enough at upper elevations to allow effective hunting, yet snow unsupportive enough at mid-elevations that predators would otherwise have been unlikely to cross it in the absence of snowmobile trails. A retrospective analysis of snow data already collected within Mount Revelstoke National Park or through re-analysis of the snow data collected several decades ago in the North Thompson valley (Antifeau 1987) might address this. A focused effort should also be made to assemble past and future reports of predators using high-elevation snowmobile trails.

4. *Recolonization*. Mountain caribou often shift areas of use over time, and recovery in several local populations will require recolonization of unused habitats. Determining how the likelihood of recolonization of suitable but unused habitat differs between sites with and without snowmobiling would require long-term within-population retrospective analyses of telemetry and survey data.
5. *Within-season Displacement*. Assessing evidence for displacement at a temporal scales intermediate between the very short term (Tyler 1991, Mahoney et al. 2001, Powell 2004) and the long term (this study) has been undertaken at several sites (Lewis and McLellan 2007) and should be extended elsewhere as data become available.

4. Acknowledgements

I wish to thank all of the respondents who provided information and opinions listed in Appendix 2. In addition, I appreciate the efforts of J. Ballentine, W. Birkenshaw, P. Dawley and other members of the Prince George Snowmobile Club, M. East, K. Greskiw, D. Hamilton, T. Layser, A. Schmidt, D. Seaton, D. Seip, N. Shuttleworth, J. Surgenor, M. von der Gonna, W. Wakkinen, P. Wallenius, G. Watts, and J. Young in providing snowmobile mapping and survey data or checking it for accuracy. J. Hooe and N. Freeman provided valuable background information, while I. Hatter and G. Kuzyk arranged funding and acted as contract monitors. This report benefited from comments on earlier drafts provided by D. Butler, I. Hatter, D. Seip and J. Young, and an edit by G. Harcombe.

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Appendix 1: List of Questions Used to Guide Interviews

1. Are you aware of any areas where snowmobiling has displaced or is displacing caribou or is likely to soon displace caribou? Is there any empirical evidence of this?
2. Are you aware of any areas where snowmobiling and caribou appear to be coexisting without changes to caribou distribution or movements? Is there any empirical evidence of this?
3. Are there any confounding factors that may confuse the issue (e.g. other recreation in area; recent changes in population level due to predation, habitat loss, etc.)?
4. How would you characterize recent changes in snowmobile activity? Over what time frame has this occurred? Has this been general over the whole area or just in specific locations?
5. Are most snowmobilers local people? If so, are they mainly club members or not? If they are non-residents, where are they from?
6. Are there any mandatory or voluntary closures in place? Are they adhered to? Is there any evidence of closures being effective (i.e. are there changes to caribou movement because of or despite the closures)?
7. Who else should I talk to locally?
8. [WHERE APPROPRIATE] What data can you provide?

Appendix 2: Responses to Questions

Index to Topics, Local Populations and Place Names in Responses

Topic	Respondent
Alberta	13, 29, 40, 43
Adams River	16
Allan Creek	16, 17, 20, 32, 35, 39, 41
Antsey Arm	22
Austerity Creek	18
Bald Mountain	34, 46
Barkerville local population	5, 7, 19, 34, 37, 46
Battle Mountain	26
Bearpaw Ridge	9, 21, 43
Bell Mountain	21, 43
Berry Creek	20
Big Bend	16
Big Timothy Mountain	7, 46
Bill Miner Creek	46
Bischoff Lakes	16, 20
Boulder Mountain	6, 14, 15, 25
Boundary Creek	45
Bourne Glacier	6
Boss Mountain	46
Bowron Lake Park	7
Cabins	7, 15, 16, 18, 21, 35, 38
Cameron Ridge	4, 7, 37, 46
Captain Creek	43
Cariboo Mountains Park	7
Castle Creek	7
Cat-skiing (see Displacement, other causes)	
Celista Mountain	28
Central Rockies local population	11, 18
Central Selkirk local population	15, 18, 45
Chappell Creek (see Miledge Creek)	
Char Creek	45
Clearwater Lake	16
Clemina Creek	16, 32, 35, 41
Closures (see Zonation)	
Clubs	9, 10, 15, 16, 23, 26, 31, 33, 34, 35
Compliance (see Zonation)	
Cooper Lake	8
Commercial snowmobile operations	34
Darkwoods property	45
Deception Mountain	10, 46
Displacement, lack of	8, 9, 18, 19, 22, 23, 25, 27, 32, 35, 47
Displacement, long-term or range abandonment	1, 2, 6, 10, 14, 15, 19, 20, 21, 28, 33, 37, 38, 39, 42, 43, 45, 46
Displacement, other causes (or lack of other causes or potential for other causes)	8, 10, 15, 16, 17, 18, 20, 21, 25, 27, 28, 30, 32, 33, 35, 36, 39, 40, 41, 45, 46
Displacement, short term	2, 4, 16, 17, 21, 22, 24, 35, 36, 42, 43, 44
Dome Creek	43
Eureka Peak (Eureka Mountain)	10, 27, 46
Finn Creek	16, 47
Flourmill Creek	10, 26, 33
Foghorn Mountain	47
Forest, use of by caribou or snowmobiles	10, 16, 20, 21, 32, 35, 44, 47
Frisby Ridge	6, 14, 15, 23, 25
George Mountain local population	21, 43
Gleason Creek	9
Goat River	43
Gold River	18

Granite Mountain	47
Groundhog Mountain	2, 16, 20
Habituation	14, 45
Haggen Creek	43
Hamling Lakes	45
Harp Mountain	47
Hart Ranges local population	9, 21, 38, 43, 44
Helicopters (see Displacement, other causes)	
Herrick Creek, McGregor River	43
Highway 3	45
Holmes River	12
Hunter's Range	28, 39
Kakwa Park	29
Keystone Creek (see Standard Basin)	
Kootenay Mountain	45
Kootenay Pass	45
Lempriere Creek (see Miledge Creek)	
Lichen Mountain	28
Lucille Mountain	21, 38, 43
Mackenzie	44
Maryland Creek	45
McBride area (see also Bell and Lucille mountains)	38, 43
McGregor River (see Herrick Creek)	
McGregor Mountains	21, 30
Mica Mountain	10, 37, 46
Miledge, Chappell and Lempriere creeks	2, 16, 17, 20, 32, 35, 39, 41
Monashee local population	28, 39
Monk Creek	45
Mortality, unknown cause	14, 15
Mount Agnes	7
Mount Revelstoke National Park	6
Moyie River	31
Mud Creek	16
Narrow Lakes local population	38
North Cariboo Mountains local population	9, 21, 38, 43
North Queest Mountain (see Queest Mountain)	
North Thompson valley or river	2, 17, 20, 35
Northern ecotype	8, 13, 29, 36, 38, 40, 44
Origin, snowmobilers	4, 6, 7, 8, 9, 11, 15, 16, 19, 27, 28, 29, 31, 32, 34, 35, 36, 41, 45, 46
Otter Creek (see Captain Creek)	
Pack River	42
Parks and wilderness areas, general	1, 24, 42
Permits (see Zonation)	
Predators	5, 9, 10, 12, 13, 18, 21, 27, 30, 33, 38, 39, 40, 46
Priest Lake	1
Pukeashun Mountain	28, 39
Queest and North Queest mountains	2, 20, 22, 28, 39
Quesnel Lake	7, 46
Raft Mountain, Raft River	2, 16, 20, 37, 47
Ratchford Creek	28
Red Mountain	21
Renolds Creek	38
Renshaw Creek	21, 43
Research, effects of	27
Revelstoke local population	2, 6, 14, 15, 20, 22, 23, 28, 39
Roads	1
Roberts Peak	7
Sale Mountain	6
Selkirk Crest	1
Sightings, or lack of	3, 4, 9, 10, 18, 34, 47

Silvercup Ridge	15, 25, 45
Skiing (see Displacement, other causes)	
Snowcat -skiing (see Displacement, other causes)	
Snowmobile activity/use levels	1, 2, 6, 7, 8, 9, 14, 15, 16, 18, 19, 20, 21, 23, 25, 27, 28, 31, 32, 34, 35, 37, 38, 39, 42, 45, 46
South Purcell local population	8, 31
South Selkirk local population	1, 24, 42, 45
Spahats Creek	2
Stagleap Park (see Kootenay Pass)	
Standard Basin, Keystone Creek	6, 14, 23
Sugarbowl-Grizzly Den Park	9, 43
Table Mountain	2
Technology, improvements in	4, 2, 46
Telkwa Mountains	36
Three Ladies Mountain	4
Torpy River	9, 21, 43
Trophy Mountain	2, 26, 33
Twin Peaks	10
Two Mouth Lakes	42
Two Sisters Mountain	19
Waldy Lake	1
Wells Gray North local population	4, 7, 10, 26, 27, 37, 46
Wells Gray Park	10, 26, 33
Wells Gray South local population	2, 3, 10, 16, 17, 20, 26, 32, 35, 39, 41, 47
West Arm Park	45
Wood Peak	42
Wolves (see Predators)	
Yanks Peak	4, 7, 19, 27, 34, 46
Zonation, Closures, Compliance, Permits	1, 3, 6, 7, 9, 10, 15, 16, 19, 20, 23, 24, 26, 27, 28, 31, 32, 33, 34, 35, 36, 41, 42, 43, 45, 46

Summary of Respondents' Comments

1. Researcher or resource manager discussing the SOUTH SELKIRK local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>BC</u>: Snowmobiles are more or less everywhere on the BC side, although he can't say for sure that displacement is occurring. However, the Waldy Lake area formerly had regular groups of 10-15 animals, but now has heavy snowmobile use (access via gas pipeline road onto Selkirk Crest ridge) and there are no or few caribou in that area now.</p> <p><u>USA</u>: There is quite a lot of activity near Priest Lake, where roads are groomed. The US Forest Service works with snowmobile clubs to keep people on groomed roads.</p>
<i>Confounding factors.</i>	Numerous translocations make causes of some shifts in movements uncertain.
<i>Closures.</i>	On federal land (USA), there are large areas without snowmobile access due to wilderness area designations (few violations), or with minimal access due to roads being unplowed and ungroomed. On state land, snowmobiles are unregulated but there is not much activity due to unfavorable terrain.
<i>Available data.</i>	Can provide telemetry data if needed.

2. Researcher or resource manager discussing the WELLS GRAY SOUTH and part of the REVELSTOKE local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p>During his research in the North Thompson in the late 1970's, there was not much snowmobiling compared to now, but there were several occasions when caribou that were established in certain areas in late winter moved out at the same time that snowmobilers arrived.</p> <p><u>Groundhog Mountain</u>: When snowmobilers began using the gentle-sloped side of the mountain one winter, the caribou group stopped using that side and moved to the steeper terrain on the other side of the mountain.</p> <p><u>Miledge Creek</u>: Once snowmobiles reached open, gentle ground at higher elevations where caribou had been, caribou moved to steeper terrain.</p> <p><u>Queest Mountain</u>: When working in Salmon Arm in early to mid 1990's he saw a situation several times (once from air, once or several times on ground) where there were only old caribou tracks on the part of Queest Mountain where snowmobiles were active, but fresh tracks only on part of mountain where snowmobiles were absent.</p> <p><u>Raft-Trophy-Table mountains-upper Spahats Creek</u>: During his study up to 1980, he regularly had animals in these areas during winter (generally on the NE portion of Raft, SE through NE side of Trophy, and northward to Table Mountain; hardly ever on S side of Raft). One winter (perhaps 1979/80), there was a group of about 8 or 9 animals including a collared on both sides of Spahats, and another group of 6+ on the north side of Trophy (toward Table Mountain). NOTE: These areas appear to have low to no use by Mountain Caribou now and include heavy snowmobiling sites.</p>

<i>Available data.</i>	If still available, original maps from regular flights on standardized routes he did throughout winters for his research, which are equivalent to survey flights (but of less complete coverage). He also flew with BC Parks on regular survey flights in 2 years (perhaps 1977 or 1978 and also about 1980).
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3. Recreational or commercial snowmobiler discussing part of the WELLS GRAY SOUTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has never seen a caribou while on snowmobile; used to snowmobile in mountains from 1965 to early 1980's. Riders are very conscientious of need to leave caribou undisturbed.

4. Researcher or resource manager discussing the WELLS GRAY NORTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Saw caribou once on "Three Ladies Mountain" (north arm of Quesnel Lake). He saw them and turned around but several other snowmobilers went by him and surprised the caribou. They moved off and kept going for a long way, though not running. He has talked to one or two other people who have had same experience. Most people don't see caribou when snowmobiling. Not aware of any areas where high levels of snowmobiling and caribou coexist. Based on technological improvements, expects increasing conflicts between caribou and snowmobiling.
<i>Recent changes in snowmobile activity.</i>	Big change in early to mid 1990's – machines continually getting, lighter, more powerful, longer tracks and big paddles.
<i>Snowmobiler origins.</i>	Yanks Peak main destination in Cariboo; Cameron ridge for more skilled, aggressive riders.

5. Researcher or resource manager discussing part of the BARKERVILLE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	On several occasions while doing winter maintenance work in Bowron Park about 1980, he found wolves using snowmobile tracks. This was always in the valley bottoms. There were moose and occasionally caribou in the valley bottom.

6. Researcher or resource manager discussing the REVELSTOKE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>Frisby Ridge</u>: Caribou used to spend time on top of ridge. Now they cross it occasionally, but are not spending time on top, where snowmobile route is (are using slopes on east and west sides). Considers this to be full-blown displacement.</p> <p><u>Standard Basin - Keystone</u>: Major displacement, based on observations of past locations. Caribou numbers just north of Revelstoke on east side of reservoir are being assessed; appear to be declining there.</p> <p><u>Sale Mountain</u>: Unsure of situation</p> <p><u>Boulder Mountain</u>: Complete loss of use of that area.</p> <p>Caribou appear to have been displaced into non-snowmobile or low-snowmobile areas and to that extent are now co-existing, but only because they are in secondary habitats.</p>
<i>Confounding factors.</i>	No, overall population has remained quite stable.
<i>Recent changes in snowmobile activity.</i>	Dramatic increase. Increase has occurred over a long period on Frisby Ridge; more recent increase (last five years) east of reservoir.
<i>Snowmobiler origins.</i>	Majority not local; come from Alberta, Saskatchewan, USA.
<i>Closures.</i>	Frisby Ridge has had long-standing closure of areas to sides of main ridgeline (now legislated). Recent agreement leaves all high-value caribou habitat east of reservoir open for snowmobiling; good management north of that on east side; west side down to Frisby Ridge closed except for a corridor to Bourne Glacier. Closures are relatively well adhered to; relatively little infringement on Frisby Ridge and into Mount Revelstoke National Park.
<i>General comments.</i>	There are observational data available that haven't been used in Revelstoke analyses so far.

7. Researcher or resource manager discussing part of the BARKERVILLE and WELLS GRAY NORTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Mt Agnes, Yanks Peak, Cameron Ridge have had an incredible increase in use (including building a 28-bed cabin on Yanks); don't see much for caribou there now. Big Timothy Mountain also no longer has caribou and has heavy snowmobile use.
<i>Recent changes in snowmobile activity.</i>	Long, gradual increase in use since early 1980's.
<i>Snowmobiler origins.</i>	Probably 80% come from the 100-Mile House to Prince George area. Most of rest from elsewhere in BC.
<i>Closures.</i>	Bowron Park has always been closed. Proposal now to open a corridor through it to reach Robson Valley. Cariboo Mountains Park has use only on east side (Roberts Peak via Castle Creek from Robson Valley); west side access restricted because of Quesnel Lake.
<i>General comments.</i>	Snowmobile strategy planning subsequent to CCLUP still underway.

8. Researcher or resource manager discussing the SOUTH PURCELL local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has seen with northern ecotype caribou a very strong response to helicopters, so expects this holds true for caribou here. Has seen caribou within 500 m of snowmobiles on Cooper Lake and caribou were apparently not paying any attention to machines.
<i>Recent changes in snowmobile activity.</i>	Major increase after about 1990.
<i>Snowmobiler origins.</i>	Mostly local in South Purcells.

9. Recreational or commercial snowmobiler discussing parts of the CARIBOO MOUNTAINS and HART RANGES local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	His club's membership doesn't ride much in areas with high caribou values, such as Bearpaw Ridge, and don't often see caribou. Some people do go to such places but this tends to be difficult to access, with no formal trails. Club members most active in the defined recreation area in upper Torpy, which has fewer caribou (caribou tend to move out of that area to Gleason and other nearby areas in the late winter). Even in upper Torpy, they try to avoid areas where caribou tend to be. When caribou do see snowmobilers, they tend to be curious. Club members don't feel wolves use tracks to access high-elevation sites (though they do follow tracks in lowlands). Doesn't see co-existence of high numbers of caribou with high numbers of snowmobilers since snowmobilers tend to avoid areas with lots of caribou in the first place.
<i>Recent changes in snowmobile activity.</i>	The Prince George Snowmobile Club membership increased about 10-fold in a few years (partly due to insurance requirements). Big increase in membership began about four years ago, and sales of snowmobiles parallel this, especially those designed for mountains.
<i>Snowmobiler origins.</i>	Most riders near to Prince George are locals. The PG Snowmobile Club membership of 565 represents only ~10% of registered snowmobiles in PG. Membership increasingly younger and more willing to travel.
<i>Closures.</i>	Promote the use of areas with less or no conflict. Only closure is the new park in Raven-Grizzly Den area (which was previously closed anyway). Hasn't heard any indication of MWALP and MSRM moving toward any other closures.
<i>Available data.</i>	Willing to work on mapping of use areas if needed.
<i>General comments.</i>	Publicizing areas with high caribou values may lead to some people going there specifically to see the caribou.

10. Recreational or commercial snowmobiler discussing parts of the WELLS GRAY NORTH and WELLS GRAY SOUTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Recognizes that very heavy use of an area by snowmobiles will cause them to move out. Sees somewhat fewer animals over time (big drop about 1993/94) but likely due to other factors. Riders very seldom see caribou. He has only seen caribou at a distance, but other riders who explore more report that if you stop the machine and watch, caribou resume normal activity. Twin Peaks (west of Mica Mountain) is used as an occasional exit route; has ~5% of the use that Mica has, and just for travel, not playing; heavily wooded. They see caribou there almost every year.
<i>Confounding factors.</i>	Major decline from predation. Now only 18-20 animals in the area where his club is most active.
<i>Recent changes in snowmobile activity.</i>	Long, gradual increase.
<i>Snowmobiler origins.</i>	Quite a few from out-of-region; multiple access points.
<i>Closures.</i>	They are pulling back from areas where caribou occur. Eureka Peak is closed (originally an ATV-goat issue). Also a voluntary closure at Deception Mountain (closed for ~12 years) and at the Flour Mills in Wells Gray (closed after Feb 15).

11. Researcher or resource manager discussing the CENTRAL ROCKIES local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	The terrain and lack of access to most of the Central Rockies local population prevent significant access. There is potential for some issues to develop, but so far there don't seem to be any problems.
<i>Recent changes in snowmobile activity.</i>	Still very little activity.
<i>Snowmobiler origins.</i>	Mostly local.

12. Other backcountry observer discussing area near the HART RANGES local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Saw wolf tracks following snowmobile trail on the valley bottom in the Holmes River about 7 or 8 years ago.

13. Researcher or resource manager discussing the NORTHERN CARIBOU ecotype on the East Slopes (mostly Alberta)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	One of her major concerns is wolf access along snowmobile tracks. Occasionally sees wolves using packed snowmobile trails, and wolves almost certainly learn that this provides good access to caribou. There is very heavy snowmobile use along linear disturbances (seismic lines, etc.) on winter range in the foothills. Caribou use the plateaus less now than they did formerly; closer to mountains now, and more concentrated. Maligne Lake road in Jasper National Park is used by wolves to access higher elevations.
<i>Confounding factors.</i>	Find wolves up high regularly (regardless of snowmobile tracks).
<i>Closures.</i>	Some of the more mountainous areas in Alberta are closed, but this is regularly violated, and she has seen wolves following snowmobile trails into these areas.

14. Researcher or resource manager discussing the REVELSTOKE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<u>Boulder Creek</u> : apparent complete displacement. <u>Frisby Ridge and Standard Basin</u> : apparently in process of displacement. Used to regularly be 20-30 caribou on Frisby Ridge, now getting hard to find tracks (still a few animals there). Concern that only a few habituated animals remain but others gone and unlikely to recolonize. Had high mortality rate among collared caribou on Frisby from various causes, but no evidence to clearly link it to snowmobile activity. Do not appear to be any areas where caribou and snowmobiles co-exist in any numbers.
<i>Recent changes in snowmobile activity.</i>	Started to increase rapidly about 4-5 years ago.

15. Researcher or resource manager discussing the CENTRAL SELKIRKS and part of REVELSTOKE local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Have displaced caribou from Boulder Mountain. Hut there was originally constructed as an emergency shelter and was to be closed if caribou impacted. In process of displacing caribou from Silvercup Ridge. Based on survey and telemetry observations, caribou are located downslope when snowmobiles on ridge. Also, there is high mortality among these caribou (though not in winter) – possible link to stress in winter? Except for Frisby Ridge, nowhere that they coexist. When snowmobiles move in, caribou move downslope or out of area altogether.
<i>Confounding factors.</i>	Snowcat skiing (Great Northern Mountain): caribou move out until cat-skiing is over, then move back in until displaced by snowmobilers using snow-cat trails. Rates cat-skiing as a high level of concern

	(Simpson and Terry ranked as medium). Predation potentially affecting mortality rate (unknown). Habitat loss/fragmentation, inter-species competition, predation, highways, reservoirs, forestry, urban expansion, forestry, backcountry recreation all contribute to declines.
<i>Recent changes in snowmobile activity.</i>	Substantial increase over past decade in specific areas with good access and good snowmobiling. Tremendous technological improvements in snowmobiles allow access to previously unusable areas.
<i>Snowmobiler origins.</i>	Most come from elsewhere in western Canada (BC to Manitoba) and NW USA. Non-locals tend to come in groups or clubs.
<i>Closures.</i>	Frisby Ridge; some in Invermere Forest District.
<i>Available data.</i>	Old survey and sightings data have been compiled. MWLAP or MSRM have all the survey and telemetry data for Central Selkirks.

16. Researcher or resource manager discussing part of the WELLS GRAY SOUTH local population (Clearwater Forest District)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>Raft Mountain</u>: Has two cabins for the Clearwater Snowdrifters. Caribou use the north and south edges of mountain, but not in middle near cabins, where snowmobilers are.</p> <p><u>Clemina Creek</u>: Good habitat but no anecdotal sightings for 20 years. No snowmobiling prior to about 15 years ago; Valemout Snowmobile Club cabin built about 10-12 years ago; now up to 150 snowmobilers/day.</p> <p><u>Allan Creek</u>: There used to be perhaps 100 animals in the Allan-Lempriere creeks area. There was a big fire in 1962 which eliminated a lot of habitat, and there are now about 27 animals. They seem to be using a lot of north aspects, where forest remains. A cabin was built 12 years ago at the ESSFp-AT transition. There is less use here than in Clemina, and it tends to be snowmobilers going to the headwalls near the back end. Situation is unclear – perhaps less impact here due to nature of terrain being sought in this area.</p> <p><u>Miledge-Chappell creeks</u>: Snowmobilers directed to alpine, but people occasionally drop into subalpine basins at Norbert's Nose, which can displace the roughly 40 caribou that occur in that area.</p> <p><u>Others</u>: Concern that there will soon be problems in Bischoff Lakes and Groundhog Mountain as snowmobile activity continues to increase (commercial proposal for Bishoff Lakes; cabin on Groundhog, in area where caribou from Mud-Adams gather before moving south in late winter).</p>
<i>Recent changes in snowmobile activity.</i>	Prior to about 15 years ago, there were large areas with no access due to inability of machines to reach difficult terrain and operate in difficult snow conditions.
<i>Snowmobiler origins.</i>	Quite a few from prairies; many coming through Valemout. Clubs in Clearwater and Valemout.
<i>Closures.</i>	Good cooperation from snowmobile club; going to be losing patrols. Some infractions where people drop into subalpine bowls rather than moving directly through to alpine.
<i>Available data.</i>	Report with anecdotal info (and maps) done in 1997 going back to 1940's, and incidental sightings

	records in electronic form from MWLAP and MSRM, Kamloops.
<i>General comments.</i>	Historically, perhaps 1000 animals apparently moved from winter ranges near the Big Bend to summer ranges near Clearwater Lake via Finn Creek, Mud Creek.

17. Researcher or resource manager discussing part of the WELLS GRAY SOUTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	In 2001, a group of caribou in Miledge-Chappell that included radiocollared animals made an unexpected movement into the North Thompson headwaters, then moved back again the following week. Wonders if the movement was due to a disturbance. In Allan Creek, caribou use spur ridges while snowmobiles use the main ridge, despite the better caribou habitat appearing to be on the main ridge.
<i>Confounding factors.</i>	Heliskiing tracks overlap caribou tracks sometimes. Hard to tell about sequence of events, but has had skier describe skiing through a group of them. Perhaps use continues in Miledge-Chappell and Allan because of adjacency of early winter habitat near Highway 5; it makes sense energetically to keep using the snowmobiling and heliskiing areas even if there is some disturbance because it is high quality, accessible habitat.

18. Recreational or commercial snowmobiler discussing parts of the CENTRAL ROCKIES and CENTRAL SELKIRKS local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has never seen caribou while on snowmobile (though they are seen in the summer in the Gold River and Austerity areas), and hasn't heard of anyone seeing caribou during the winter in the Silent Pass area (Central Rockies local population). An acquaintance has photographed them near Revelstoke from snowmobile without any apparent response by caribou. Wolf access issues into high elevation very minor due to inability of wolves to move in deep snow once they get off the track. Very few people go to the Central Rockies local population's range, due to difficult access.
<i>Confounding factors.</i>	Predators in seasons other than late winter and loss of habitat the big issues. Backcountry cabins used by heli-hikers are becoming common and are causing a problem.

19. Recreational or commercial snowmobiler discussing part of the BARKERVILLE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Were caribou on Yanks 25-30 years ago, when there were far fewer snowmobiles (now use nearby Twin Sisters area). Has been 25 years since he has seen a caribou on snowmobile. Doesn't think snowmobiling has had as big an impact as it is sometimes portrayed, although it does have some.
<i>Recent changes in snowmobile activity.</i>	Dramatic increase in number of sleds in last few years (very few 25 years ago).
<i>Snowmobiler origins.</i>	Quesnel, Prince George, Williams Lake, perhaps 5% from out of province.
<i>Closures.</i>	Planning underway, probably to include closure on Two Sisters. He supports this and doesn't go there anyway because of the caribou.

20. Researcher or resource manager discussing the WELLS GRAY SOUTH and part of REVELSTOKE local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p>Miledge and Lampriere creeks: Still caribou, but far less than 5-15 years ago. Feels the problem is presence of snowmobiles, regardless of part of area being closed. It is possible that coexistence is occurring but he believes not.</p> <p><u>Allan Creek</u>: Used to some extent historically (generally present during surveys in 1980s); now having trouble finding a track, and no animals seen.</p> <p><u>North Queest</u>: heavily used by snowmobiles; only find caribou lower (outside of areas used by snowmobiles), while snowmobiles are in classic late-winter habitat.</p> <p><u>Berry Creek and headwaters of Raft</u>: Virtually always find caribou there on surveys, and there has been no snowmobile use. However, there is now a logging road nearby and he has seen one or two snowmobile tracks in last year. No problem yet, but a great opportunity to study effects.</p>
<i>Confounding factors.</i>	The overall population is stable and there are no confounding factors in North Thompson.
<i>Recent changes in snowmobile activity.</i>	Snowmobile use has exploded in Miledge-Lampriere, in last 5-10 years. Steady increase over past 20 years in Allan. Bischoff Lakes and Groundhog Mountain have seen rapid increase over past five years.
<i>Closures.</i>	In Miledge-Lampriere, the area where snowmobiles are allowed does included quite a bit of fringe habitat (parkland). He has photos of snowmobile activity within closed area.

21. Researcher or resource manager discussing the NORTH CARIBOO MOUNTAINS, GEORGE MOUNTAIN and HART RANGES local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>Bell and Lucille mountains</u>: Caribou were common right across both mountains prior to ~ 1982/83. Now they are seen only on fringes (steep, timbered slopes).</p> <p><u>George Mountain</u>: Hard to say if snowmobiling was more than a contributing factor to decline.</p> <p><u>Red Mountain (in McGregor Mountains)</u>: while on skis observed caribou on next ridge over; snowmobiles arrived and moved in to look at caribou; snowmobiles then stopped, but caribou ran for >2 km (were still running when they disappeared from view). These caribou would have had very little previous experience with snowmobiles.</p> <p><u>Upper Torpy River (two ridges east of Bearpaw Ridge)</u>: Originally, this ridge wasn't as heavily used as Bearpaw, so snowmobile development was allowed. Access began in early 1980's, with major increases ~ 1990. Now there are few caribou tracks.</p> <p>No areas of coexistence – very few machines required to create a problem.</p>
<i>Confounding factors.</i>	George Mountain has lots of other recreation and logging. In Upper Torpy (and most places) the key habitat at higher elevations is protected, so loss of habitat is not an issue. Renshaw Creek never did have much for caribou even before it became heavily snowmobiled.
<i>Recent changes in snowmobile activity.</i>	Bell and Lucille were snowmobiled heavily even in the 1980's, and use has increased since. George Mountain also used a lot even in early 1980's; has decreased a bit in last five years.
<i>General comments.</i>	<ul style="list-style-type: none"> - Does not see wolf access to <u>high</u> elevations via snowmobile tracks as an issue; has seen three wolf-killed caribou at high elevations (Bearpaw, McGregor Mountains, elsewhere), all in areas without snowmobile tracks. Snowmobile trails are used for access by wolves at <u>low</u> elevations. - Backcountry skiing a problem at high densities: in an area of the McGregor Mountains known as The Farm, caribou were regularly seen 7 or 8 years ago, but there is now a ski cabin and lots of use there now, including weekdays, and there are few observations of caribou there now (he skis there himself).

22. Recreational or commercial snowmobiler discussing the southwest corner of REVELSTOKE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p>Not aware of any displacement, but based on the way snowmobiles travel expects that they would displace them when moving back into more remote areas. However, he normally snowmobiles in areas where there are few caribou anyway (Queest, North Queest). Has seen caribou up Antsey Arm in summer but not in winter.</p> <p>Has seen one track north of North Queest.</p>

23. Recreational or commercial snowmobiler discussing the REVELSTOKE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	There has been snowmobiling on Frisby Ridge for 30 years, with the restricted access program in place for 15 – 18 years, and there is still regular caribou use. Although the caribou are on all parts of the ridge, they appear to be mostly in the areas used heavily by snowmobiles. Caribou use the snowmobile trails for traveling, but also bed and feed in areas where snowmobiles are, indicating they must have some level of comfort. Also see caribou in Keystone-Standard area. Not a lot of apprehension on the part of caribou as long as they aren't approached directly or fast. Caribou are more likely to get up and move off if snowmobilers stop their machines and especially if riders get off the machines. Believes they have demonstrated that snowmobiles and caribou can co-exist, and that the program at Frisby Ridge is working.
<i>Recent changes in snowmobile activity.</i>	Increasing.
<i>Closures.</i>	Frisby Ridge is zoned for corridors and play areas; a number of areas on the side are closed. There is very good compliance, even among non-residents. Draft agreement regarding further closures elsewhere in Revelstoke local population's range.

24. Researcher or resource manager discussing the SOUTH SELKIRK local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	In at least one situation, snowmobile tracks were on top of caribou tracks, but it was not clear whether chasing had occurred.
<i>Closures.</i>	Closure area in Idaho; wilderness area in Washington. Recreation strategy for the Kaniksu National Forest and for the entire ecosystem underway.
<i>Available data.</i>	Has GIS layers with snowmobiling (routes, maintained roads, play areas), coarse caribou habitat quality, and telemetry on USA side.

25. Other backcountry observer discussing parts of the REVELSTOKE, WELLS GRAY SOUTH and CENTRAL SELKIRKS local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has never observed caribou running from a snowmobile (though he has seen them run from helicopters used for heliskiing).
<i>Confounding factors.</i>	
<i>Recent changes in snowmobile activity.</i>	Activity by snowmobilers took off dramatically about five years ago. Silvercup Ridge has only become a

	heavy snowmobiling area in the past year. Revelstoke people formerly were almost entirely on Boulder and Frisby, but as those became busy they began using areas farther north up the reservoir, and the areas being used keep expanding farther north.
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26. Researcher or resource manager discussing parts of the WELLS GRAY SOUTH and WELLS GRAY NORTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Flourmill Creek: (north of Mahood Lake; accessed from 100 Mile House); glading. Was voluntary agreement with club to not use after February (when caribou present there); now signed so mandatory. Timing prevents problems. Trophy Mountain: Historically not a lot of caribou (most are northeast of that); back-country skiing on north side, snowmobiling on south. Battle Mountain: caribou present; no snowmobiling.
<i>Closures.</i>	Wells Gray Park closed except for designated areas; timing restriction in Flour Mills, as noted above. A bit of trespass on the east side from the Highway 5 corridor; this is occasionally patrolled.

27. Recreational or commercial snowmobiler discussing parts of the WELLS GRAY NORTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<ul style="list-style-type: none"> - Doesn't feel that snowmobiles are a big issue for caribou; certainly not on par with predators. Caribou are not often seen by snowmobilers, but when seen they tend to continue acting normally when machines stop. Caribou are sometimes in timber slightly below the open areas used by snowmobiles even when snowmobiles present. Similar situation in other areas with roads or oilfield equipment – little or no fear evident. Riders are interested in seeing wildlife and tend to act responsibly. - Other species seem to have little reaction to vehicles other than to step off a short distance. - Feels that wolf access to alpine via snowmobile tracks is rare if it happens at all. Caribou are dispersed and hard to hunt anyway, and if wolves left tracks they would have trouble moving through the deep snow. - Perhaps snowmobile tracks improve caribou mobility.
<i>Confounding factors.</i>	Most areas with long histories of snowmobile access also have long histories of other resource extraction – lower numbers of caribou not necessarily related to snowmobiles (e.g. Yanks Peak). Also, disturbance from collaring may make them more sensitive to future disturbance.
<i>Recent changes in snowmobile activity.</i>	Not a particularly dramatic increase in snowmobile activity locally because they don't get the influx from Alberta.
<i>Snowmobiler origins.</i>	Mostly locals; as you go further north, increasing numbers from Quesnel and Prince George.
<i>Closures.</i>	Eureka Peak closed. However there have been no caribou there for many years, and they hope to re-open it.

28. Researcher or resource manager discussing the MONASHEE and southwest corner of REVELSTOKE local populations (Salmon Arm Forest District)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Concurrent with snowmobiling expansion, Queest Mountain has had no caribou sightings for ~10 years and Pukeashun has had none since 1988. Lichen Mountain (near Pukeashun) and Hunters Range also have none. Caribou appear to almost invariably be using micro-patches of habitat (often surrounded by unfavorable terrain) where there is no snowmobile activity, rather than the large patches where snowmobiles are. No areas of coexistence - anywhere that caribou exist, there is either no snowmobile activity or low levels of snowmobile activity. For example, caribou still use North Queest Mountain and areas to the north of it, but those locations have far fewer snowmobiles than Queest. Celista Mountain has considerable snowmobile use and caribou remain, but use of this area by snowmobiles is recent.
<i>Confounding factors.</i>	South of Highway 1, the lack of use of the Hunters Range may simply be due to the Monashee local population being very small. In general, the areas with high snowmobile activity have extensive access, which is associated with heavy timber harvesting, so that may drive the loss of animals.
<i>Recent changes in snowmobile activity.</i>	It is increasing in intensity and extent. Some areas have only recently been pioneered (such as Celista Mountain).
<i>Snowmobiler origins.</i>	This depends where you are. The out-of-region sledders (mostly from Alberta) tend to be more concentrated in areas that have been heavily marketed. This tends to push some of the locals into more remote areas.
<i>Closures.</i>	There is one that is continuous with the closure on the northwest side of the Revelstoke reservoir (extends over height-of-land in Monashees into the Ratchford River). This is 2 years old. Compliance unknown.
<i>Available data.</i>	Telemetry data.

29. Researcher or resource manager discussing part of the KAKWA Park area (NORTHERN CARIBOU ecotype)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Believes there are no major problems in Kakwa Park; most animals are northern ecotype so move to foothills in winter (some in Alberta) and are therefore not in contact with snowmobiles in Kakwa. However, not sure what would happen in absence of snowmobiling. On a regional basis, perhaps better to have snowmobiles in Kakwa than in areas where caribou winter at high elevations.
<i>Snowmobiler origins.</i>	Mostly from Alberta.
<i>Available data.</i>	Lots of caribou research done from Alberta side (currently West Central Alberta Caribou Project)

30. Other backcountry observer discussing HART RANGES subpopulation

TOPIC	COMMENTS
<i>General comments.</i>	Found a caribou killed by wolves in McGregor Mountains; wolves had accessed the area without any snowmobile or ski tracks. Caribou have followed his ski tracks on three occasions.

31. Two researchers or resource managers discussing the SOUTH PURCELL local population

TOPIC	COMMENTS
<i>Recent changes in snowmobile activity.</i>	Noticeable increase in snowmobiles in region over past five years.
<i>Snowmobiler origins.</i>	Mostly local.
<i>Closures.</i>	A route for snowmobiles to avoid key caribou areas in the Moyie drainage has been agreed to with the Cranbrook snowmobile club. They charge fees and do trail maintenance. There is buy-in from the club leadership, but not necessarily from the membership; not known whether closures are being respected but believes there are regular violations.
<i>Available data.</i>	MOF has maps of designated snowmobile route in Moyie and general areas of use elsewhere in Cranbrook Forest District.

32. Recreational or commercial snowmobiler discussing part of the WELLS GRAY SOUTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p>He and other snowmobilers regularly see caribou at Allan and Miledge-Chappell snowmobile areas. Hasn't seen them feeding – sees them out in open; generally just standing there, sometimes bedding, sometimes walking. When he encounters them he makes sure no one disturbs them. People stop machines, watch, and eventually leave the other direction. Seem to disproportionately go to areas where people were formerly stopped, eating (attracted to dropped food or other scents?).</p> <p>In “Caribou Bowl” (Allan Creek) he sees caribou most mornings. Snowmobilers tend to go there early in the day (on their way in). When they arrive, caribou go about 100 m into forest, then re-appear when snowmobiles leave.</p> <p>In “Superbowl” (Allan Creek) he watched caribou this winter. When snowmobiles arrived, they would have been noticed by caribou but were mostly out of sight due to terrain. The caribou continued moving through the bowl for about 30 minutes.</p> <p>Caribou don't seem to use the back half of Allan Creek (ridge about 13 km long).</p> <p>He also sees caribou in Chappell; he hasn't been there in mornings lately, but other snowmobilers report seeing them. Caribou there tend to be seen in open areas in poor weather, in timber in good weather.</p> <p>A few people report seeing tracks in Clemina Creek; he never has.</p>

<i>Confounding factors.</i>	Heliskiing in area. Has heard of several reports of caribou running away from helicopters, including one this winter in Miledge-Chappell in which the helicopter apparently circled the animals, who took off running in all directions. Back half of Allan Creek steeper terrain.
<i>Recent changes in snowmobile activity.</i>	Allan and Miledge-Chappell were used in 1970's but use increased a lot after 1983. Now 80-300 machines per day. The back half of Allan has only been accessible for two years due to snowmobile technology.
<i>Snowmobiler origins.</i>	Virtually all Albertans.
<i>Closures.</i>	Designated route or play areas in Miledge-Chappell. Good compliance. One small spot where a caribou area is in non-treed ground, and snowmobiles regularly go about 50 m into that (sign often buried in snow). Also, about three times per month, snowmobiles use the closed Lampriere Creek road for access.

33. Researcher or resource manager discussing Wells Gray Park

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Populations within park tend to be stable; those east and west declining. Feels chronic low-level disturbance more of an issue than occasional harassment.
<i>Confounding factors.</i>	Areas of decline outside of parks have many other issues. Direct mortalities seem to be from other sources. High mortality, potentially due to declining moose in face of predators that have developed a tradition of using park. Northeast part of park has CMH heli-skiing operation.
<i>Closures.</i>	<u>Trophy Mountain</u> : was used when it was a recreation area not a park; now use allowed for two weekends a year, by permit. However, there are no caribou right there, so it is not an issue. <u>Flour Mills</u> : Was also a recreation area prior to 1996. Agreement with Mica Mountain Riders for them to go there only until Jan 31(?); caribou move in after that time for rest of late winter and calving. Few problems with non-compliance there. More significant problems with trespass all along west and northeast boundaries. Some sledders moving into heli-skied area.

34. Recreational or commercial snowmobiler discussing the BARKERVILLE local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has never seen a caribou while on snowmobile; has seen only on highway.
<i>Recent changes in snowmobile activity.</i>	Has been steady growth for about 30 years. No sudden explosion in use locally, but a definite increase in past five years. This is due in part to better trail maintenance (there has been some localized

	grooming by club members for nearly 20 years but commercial operation does some of the grooming now); also better machines. For example, in the Burdett-Meridian areas (just south of Bald Mountain), early winter use has only been possible for 2 – 5 years as machines weren't capable of it before that. Yanks Peak is getting increasing numbers, but has always been heavily used.
<i>Snowmobiler origins.</i>	Most snowmobilers from Prince George, Quesnel and Williams Lake. Less than 20% out of province.
<i>Closures.</i>	Some agreements more or less in place but not finalized.

35. Researcher or resource manager discussing the North Thompson area of the WELLS GRAY SOUTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>Allan Creek</u>: Caribou here seem to pay little attention to snowmobiles; has on three occasions seen caribou come out of trees into open at cabin when snowmobiles present and active. Generally, they tend to move out of openings when snowmobiles present, but then back in as they pass (e.g. Caribou Bowl). He has personally startled a group of three caribou when traveling up the road; snowmobiles stopped, caribou went ahead on road for a long way before moving off to side.</p> <p><u>Miledge-Chappell</u>: Caribou tend not to come out into the open in daylight here (when snowmobiles present) but tracks are often present right across the top of the mountain, indicating they are coming out sometime between late afternoon and early morning. Believes there are just as many caribou, just not seen the way they are in Allan.</p> <p><u>Clemina</u>: Never sees sign of caribou.</p> <p><u>"Oasis" (between Allan and upper North Thompson)</u>: Has seen tracks in the early winter, but never later in season. Fairly heavy snowmobile use up high. Appears to be good forest types or terrain for caribou there.</p>
<i>Confounding factors.</i>	There are no major impediments to caribou movement or blocked escape routes in either Allan or Miledge. There is heli-skiing in both locations; in Allan (CMH) it is away from the main areas of caribou use; in Miledge (Mike Wiggle) it overlaps significantly (Norbert's Nose).
<i>Recent changes in snowmobile activity.</i>	The major increase has occurred in the past four years; far fewer eight years ago. Allan has about triple the number of sledders as Miledge-Chappell (Miledge has 7-8/day on weekdays and 30-100 on weekends).
<i>Snowmobiler origins.</i>	Were mainly local eight years ago, but now are ~90% non-local (mainly Albertans) in the designated snowmobile areas. Valemount snowmobile club does the trail maintenance and charges fees. Locals often go to other, non-designated areas.
<i>Closures.</i>	In Miledge, there is a Wildlife Act motor vehicle closure limiting snowmobiles to alpine and access up road or trail. Much of the play area boundary is natural (terrain or trees), but other parts are not. Major increase in compliance over past three years.
<i>General comments.</i>	In Miledge, has seen caribou tracks four times this year out of seven visits.

36. Researcher or resource manager discussing the TELKWA herd (NORTHERN CARIBOU ecotype)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Telkwa Mountains had close to 300 animals in late 1960's. Perhaps due to hunting, heli access, heli-assisted hunting, etc. associated with new mine, numbers decreased for a decade or two. Population began to rebound until 1990s, when access to area increased again, including use of ATVs and snowmobiles at north end of mountains (formerly in other locations). Population declined to as few as 8; reasons not entirely clear. Has noticed in one area with snowmobile access that collared caribou tend to move to another ridge when snowmobiles have been through areas caribou were using. In contrast, in area without snowmobiles, caribou tend to be sedentary during the same time.
<i>Snowmobiler origins.</i>	Mainly local; formerly mainly from Huston (south), now also from Smithers (north).
<i>Closures.</i>	Many efforts in the past to restrict access or establish a park; not successful. Now some voluntary closures and code of behavior in place.

37. Researcher or resource manager discussing the BARKERVILLE and WELLS GRAY NORTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Cameron Ridge: Routinely had 18-20 caribou (some collared) until snowmobiles started to come into area from Maeford Lake; then use declined. Similar situation on Mica Mountain. Thinks that research data from 1980s showed Raft Mountain was an important area for caribou in 1970's; now has no or almost no use by caribou and very high levels of snowmobile use.
<i>Recent changes in snowmobile activity.</i>	Cameron Ridge went from no snowmobile use to quite heavy use when snowmobilers began using a recent access road.
<i>Available data.</i>	Provided locations for two collared caribou (part of group of 18) that were apparently displaced from Cameron Ridge by arrival of snowmobiles.

38. Researcher or resource manager discussing the NORTH CARIBOO MOUNTAINS, NARROW LAKE and HART RANGES local populations and also the NORTHERN CARIBOU ecotype

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>Lucille Mountain</u>: Caribou pretty much stopped using it at the same time that heavy snowmobile use began (were a few left in 1978, but heavy snowmobile use was underway then, and they declined thereafter).</p> <p><u>Mount Renolds-Renolds Creek (northern ecotype)</u>: In two successive winters 3 and 4 years ago, he flew twice per winter over an area heavily used by snowmobilers (who had leased a cabin from a guide-outfitter). Despite normally being there throughout the winter, and being present both years in early winter, the caribou in those two winters were not using the area by late winter.</p> <ul style="list-style-type: none"> - Use of snowmobile trails by wolves only an issue for low-elevation sites. - Little snowmobile activity in Narrow Lake area
<i>Recent changes in snowmobile activity.</i>	<p>McBride area use began to increase markedly in about 1981 or 1982. Most of the really heavy snowmobile use is on the northeast side of the Trench (Hart Ranges local population). There are several applications for additional backcountry snowmobile cabins.</p>
<i>Available data.</i>	<p>Potentially some baseline info in thesis by Michael Bloomfield.</p>

39. Researcher or resource manager discussing the south end of REVELSTOKE, west end of MONASHEE and part of WELLS GRAY SOUTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p>Given the normal reticence of caribou to move in late winter, the potential impact of snowmobiles is high. Does know of at least one case where wolves successfully hunted caribou in late winter at high elevations in the north end of Wells Gray Park, so they are able to hunt caribou in late winter and feels the issue of providing them access to high elevations is a real one.</p> <p><u>Queest, North Queest, Pukeashun, Hunters Range</u>: Low level of use potentially due to snowmobile activity (but no strong evidence)</p> <ul style="list-style-type: none"> - No tracks in Pukeashun since 1988 <p><u>Allan Creek</u>: It seems that caribou are being pushed away, but there are few caribou there anyway so this is not clear</p> <p><u>Miledge</u>: 200-300 trucks in the parking lot per weekend</p>
<i>Confounding factors.</i>	<p>Hunters Range: had caribou; now lots of snowmobiles but no caribou; however, heavily harvested 20-30 years ago.</p>
<i>Available data.</i>	<p>Has compiled sightings info dating back several decades, but much of this is still hand-drawn on maps; MOF staff member has interviewed people locally for old sightings and has compiled it. Survey data from 1988 (good); 95 (incidental), 98, (good), 99 (partial). Doing one in 2002. Has Wells Gray Park data but only a few years back. Parks has old Wells Gray data, but they did summer counts then.</p>

40. Researcher or resource manager discussing Alberta East Slopes (NORTHERN CARIBOU ecotype)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Has been some work on wolf access to snowmobile tracks but not a lot of solid results. Overall, issues of disturbance and wolf access are considered smaller than those related to industrial effects. Wolf access a bigger concern in Jasper National Park, due to track setting on Maligne Lake Road.

41. Researcher or resource manager discussing part of the WELLS GRAY SOUTH local population (Clearwater Forest District)

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Concern over activities in Chappell Creek (both helicopter and snowmobile activity there) because this is an important caribou area. Less of a concern in Allan and Clemina creeks, because of minimal use by caribou. In Chappell Creek, there have been snowmobile tracks on top of caribou tracks, but it is not clear that they were there at the same time.
<i>Snowmobiler origins.</i>	Some local; majority Albertans.
<i>Closures.</i>	Section 105 closure in Chappell. Regulations are that they must stay on trail en route to alpine, and must back off if caribou are seen.

42. Researcher or resource manager discussing the SOUTH SELKIRKS local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<ul style="list-style-type: none"> - In one case in the early 1990's on the BC side, a caribou was apparently run by a snowmobile (i.e. the tracks indicated the animal had been running a great distance and had been herded). - Another case on Two Mouth Lakes (Idaho) in which it appeared that a group of four caribou which had been using the basin all winter had been bedded on a lake, then were startled by snowmobiles arriving (i.e. fresh snowmobile tracks over caribou bed area); not clear whether snowmobiles actually pursued the caribou, but animals left the area and did not return that winter. - The area at the head of Shaw Creek (Wood Peak area, BC) has been used as the main late winter area for last 5 or 6 years. Caribou were using both the upper and lower lakes. Then, logging extended farther up the creek 2 or 3 years ago and snowmobiles began accessing the lower lake. Caribou are now using only the upper lake and also some steep terrain northeast of the upper lake, which is poorer habitat. - One case in Pack River (tributary of Pend D'Oreille Lake) in which there was some significant snowmobile tracks amongst a group of caribou that were remaining in the area; however not clear whether caribou arrived before or after the group of snowmobiles.
<i>Recent changes in snowmobile activity.</i>	Has been a continuous increase. The pace of increase picked up about 4-5 years ago.

<i>Closures.</i>	In addition to wilderness areas, there is ~50 km ² closed in the upper Pack River. There has been good compliance. However, there are currently no caribou there, and the closure is likely to be challenged in court.
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43. Researcher or resource manager discussing the GEORGE MOUNTAIN, HART RANGES and NORTH CARIBOO MOUNTAINS local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	George Mountain: Caribou disappearing or disappeared but no clear evidence of why. McBride area: Lots of snowmobiles and lots of areas that formerly had more caribou; linkage between these two facts unclear. Haggen-Dome-Sugarbowl-Goat area: Core of caribou range; low but increasing levels of snowmobile activity and still lots of caribou. Sugarbowl is closed to snowmobiles (park? MOF closure?); when this is violated, caribou go to the other side of the mountain (based on radiotelemetry work). Bearpaw-Torpy River (three ridges): No access on south ridge; second ridge has lots of snowmobile access and few caribou; third ridge has less snowmobile use and more caribou. Captain-Otter area: Now roaded and moderate levels of snowmobiling; don't know about effect on caribou. Herrick-McGregor: Snowmobiling starting here; MOF permitted a trail; again, effect not known.
<i>Confounding factors.</i>	George Mountain: fragmented, isolated, heavily logged, lots of skiing. Renshaw (Hart Ranges): very few caribou, and has been that way since 1970's (perhaps were originally Alberta caribou that crossed over, and since Alberta caribou numbers now much lower there are none to move into the area). Bell and Lucille mountains: similar situation; few caribou even before snowmobiling increased.
<i>Snowmobiler origins.</i>	In McBride area, most snowmobilers are from Alberta; elsewhere they are mainly local.
<i>Closures.</i>	Sugarbowl; violations relatively rare (but no enforcement). Some other new protected areas.
<i>Available data.</i>	Inventory is limited and spread over a large area.

44. Researcher or resource manager discussing the TRANSITIONAL area between HART RANGES local population and NORTHERN CARIBOU ecotype

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	In a March 1996 survey in the portion of the Rockies near Mackenzie where the caribou were using the subalpine forest, respondent found either snowmobile tracks or caribou in any given basin, but not both. This might have been because the snowmobiles were displacing the caribou.
<i>Available data.</i>	Will mail report from that survey.

45. Researcher or resource manager discussing the SOUTH SELKIRKS and CENTRAL SELKIRKS local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	<p><u>South Selkirks:</u> Terrain (narrow, steep-sided ridges) somewhat limiting to use, so issue hasn't been particularly big (although the access via Highway 3 contributes to it being used more than would be expected based on the terrain). Caribou MAY be somewhat habituated to snowmobile use here, if predictable, due to them being used to Highway 3 road traffic. There is some use of Char and Maryland creeks (south side of Highway 3, east of Kootenay Pass) and area south of Stagleap Park. Char is mostly big clearcuts. Maryland has potential to lead into more important caribou areas in Boundary and Monk creeks, but not sure of extent of conflict. North of Stagleap, Darkwoods property is closed to snowmobiles and has poor terrain, and the area just south of the West Arm of Kootenay Lake has very poor access or is in West Arm Park. In any event, West Arm area has very little use by caribou in winter. There was one unusual movement of a group of caribou to Kootenay Mountain (east edge of Selkirks) but unknown if related to disturbance.</p> <p><u>Central Selkirks:</u> Hamling Lakes has high potential for conflict due to good caribou habitat and good snowmobile terrain, although access is fairly difficult most of the time. There is less use (terrain) north of Hamling. Silvercup Ridge is very good terrain once snowmobiles reach the top. Unsure of level of snowmobile use and its effect on Silvercup, although it is suspected that caribou activity has declined. If there is any straightforward coexistence, it is not obvious.</p>
<i>Confounding factors.</i>	<ul style="list-style-type: none"> - Regular influx of transplants has confounding effect on movement. - High levels of ski touring at Stagleap Park. - A cat-ski operator on Great Northern Mountain (just northwest of Silvercup) has reported that there have been no caribou around in late winter. The operator there keeps most snowmobiles out. Has heard that the caribou move across the valley when the cat-skiing starts.
<i>Recent changes in snowmobile activity.</i>	Steady growth; people coming from farther away. Pace of growth fairly slow except maybe at Silvercup. NOTE: Fish and Wildlife Compensation Program staff member notes that there are increasing numbers of Americans snowmobiling in the Kootenay Pass area.
<i>Snowmobiler origins.</i>	In the South Selkirks, significant numbers of people from Idaho, in addition to locals. Hamling is mostly local. Silvercup is being promoted as a destination snowmobile area.
<i>Closures.</i>	One heli-ski closure area on Silvercup Ridge.
<i>Available data.</i>	Survey data.

46. Researcher or resource manager discussing the BARKERVILLE and WELLS GRAY NORTH local populations

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Big Timothy Mountain: last caribou there about 1968 (N.B.: possibly before heavy snowmobile use). Yanks Peak, Groundhog Lake (Bald Mountain), Cameron Ridge: Have lost or mainly lost caribou use. Mica Mountain (northeast of Deception): Caribou have moved from there to more rugged areas at Boss Mountain, concurrent with increasing snowmobile use. No areas where caribou making normal use of areas with significant snowmobile use. On the fringes of some snowmobile areas (Yanks Peak, Cameron Ridge, Mica Mountain), they sometimes see bachelor groups.
<i>Confounding factors.</i>	Some predation, some valley-bottom habitat loss, but there is a lot of high-elevation habitat in very good condition. Big Timothy is isolated. Lots of summer placer activity on Yanks Peak. Molybdenum mine on Big Timothy.
<i>Recent changes in snowmobile activity.</i>	Some areas were used by snowmobiles long ago (Big Timothy and Yanks were used at least as far back as 1969/70). Some increases have been due to road access, such as Cameron Ridge, Mica Mountain, Bill Miner Creek. In the last five years, machine improvements have increased areas available for use.
<i>Snowmobiler origins.</i>	Mostly snowmobilers are from within the region (100 Mile House to Prince George), except near Wells-Barkerville. Many locals bring friends from outside of region. Mica users almost all local; Cameron and Yanks users from Williams Lake, Prince George, Quesnel; users south of Quesnel Lake from Williams Lake, 100 Mile House
<i>Closures.</i>	Eureka Mountain (above Crooked Lake); everything over 1500 m elevation closed.
<i>Available data.</i>	MSRM may be letting a contract to GPS snowmobiling areas.

47. Recreational or commercial snowmobiler discussing part of the WELLS GRAY SOUTH local population

TOPIC	COMMENTS
<i>Evidence or areas of displacement or of co-existence.</i>	Seldom sees caribou tracks (has a few times in Finn Creek but there is little snowmobiling there). In most places, snowmobiling is in alpine, where there are no caribou; snowmobiles can't really get into the timbered areas. Raft Mountain used a lot by snowmobilers but has no caribou. He also accesses Harp Mountain, Foghorn Mountain. Granite Mountain with a special use permit. Minimal disturbance to caribou if you stop machine but don't get off.