

## **STEWARDSHIP PRACTICES FOR OUTDOOR RECREATION**

*An initiative to foster stewardship of the environment by providing information to recreation and tourism audiences.*

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# **Snowmobiling and Mountain Caribou: A Literature Review of Stewardship Practices**



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Prepared for:  
Eileen Fletcher  
Tourism Action Society for the Kootenays  
Revelstoke, BC

Prepared by:  
Selina Mitchell  
&  
Dennis Hamilton, RPBio.  
Nanuq Consulting Ltd.  
Nelson, BC

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## INTRODUCTION

### **Background**

Mountain caribou are an ecotype of woodland caribou (*Rangifer tarandus caribou*) that are found almost exclusively within southeastern British Columbia (MCTAC 2002). Mountain caribou are distinguished from other woodland caribou by the manner in which they use their habitat. Unlike other woodland caribou, when the snowpack deepens this ecotype migrates upslope to feed on arboreal lichens that grow on trees in the sub-alpine (Morris 2004).

Mountain caribou are recognized as *threatened* by the Committee on the Status of Endangered Wildlife (COSEWIC). Herds of caribou within the southern portion of their range have declined by upwards of 50% in the last 10 years (MCST 2005). Many factors may be responsible for this decline in caribou populations. The four primary threats to mountain caribou populations include habitat loss and fragmentation, changes to their relationship with predators, climatic change, and increased disturbance by human activities (MCTAC 2002, Morris 2004, MCST 2005). Mountain caribou recovery planning is currently underway provincially under the direction of the Species at Risk Coordination Office (SARCO), Integrated Land Management Bureau of the Ministry of Agriculture and Lands.

Of all of the factors contributing to the decline of mountain caribou, human disturbance may be the easiest to address (MCST 2005). One way human disturbance can be mitigated is through managing backcountry recreation. In comparison to other types of backcountry recreation, snowmobiling poses one of the greatest threats to caribou since favourable snowmobiling terrain often coincides with high value late-winter mountain caribou habitat (Simpson and Terry 2000, Paquet 1997).

Nature based recreation and tourism is rapidly growing in rural British Columbia. Growth rates of up to 15% per year are projected to continue into the future. At least one hundred different entities distribute information about fifty outdoor recreation activities on land and water. Not surprisingly outdoor enthusiasts find that stewardship information is scattered and inconsistent. Smaller businesses and recreation organizations regularly report that information is difficult to find and understand (TASK Steering Committee 2007).

The Tourism Action Society for the Kootenays (TASK) is a group initiative to foster stewardship of the environment by providing information to recreation and tourism audiences. The goals are to:

1. develop consistent and comprehensive information to foster stewardship of the environment within the nature based recreation and tourism sector in British Columbia
2. deliver useful information to target audiences in the outdoor recreation community through an expanding province-wide network of agencies, organizations and advisors

As part of this initiative, a number of Activity-Habitat Pairs have been identified whereby stewardship practices for conducting recreation activities in sensitive ecosystems will be addressed. Snowmobiling in caribou habitat is one such Activity-Habitat Pair.

### **Objective**

The objective of this project was to compile a compendium of stewardship practices for the Caribou/Snowmobiling Activity-Habitat Pair as outlined in the “Information for Outdoor Recreation and Tourism Proposed Signatory Document” (Fletcher and Geisler 2006).

This document is intended to support the Stewardship Practices for Outdoor Recreation partnership initiative to improve dissemination of information pertaining to backcountry recreation stewardship throughout recreational organizations and small businesses in British Columbia.

## **METHODS**

A comprehensive literature search was completed where journals, government documents, minutes from multi-stakeholder conferences, research papers, unpublished manuscripts, and websites or publications from various interest groups were reviewed. Various caribou research biologists, government biologists and managers were contacted via e-mail and telephone to discuss stewardship practices for snowmobiles within mountain caribou habitat. Information presented was obtained from various jurisdictions including BC, other Canadian provinces and territories, Idaho, Yellowstone National Park, and northern Europe.

The literature review, interview results, and professional experience collectively contributed to produce a set of suggested stewardship practices for snowmobiling in caribou habitat. The issue of whether these are acceptable alternatives to existing practices, was not the focus of this report. The report is written on the assumption these practices will continue. Notwithstanding, we also provide an interpretative summary of literature reviewed and comments from researchers, resource managers and user representatives that we felt would be of interest to resource planners, decision-makers and recreational enthusiasts.

## **RESULTS AND DISCUSSION**

This section summarizes some of the most pertinent contributions of the literature review and interview results. An annotated bibliography of over 50 relevant documents is provided in Appendix 1. A list of people interviewed can be found in Appendix 2.

### ***Literature Review and Interview Results***

Not surprisingly, there are differences of opinion over the degree of threat that snowmobiling poses to caribou populations. Some research suggests that snowmobiling has caused declines in caribou use of suitable habitat and is a contributing factor to the decline of caribou throughout BC (Simpson 1987; CCLUP 2000; Kinley 2003; Seip et al 2007). Other literature suggests that the effects of snowmobiles on caribou are unknown or that they pose little threat to population numbers (Lewis and McLellan 2006; QHMS 2003). Such varying views appear to strain the relationship between managers of caribou habitat and snowmobilers (Simpson 2003). Regardless, it is an offense to harass a red-listed species under federal and provincial legislation.

Measurements of caribou displacement in response to snowmobiles have been confined to controlled experiments in which a snowmobile or other moving vehicle approaches caribou and displacement is measured immediately (Simpson 1987; Powell 2004; Horejsi 1981; Mahoney et al 2001). The direct physiological effects (e.g., changes in heart rate, increases in stress hormone

levels, myopathy) caused by interactions between caribou and snowmobiles does not appear to have been quantified (Kinley 2003; Welsh 2002).

Within BC, few studies have quantified displacement of caribou over the short history of snowmobiling within mountain caribou habitat. Seip et al (2007) suggest that intensive snowmobile use caused caribou displacement from traditional late winter habitat in the Hart Mountains east of Prince George. Kinley (2003) observed declines in proportions of censused caribou over time within snowmobile areas in the Purcell Mountains in southeastern BC. Displacement of caribou as a direct result of snowmobiling may be difficult to quantify because in some areas caribou appear to have already been displaced (e.g., Boulder Mtn and Big Timothy Mtn.); whereas in other areas caribou appear to co-exist with snowmobiles (e.g., Frisby Ridge and Allen Ridges; CCLUP 2000), although Lewis and McLellan (2006) suggest this may be due to habituation to snowmobile activity. There further appears to be insufficient evidence to conclude that caribou populations that experience snowmobile activity are declining more rapidly than populations that are not experiencing snowmobile activity.

Habituation is the cessation of response to repeated presentations of stimuli. Animals become habituated when repeated stimuli are perceived as non-threatening (White et al. 2006). When dealing with the responses of caribou to snowmobiles, it is important to note that caribou appearing unaffected and thus habituated to snowmobile presence may be responding physiologically to snowmobiles despite the lack of observed displacement. (T. Kinley *pers comm.*). Although the physiological responses of caribou to snowmachines has not yet been quantified, research suggests that caribou become habituated to snowmobiles in regions where steep and varied topography exists, as these habitat types provide refuge and allow caribou to avoid direct interactions with snowmobiles (Lewis and McLellan 2006). In addition to providing areas where snowmobiles cannot access caribou directly, steep topography can also constrict caribou movements so that they are forced, in some circumstances, to come in close contact with snowmobiles. Habituation is less likely within rolling topography where caribou can migrate easily (Lewis and McLellan 2006)

A slow growth in snowmobiling activity and spatial and temporal predictability in snowmobiling activities (often brought about by government restrictions on snowmobiling activity), also appear to be necessary pre-conditions for habituation (Welsh 2002; IFS 2004; Kinley 2003; Lewis and McLellan 2006). Snowmobile activity within the backcountry has recently increased, in part due to greater road access, improved engineering and design of snowmachines and the overall growth in the number of snowmobilers. Webster (1997) recommends that caribou should not become habituated to human activities (Webster 1997), while other literature recommends gradual habituation of these animals to snowmobiles (Simpson 1987; Lewis and McLellan 2006). This may minimize what appears to be one of the larger threats to these animals around snowmobile areas: displacement of these animals into less productive or avalanche-prone terrain (Simpson 1987; Webster 1997; Simpson and Terry 2000; Morris 2004). Additionally, displacement may concentrate caribou populations so that they become an easier target for predators (Simpson 1987; CCLUP 2000). A certain level of predictable snowmobile activity is required to facilitate habituation, but too much snowmobile activity could eventually cause displacement of caribou (Kinley 2003).

Regardless of the divergence of opinion, managing snowmobiling activities to minimize the amount of disturbance and displacement it may cause to caribou populations remains of

paramount importance in support of recovery efforts for the endangered mountain caribou populations in BC.

### ***Suggested Stewardship Practices for Snowmobiling in Caribou Habitat***

Two basic premises accompany the stewardship practices presented in this document:

1. snowmobiling activity in caribou habitat is assumed, excluding those areas where closures are already established; and
2. it is the responsibility of the individual (or group) to be informed and become knowledgeable in the practices required to operate a snowmobile(s) in caribou habitat.

## **Summary of Potential Stewardship Practices for Snowmobiling in Caribou Habitat**

### **SNOWMOBILER RESPONSIBILITIES**

**1. Become well-informed about the area you plan to snowmobile in.**

Any individual who is snowmobiling in BC should contact the local snowmobile club in the area of planned activities to determine where wintering mountain caribou may reside and become familiar with all restrictions and regulations pertaining to mountain caribou conservation in these areas. Local club representatives are knowledgeable about the regulations and the management plans that have been implemented to protect caribou in their area. Some examples of this basic knowledge include

- caribou ecology (winter seasonal use patterns and distribution);
- local or population level caribou/snowmobile access plans and snowmobiling restrictions;
- basic stewardship practices required to mitigate conflicts between caribou and snowmobiles; and,
- implications and potential conflicts created when snowmobiling in caribou habitat (i.e., how the actions of the few reflect on the many).

Under snowmobile management agreements, both provincial and local snowmobile clubs have assumed various levels of responsibility to educate both their members and non-affiliated snowmobilers about snowmobiling in areas occupied by caribou. Potential contact sources are listed in the table below. A recently issued government brochure entitled “Snowmobiling and Caribou in British Columbia” and the document “Snowmobiling in the Columbia and Rocky Mountains of British Columbia” have been widely distributed throughout BC and outline proper etiquette when snowmobiling in caribou habitat. These documents can be accessed by visiting websites listed below.

Source	Contact
Provincial Snowmobile Club	<p><b>BC Snowmobile Federation.</b>                      Phone: Toll Free 1-877-537-8716 or 1-250-860-8020                      website: <a href="http://www.bcsf.org">www.bcsf.org</a>                      e-mail: <a href="mailto:office@bcsf.org">office@bcsf.org</a></p> <p><b>The Association of British Columbia Snowmobile Clubs</b>                      Phone: 1-250-593-4770                      website: <a href="http://abcsnow.ca">abcsnow.ca</a>                      email: <a href="mailto:info@abcsnow.ca">info@abcsnow.ca</a></p>
Regional/District Snowmobile Club	Contact information for local snowmobile clubs can be attained from the provincial organizations listed above
Government <sup>1</sup>	Ministry of Environment – district and regional offices Ministry of Forests – district offices Species at Risk Coordination Office – Victoria, BC
Internet	Many websites available – local clubs, tourism, businesses

**2. Be vigilant for posted regulations and restrictions.**

Be aware of closures and regulations within your snowmobiling area. Not only are there potential adverse implications to the endangered mountain caribou, there are also personal legal ramifications and penalties and implications to the snowmobile community-at-large for the actions of individuals. The misguided adventures of one or more individuals can reflect and have negative consequences on the majority of responsible snowmobilers and the snowmobiling community. To access information on snowmobile closures areas, consult the BC Hunting and Trapping Synopsis, available at local government offices and on the web: <http://www.env.gov.bc.ca/fw/wildlife/hunting/regulations/>

**3. While snowmobiling follow best stewardship practices to reduce your impact on caribou:**

- If caribou tracks are observed do not follow the tracks.
- If you see caribou, do not approach.
  - Approaching caribou, either by snowmobile or foot, may disturb caribou or cause them to retreat into areas of lesser quality habitat, where greater energy may need to be expended to meet daily requirements for survival.
- Make every effort to minimize disturbance.
  - If caribou are close, turn off your snowmobile and allow the animals to calmly move away.
  - The effects of snowmobiles on caribou are reduced by maintaining a sufficient distance from the animals. Caribou may cease to withdraw if a snowmobile approach is halted. A separation of at least 500 m from caribou is recommended.
- Take precautions to stay away from caribou when encountered.

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<sup>1</sup> Toll-free provincial government number: 1-800-663-7867

- If by random chance you encounter caribou, leave the area. After encountering mountain caribou and taking the precautionary steps to reduce their response to your presence (see above), it is recommended that snowmobilers leave the area. Apparently, “strong and lasting” effects on caribou may not be noted when snowmobiles are no longer present within high-use snowmobile areas (Powell 2004).
- Do not make caribou run from your snowmobile. Horejski (1981) suggests that snowmobile speed is a factor in caribou disturbance (limiting speed may limit the “looming” effect that caribou supposedly experience in the presence of an approaching snowmobile). It is suggested that one of the best ways to minimize disturbance is to prevent the caribou from running in response to the snowmobile (Powell 2004). Along with energy expenditures, the amount of time that it takes caribou to recover from disturbance and return to pre-disturbance activities increases when caribou run.

**4. Diminish your impact on caribou by adjusting/refitting your snowmobile.**

Noise may be a factor in caribou disturbance. Although noise may not be the primary cause of disturbance (human scent appears to have a much greater effect on caribou), various technologies exist that can minimize snowmobile noise. Therefore, this type of disturbance can be mitigated. Try and diminish the amount of noise that your snowmobile produces:

- Use 4-stroke engines
- Use mufflers designed to decrease the amount of noise produced by your machine
- Ensure that equipment is properly maintained

**5. Report any infractions of snowmobile regulations.**

*Observe, Record and Report* - One of the easiest ways to do this is through the Report All Poachers and Polluters (RAPP) program. This BC Government program offers a 24 hour hotline for contacting Conservation Officers. Phone: 1-877-952-7277. Cellular Dial #7277.

**PROACTIVE GUIDANCE BY SNOWMOBILE CLUBS**

**6. Teach snowmobilers about caribou and best stewardship practices for your areas.**

Under numerous snowmobile management agreements, snowmobile clubs have the responsibility to educate both their members and non-affiliated snowmobilers regarding caribou.

**7. Gather information on caribou in your region and participate in caribou management planning.**

- Contact the Species at Risk Coordination Office (SARCO)
- Contact caribou experts and regional/local government officials
- Invite caribou experts to engage in club meetings and activities
- Participate in strategic planning activities around managing snowmobile areas
- Critique and develop caribou management plans within collaborative meetings involving various stakeholders

#### **8. Disseminate information to as many snowmobilers as possible.**

Some preliminary studies suggest that individuals riding in managed snowmobile areas within BC may not understand the rules and regulations governing these riding areas. In some regions of BC, the majority of snowmobilers are out-of-province riders. BC clubs must educate these riders if management areas are to be successful.

- Network with out-of-province clubs
- Place information signs regarding snowmobile zones at the beginning of access roads and throughout snowmobile areas
- Place brochures regarding mountain caribou with snowmobile clubs and at various locations throughout communities, including tourist information centres, snowmobile shops, restaurants, and accommodations
- Increase public media announcements regarding caribou habitat and snowmobile best practices

### **SUMMARY and COMMENTS**

The following is a summary of supporting information that was compiled during the literature review and interviews. It is provided as additional supporting information. The opinions expressed are those of the authors.

#### ***Stewardship Practices, Management and Decision-making***

Overall, the objectives of these stewardship plans are to prevent the already restricted caribou range from becoming even more constrained due to displacement from areas of their habitat. Additionally, these practices strive to prevent any future population-level declines as a result of stresses invoked by snowmobile activities.

Few cases appear to demonstrate that snowmobiling activities directly resulted in caribou mortality and managers will probably never be able to establish a direct link between snowmobile activities and caribou mortality, due to a variety of confounding factors (Kinley 2003; Apps and McLellan 2006). Consequences of snowmobile activity in mountain caribou habitat have included “habitat abandonment, an increase in home range size, and an increase in activity when caribou are normally inactive” (CCLUP 2000). At its worst, snowmobiling is considered an additive factor in the decline of mountain caribou populations.

Within the constraints of existing science, managers are often asked, or choose, to employ the precautionary principle when dealing with caribou habitat (Simpson and Terry 2000; Lewis and McLellan 2006; Gros Morne 2006). According to the precautionary principle, where threats of irreversible environmental degradation exist, lack of scientific certainty should not be used as a reason to postpone measures that would prevent this environmental degradation. Of all the factors that are potentially responsible for disturbing caribou, snowmobiling activities are the easiest to address (MCST 2005). In the face of rapid decline, it is necessary to address this issue.

The best stewardship practice available to managers is to eliminate conflicts between mountain caribou and snowmobiles entirely and remove snowmobiling from mountain caribou habitat (Lewis and McLellan 2006). This can be achieved through voluntary or legal closures (Seip et al. 2000). If snowmobiling must occur within mountain caribou habitat, it appears that designing detailed management plans, limiting snowmobile numbers, and clearly outlining designated snowmobile closure areas may be the most efficient way to manage snowmobile disturbance and facilitate habituation (e.g., Frisby Ridge; Simpson 1987).

On a proactive basis, voluntary closures under regional management plans such as the Cranbrook West Recreation Management plan, the Quesnel Highlands Management Plan, the Valemont SRMP, to name a few, have been successfully implemented. There have also been Section 58 closures to protect Mountain Caribou habitat.

Promoting and developing areas outside of caribou habitat may also help to eliminate some of the snowmobiling occurring within mountain caribou habitat (Seip et al. 2000; Gros Morne 2006). Activities such as developing and grooming trails outside of sensitive areas may help to direct activities elsewhere (Gros Morne 2006). Neglecting to promote and maintain snowmobile areas within mountain caribou habitat may also help to direct snowmobiles elsewhere (Powell 2004). Not ploughing snow on long access roads to snowmobile areas has been known to discourage use (T. Kinley *pers comm.*). Cutting off access routes to sensitive areas may prevent snowmobiling within them (Simpson 1987; IFS 2004; RAG 2003). Access to these areas can be terminated by activities such as deactivating and revegetating, or recontouring forest service roads (IFS 2004; RAG 2003).

One key component in snowmobile management planning in caribou habitat appears to be restricting snowmobile activities geographically and by activity (e.g., trail riding vs. high-marking), since it is the widespread nature of snowmobiling that threatens to disperse mountain caribou and the capacity of widespread stimuli to overwhelm the animals (Simpson 1987; Hooge et al. 2001; Welsh 2002; Powell 2004). This approach has been taken within the Kootenay Lake Forest District portion of the South Selkirk and South Purcell caribou herd areas, through the creation of "Corridor Access Routes" and "Designated Recreational Snowmobiling Areas".

At the landscape level, a few small intensively used areas may have less impact than several large areas receiving moderate use (CCLUP 2000). Snowmobile areas should occur in areas where the potential for caribou tolerance of snowmobiles is higher and within relatively steep enclosed terrain (Lewis and McLellan 2006). When designating snowmobile areas, managers should avoid good late-winter caribou habitat such as sub-alpine environments that contain trees supporting arboreal lichen (Morris 2004). Snowmobiling areas should have well-defined and well-marked boundaries in order to foster compliance with closures (Roorda 2006). Ideally snowmobile areas should be easily accessed from several communities within a given region (CCLUP 2000). Plateau regions that have not seen large numbers of snowmobilers should be closed to snowmobiling until caribou numbers increase, since caribou are often unable to find refuge from snowmobilers in these regions (Lewis and McLellan 2006). Viewing stations, maintained trail networks and signage may be necessary to implement established trail use and non-disruptive wildlife viewing and compel snowmobilers to stay within the snowmobile area (Powell 2004).

Historical snowmobile areas in mountain caribou habitat should be maintained and promoted in lieu of developing new ones (Powell 2004; CCLUP 2000). Clearcuts compose a significant proportion of historical snowmobile area in much of the province, creating pressure to develop new snowmobile areas as these habitat types are eventually lost due to regeneration (T. Watt *pers comm.*). Where snowmobiling in mountain caribou habitat has not yet reached a level where it is dispersing caribou populations, it should, according to the precautionary principle, be constrained as much as possible through restrictions and closures (Simpson 1987). However if these restrictions are going to be implemented in a voluntary manner then implementation will be dependent to the extent that snowmobile clubs are in agreement and are willing to enforce and promote such restrictions.

Many experts appear to recommend a zoning approach to creating snowmobile areas (ILMB 2004). Land-use zoning can occur “by location, by elevation, by activity, or by date” (Brade 2003). Access corridors and other “refinements” may allow restrictions on area, season, or altitude of snowmobile activities to be adjusted according to their geography. The zoning approach may be implemented using the Wildlife Act (Brade 2003). It is recommended that adaptive management principles are applied to zoning so that management plans may be adapted over time to meet future needs as caribou dispersal and snowmobile activity changes (CCLUP 2000).

Snowmobile closure zones are for more sensitive caribou habitat and management zones for less sensitive habitat. In the snowmobile management zones, snowmobiling is actively supported and fostered through promotion and the development of infrastructure. In the closure zones, snowmobile activity is either banned or restricted to a well-defined travel corridor designed to transport snowmobilers away from the area and into less sensitive areas or management zones (ILMB 2004). Snowmobile management zones should be placed outside of “no harvest” and “modified harvest” areas which are designed to limit the impacts of forestry upon caribou food supplies (MWALP 2002).

Within these snowmobile zones, advocated by the Valemont to Blue River Winter Recreation Sustainable Resource Plan, snowmobilers are charged fees to support services like cabin and trail maintenance and snowmobile patrol (ILMB 2004). Snowmobiling is managed within these zones according to partnerships between local organizations and the Provincial government. Overall, community based development is proposed by this plan, whereby community groups would be responsible for snowmobile snow patrols and for raising funds for future developments. Community groups would also be involved in promoting communication between government and interest groups (ILMB 2004).

Voluntary closures have been instigated throughout BC in partnership with snowmobile clubs, and compliance with closure zones appears to vary throughout BC, with compliance being excellent in some regions and lacking in others (Simpson 1987; L. DeGroot, C. Legebokow and G. Price *pers comm.*). In some cases these clubs appear to have been successful at self-policing and enforcing regulations. In cases such as snowmobile “caution zones” or ambiguous snowmobile access routes through closure zones, some snowmobile clubs and non-affiliated snowmobilers may not be taking a precautionary approach to snowmobiling. This has led to

unnecessary interactions with prime caribou habitat and caribou themselves (C. Legebokow and G. Price *pers comm.*).

A precautionary approach to snowmobiling may develop in response to an increased land ethic within snowmobile clubs. The association of British Columbia Snowmobile Clubs (ABCSC) has recently developed an “Adopt-a-Herd” program, which focuses directly on Mountain Caribou/snowmobile interaction and involves cooperative information sharing between the ABCSC and the MoE (T. Watt *pers comm.*). Various regional snowmobile clubs also appear to be developing a land ethic (SRWCS 2007). Development of this ethic could be fostered if caribou experts continue to engage these groups and public media and discuss issues surrounding caribou. Additionally, government should actively promote responsible club policy, self-policing, off-trail restrictions and codes of conduct (RAG 2003).

Increased snowmobile numbers may lead to increased disturbance of wildlife (White et al. 2006). At least two national parks are in the process of limiting disturbance by capping the number of individuals that are allowed to snowmobile within the park (White et al. 2006; Gros Morne 2006). Since habituation of caribou appears to be reliant upon slow growth in snowmobilers’ numbers, caps on snowmobiler numbers could be used to foster slow growth in the industry.

Snowmobile permits appear to be one method for limiting snowmobile activities within parks. In Gros Morne National Park, free mandatory snowmobile permits are advocated as a method to limit snowmobiler numbers and restrict the snowmobile season, while providing snowmobilers with useful information regarding closures and ideal behaviour (Gros Morne 2006). In the Valemont to Blue River Winter Recreation Sustainable Resource Plan, paid permits are recommended as a means to help facilitate regulation and maintenance of snowmobile activities within this region (ILMB 2004). Public consultation within Idaho revealed that some members of the public were in favour of a permit lottery system (IFS 2004). These lotteries could be geared towards local communities and individuals since these people may be responsible for the management of these snowmobile regions.

Many different perceptions exist on the extent to which caribou react to snowmobiles. In some cases these different perceptions stem from individuals having limited access to extensive knowledge on which to base their perceptions (Kinley 2003). Therefore, building a uniform and objective knowledge base within various caribou habitat user groups may be beneficial to ensuring that misguided perceptions are filtered.

### ***Information Sharing***

The following is a summary of suggested methods for disseminating information regarding mountain caribou and snowmobile closures.

- Fostering communication between snowmobile clubs, caribou experts and government officials (Simpson 2003).
- Placing caribou experts in greater contact with snowmobile clubs. For example, engage in snowmobile club meetings, activities, or participate on snowmobile groomer committees (Simpson 2003; IFS 2004).

- Placing information signs at the beginning of access roads and throughout snowmobile areas - in cooperation with Ministry of Transportation - Sites and Trails Branch (Roorda 2006; F. Thiessen *pers comm.*)
- Critiquing and developing caribou management plans within collaborative meetings involving various stakeholders (RAG 2003; Simpson 2003).
- Placing brochures regarding mountain caribou with snowmobile clubs and at various locations throughout communities in which snowmobilers are found, such as tourist information centres, snowmobile shops, restaurants, and accommodations (ILMB 2004).
- Increasing public media announcements regarding caribou habitat and snowmobile best-practices (IFS 2004).

### ***Snowmobiling Clubs and Organizations***

Some snowmobile clubs appear to be experiencing alienation from government regulation processes (Simpson 2003). They feel that their concerns are not being adequately addressed by government due to the “redneck” stereotype that they have acquired. Governmental interactions with these groups, such as undertaking snowmobile activities with them, and incorporating them into multi-stakeholder meetings, appears to facilitate feelings of inclusion within management processes (Simpson 2003). Overall, greater interaction was shown to facilitate greater cooperation between interest groups and government (Simpson 2003). Having government biologists working with recreational and commercial snowmobiling clubs to voluntarily improve activities within the backcountry requires a large degree of flexibility but provides better representation of different interests (MWALP 2002). Snowmobile clubs would prefer that government justify snowmobile closures by using science and not implement unnecessary closures.

Some studies suggest that individuals riding in managed snowmobile areas within BC may not understand the rules and regulations governing these riding areas. In some regions of BC, the majority of snowmobilers are out-of-province riders. In response, BC clubs have taken on an obligation to educate riders to promote management implementation and compliance.

Partnerships with snowmobile clubs appear to have been quite successful in managing snowmobile activities within caribou habitat in certain parts of BC (Simpson 1987).

#### **Recommended roles for the snowmobile clubs in management plans:**

- Enforcement
- Monitoring
- Information Dissemination

### ***Monitoring***

Monitoring of snowmobiles should occur throughout mountain caribou habitat including areas with low levels of snowmobile activity, since snowmobiling activities and caribou range are both subject to change (Powell 2004). Most monitoring of snowmobiling in caribou habitat has been limited to compliance monitoring conducted by snowmobile clubs/representatives, with limited independent third party monitoring of plan implementation or effectiveness. Although many

articles recommended self-policing, other articles suggest that this method is ineffective in that it lacks transparency and credibility when users are left to monitor their own activities.

In addition, current monitoring approaches may not be able to accurately assess snowmobile activities. Deducing the extent and type of activities that have occurred in between monitoring sessions is problematic. This is particularly difficult when weather activities obliterate snowmobile tracks.

Given the complexity and magnitude of management and user-group implications around mountain caribou, their endangered status and recovery planning, a more robust monitoring system should be considered. The following types of monitoring are often referred to for monitoring within an adaptive management framework:

**Baseline monitoring** is designed to establish the starting or “benchmark” condition of a system, against which later observations can be compared.

**Implementation monitoring** is conducted to determine whether a plan is being carried out as intended; in other words, to answer the question “Have we done what we said we would do?”

**Compliance monitoring** is a subset of implementation monitoring that seeks to determine if legal requirements are being met during implementation of a plan. A regulatory authority might wish to know “Has a certain user group followed the law or its permit specifications?”

**Effectiveness monitoring** is employed to determine whether goals and objectives are being achieved; such as to answer the questions “Are the results of a particular project or program satisfactory? Have we achieved what we set out to do?” Effectiveness monitoring of snowmobile use in caribou habitats might look at how well the population is distributed in relation to habitat value and snowmobile use, or whether caribou are continuing to use areas with differing levels of snowmobile use.

Effectiveness evaluations have been shown to serve a wide range of purposes beyond confirming the success of management practices. For example, Hockings et al. (2006), in their review of effectiveness evaluation for protected areas, state that:

*“...effectiveness evaluation can:*

- enable and support an adaptive approach to management;*
- assist in effective resource allocation;*
- promote accountability and transparency; and*
- help to involve the community, build constituency and promote (protected area) values.”*

**Validation monitoring** is used to determine cause-and-effect relations in a system of interest. Managers and scientists use validation monitoring to answer question such as “Do these variables really respond the way we think they will?”. Unlike the other monitoring types, validation monitoring is concerned exclusively with gaining new knowledge about system functions or responses and thus is often part of applied research and adaptive management investigations.

One recommendation in the Valemont to Blue River Winter Recreation Sustainable Resource Plan is to develop snow patrols to monitor snowmobile areas. This SRMP has a target of employing two certified patrollers within each managed snowmobile area (ILMB 2004). These

patrols are expected to provide assistance and information to the public, monitor snowmobile areas, facilitate communication and coordination with other backcountry users, work in conjunction with enforcement officials from the Conservation Officer Service and RCMP and finally, collect statistics and maintain records for these patrols (ILMB 2004).

Despite efforts in a few areas, the roles and responsibilities with respect to self-policing, independent and random monitoring, types of monitoring, qualifications and experience of personnel conducting the monitoring, interagency & organization responsibilities/partnerships and, of primary importance, funding resources to conduct the monitoring, are inconsistent, lacking, and/or not well defined. In addition to traditional reliance on government funding and volunteers, consideration could be given to user fees applied to certain snowmobile management areas (permits) and/or funds derived from licensing snowmobiles.

The Off Road Vehicle Coalition has recently been granted funding to conduct a feasibility study and develop a process by which off road vehicles can be registered, licensed and insured in BC. Recommendations are presently before government for review and implementation (T). For a detailed review of these recommendations see “Final Recommendations for Registration, Licensing and Management of Off-Road Vehicles in British Columbia” (Vold & Sranko 2005; T. Watt *pers comm.*).

### ***Information Gaps***

Although there are signs that caribou may habituate to snowmobile activity (e.g. Frisby and Allen Ridges; Lewis and McLellan 2006), the literature examined provides very little indication that programs in place are having the anticipated effects. Monitoring has provided some short-term data on caribou locations and compliance, but has not provided any indication as to the long-term effects of snowmobiles and implemented snowmobile management regimes. No quantification or mapping of caribou dispersal before and after a management program was implemented, was noted in the literature. Very few large-scale and rigorous monitoring programs appear to exist. Monitoring often seems to be restricted to short term projects whose scope and duration is dictated by government funding.

Under these conditions we are unable to determine which management plans represent a best-practice approach. It appears that in the absence of scientific data to quantify our programs, the precautionary principle should be employed in management decisions. Perhaps the collection of statistics and monitoring by snow patrols advocated in the Valemont to Blue River Winter Recreation Sustainable Resource Plan and continued scientific studies could be used to help evaluate management plans.

Very little information was provided regarding the costs associated with management programs. There is no indication that snowmobile clubs and communities are going to be able to support their end of proposed partnerships in monitoring and enforcement, nor is there any indication that funding is available to support these programs over the long-term. There is also very little information regarding how snowmobiling groups will be trained in guiding and monitoring activities.

The effects of snowmobiling are often studied in isolation from other factors. Although there are indications that snowmobiles may be an additive factor, it is difficult to place this factor into perspective among other factors responsible for caribou decline. It is also difficult to determine which factors snowmobiling may be working in concert with to foster declines in caribou populations.

### ***Recommendations for Future Research***

The following is a list of recommendations for future research:

- Select research designs that provide unambiguous results. Collect evidence that gives clear answers to all players involved (e.g., collect data on mountain caribou locations relative to specific snowmobile areas and levels of use by both caribou and snowmobilers).
- Study caribou dispersal over years of exposure to snowmobiles. If caribou are experiencing significant dispersal as a result of snowmobile disturbance, this data may be crucial to enlist the future help of snowmobile clubs and voluntary closures. Some snowmobile clubs are not content with the uncertain science currently governing the regulation of snowmobile activities.
- Study cases of habituation in more detail so that snowmobile management areas may be designed so that caribou may become habituated to the presence of snowmobiles. Habituation may occur over several seasons and studies and management plans should be developed accordingly.
- Monitor potential declines in vegetation quality as a result of displacement of mountain caribou. A Norwegian study determined that the carrying capacity of various parts of caribou habitat was decreased due to overgrazing in response to human disturbance.
- Study the physiological effects of snowmobiles on caribou in more detail. One expert recommends examining the levels of stress hormones within caribou feces in order to determine the extent to which these animals may be impacted by the presence of snowmobiles. These investigations may allow experts to determine what type of long-term effects may occur in caribou populations as a result of snowmobile activity.
- Study the potential for snowmobile trails to facilitate predation on caribou. Determine ways in which this problem may be mitigated.
- Study the effects of other factors that may be working in concert with snowmobiles to diminish caribou populations. Since snowmobiling is among a variety of factors causing caribou population decline, snowmobiling plans should be developed in concert with plans to deal with other factors limiting caribou populations.

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## Appendix 1: Annotated bibliography of literature review

**ABC Snowmobile Clubs. Mountain caribou page. Last visit February 9, 2007. Unclear when it was last updated. <http://www.abcsnow.ca/>**

The ABC Snowmobile website serves the Association of BC Snowmobile Clubs. Clubs from various regions across BC are represented by this association whose purpose is to provide a unified voice for BC snowmobilers. On its mountain caribou webpages, this association provides maps outlining various areas in British Columbia that are restricted to snowmobiling. The Ministry of Environment, Environmental Stewardship Division and SaRCO "Snowmobiling and Caribou in British Columbia" brochure, provide guidelines for behaviour when confronting mountain caribou on a snowmobile (very similar to the ones prescribed by the Revelstoke Snowmobile Club as outlined above). ABC Snowmobile Clubs was very instrumental in working with SaRCO in the preparation of the "2007 Guide to Snowmobiling in the Columbia and Rocky Mountains of British Columbia" and is currently preparing an updated insert to the document for mailing to 1500 members in the province (Terry Watt (pers comm. May 2, 2007).

**Apps, C.D., McLellan, B. 2006. Factors influencing the dispersion and fragmentation of endangered mountain caribou populations. *Biological Conservation* 130: 84-97.** (Hard copy available)

Similar to other literature, this article suggests that a wide array of natural and human-caused factors are limiting caribou persistence. Threats to mountain caribou are not limited to the fragmentation of old growth forests on which they depend. Among other factors at the metapopulation level, this article suggests that "remoteness from human presence, low road density, and little motorized access" explained the persistence of caribou subpopulations. Apparently road networks are one of the major factors impeding population contiguity due to their capacity to increase predator access to caribou as roads are commonly "plowed or snow compacted". This article suggests that backcountry snowmobiles may elevate stress within caribou populations, or displace them from preferred habitats. Using a landscape occupancy index, investigators determined that winter motorized recreation had a small negative association with habitat occupied by caribou according to t-statistics at the metapopulation level. According to the Spearman-rank correlation coefficients derived in this study, the relationship between caribou populations and motorized recreation in the winter also had a small negative correlation. Overall, this article was very useful in outlining numerous variables that are associated with caribou presence at the subpopulation and metapopulation levels, although it did not contain a lot of information on caribou/snowmobile interactions.

**BC Ministry of Water Land and Air Protection. Unknown date. Wildlife information for commercial backcountry recreation opportunities recreation opportunities in the north central monashee mountains. <http://wlapwww.gov.bc.ca/sir/fwh/hab/cbrhab.pdf>**

This paper outlines the British Columbia government's position on commercial backcountry recreation licenses in the province. A general outline of the application process and expectations

of applicants is provided. This website also provides links to the BC guidelines for commercial backcountry recreation.

**Brade, B. 2003. Management of motorized access in high elevation mountain caribou habitat: Omineca region. Report endorsed by MWLAP.**

[http://wlapwww.gov.bc.ca/omr/documents/management\\_motorized\\_access\\_high\\_elevation\\_caribou\\_final.pdf](http://wlapwww.gov.bc.ca/omr/documents/management_motorized_access_high_elevation_caribou_final.pdf)

Among other information, this report provides sections on policy direction and conservation status of mountain caribou, management strategies, sources of disturbance and displacement, existing provincial policy, discussion, and recommendations. According to this paper snowmobiling is currently recognized as the most significant recreational cause of disturbance and displacement. Tools for minimizing conflict include land-use zoning, “by location, by elevation, by activity, or by date. Area limitations, seasonal closures, or altitude restrictions may be combined with access corridors or finer-scale refinement.” This report suggests that this type of zonation can be implemented using the Wildlife Act. Preventing easy access to mountain caribou habitat is another recommendation put forward by this report. The report also recommends the “access corridor” approach to minimize conflict (Bourne Glacier, Kootenay Region). It is also recognized that a caribou/snowmobile management system needs to be adopted that better defines the needs of snowmobilers. (Frisby Ridge, Kootenay Region). This report suggests that there may be problems associated with compliance in the zonation approach and recommends enforcement of regulations within each zone so this approach can be effective.

**British Columbia Snowmobile Federation. Homepage. Last visited February 16, 2007. Last updated in 2007. <http://www.bcsf.org/>**

The BCSF contributed to the brochure “Snowmobile (1st Edition) guide for the Columbia and Rocky Mountains of British Columbia: openings, closures, trails, clubs.”

This homepage outlines the roles of the BCSF and provides, among other services, articles, links, and forums on snowmobiling for its members. Dialogue concerning mountain caribou can also be found on this site.

**CCLUP Caribou Strategy Committee. 2000. Mountain caribou strategy: Cariboo-Chilcotin Land-Use Plan. Prepared for: BC Ministry of Water Air and Land Protection. Unpublished Report.**

[http://wlapwww.gov.bc.ca/car/env\\_stewardship/wildlife/reports/cari\\_2000\\_rpt/finalcariboureport2000eastern.pdf](http://wlapwww.gov.bc.ca/car/env_stewardship/wildlife/reports/cari_2000_rpt/finalcariboureport2000eastern.pdf)

This paper outlines the mountain caribou strategy for the Cariboo-Chilcoltin Land Use Plan. This plan recommends that snowmobiles and other forms of recreational traffic should be carefully regulated or excluded from “no harvest” and “modified harvest” mountain caribou winter range

areas. This paper further suggests that snowmobiles are a major conservation concern due to their capacity to displace caribou. If caribou are confined to higher densities by snowmobiles, predators may be able to prey upon caribou more easily. Additionally, snowmobile tracks may allow predators to access caribou habitat more easily.

One of the tasks for the committee was to define portions of caribou range that are sensitive to snowmobiles. This committee recommends using park and no harvest areas to ensure that caribou are free from human disturbance, including harassment from snowmobiles. Low harvest zones ensure that deer prey populations are limited, thus reducing the chance that predators will move into these areas and prey upon mountain caribou. A planning committee was working with local snowmobiling clubs to determine a snowmobile zoning strategy for the region at this time.

Without restrictions or regulations, the risk of increased motorized recreation within caribou habitat is considered to be very high. The authors suggest that this risk can be diminished if the proper regulations are instituted. Theoretically, these recommendations should decrease the estimated risk of impact from very high to moderate if put in place.

Snowmobile use can affect mountain caribou by displacing animals from preferred habitat. Snowmobile trails have also been known increase the risk of predation on mountain caribou as predators (especially wolves) are better able to access caribou habitat by traveling on snowmobile trails. Furthermore, caribou can experience increased daily energy expenditures when harassed by snowmobiles.

With respect to predator use of established snowmobile trails, this paper suggests that limiting snowmobile numbers will not necessarily facilitate decreased predation on caribou. The paper further suggests that caribou may abandon suitable habitat and increase home range sizes when subjected to significant levels of snowmobile disturbance. Temporal caribou activity patterns may also change as a result of snowmobile use.

In the Cariboo-Chilcoltin, caribou appear to have abandoned at least three major peaks during the late winter period as a result of heavy snowmobile use. These areas include Big Timothy Mountain, Yahks Peak-Roundtop Mountain and Groundhog Lake, located near Wells. Caribou use of Cameron Ridge, Upper Bill Miner Creek, and Mica Mountain has also declined as snowmobile activity has “expanded into” these areas in recent years. When caribou are forced to occupy a smaller range there is commonly a “corresponding decrease in population levels”.

This document indicates that literature relating to the affects of snowmobiles on caribou is incomplete. In trying to minimize the effects that snowmobiles have upon mountain caribou, this report recommends that managers adopt adaptive management where scientific studies are lacking and incorporate environmental stewardship so that land resources are only used within their capacity to sustain use. Furthermore, it is recommended that the precautionary principle be used in the decision making process in situations where there is a lack of scientific certainty. It is also recommended that wildlife management guidelines be scientifically based.

This report comments on effects of snowmobiles on caribou at the landscape level; “a few small, intensively used areas will have less impact on caribou than several large areas receiving moderate use” It is also mentioned that designated snowmobile areas should avoid high sensitivity caribou areas. Among other recommendations, this report suggests that designated snowmobile

areas should be located in areas where they can be easily accessed from several communities and in areas distant to caribou range. The authors recommend maintaining historic snowmobile areas that caribou no longer utilize as opposed to opening up new areas to snowmobiling. Additionally, the authors recommend that snowmobilers avoid “modified harvest areas” as researchers hope to evaluate winter use of these areas by caribou. This report suggests that restricting snowmobile traffic to certain times of the year (Nov 1 to Jan 15) may eliminate conflicts between caribou and snowmobiles at lower elevations. This paper also recommended that management of other wildlife species should be included in the snowmobile strategy.

**City of Revelstoke. 2002. Revelstoke Snowmobile Strategy. Last visited Feb 8, 2007. Found on a website updated in 2007. <http://www.cityofrevelstoke.com/edc/snowmobile/toc.htm>**

This website displays the Revelstoke Snowmobile Strategy in an HTML format. The Revelstoke Snowmobile Strategy was created by a steering committee from the City of Revelstoke that worked in partnership with the Revelstoke Snowmobile Club and Revelstoke Snowmobile Society. Together the groups created the Revelstoke Snowmobile Tourism Management Strategy, designed to manage snowmobiling within the region. The Steering Committee was formed in 2001 and produced this document in 2002. Environmental concerns are addressed by this group under “Environmental Issues” (section 5 of this document). According to this section, one of the critical issues for snowmobiling in the region is the preservation of mountain caribou populations. This document suggests that the snowmobile club has agreed to voluntary closure of snowmobiling areas where snowmobilers have come in contact with mountain caribou. This document also states that it is expected that any future development and/or management of trails will take wildlife impacts into consideration. Appendices C and D contain documents pertaining to mountain caribou. Appendix C, titled “Implications of Snowmobiling on mountain caribou Annual Report: Year One,” outlines the numbers of various mountain caribou populations across the province and the ramifications of snowmobiling on these populations. Appendix D outlines some of the restrictions on snowmobiling implemented by various groups in the Revelstoke region.

**Columbia Mountains Institute of Applied Ecology. 2002. Mountain caribou in 21st century ecosystems. Based on proceedings from a conference that took place October 16-18, 2002 in Revelstoke BC. [www.cmiae.org](http://www.cmiae.org).**

Information regarding mountain caribou and Snowmobile interactions were included the 16th and the 17th presentation at this conference. The 16th presentation was conducted by Bruce McLellan of the Revelstoke Ministry of Forests. The title of this presentation was “Recreation and Caribou: What Do We Know about the Effects of Recreation on Caribou?” Bruce suggests that findings regarding the interactions between mountain caribou and snowmobiles are difficult to quantify due to the short-term nature of these studies. According to this research, in areas where snowmobiles are limited to “a portion of the winter habitat” individual caribou appear to have become habituated to snowmobiles. Meanwhile caribou appear to be displaced in regions which have experienced rapid increases in snowmobile traffic and where snowmobile traffic in late-winter habitat is less limited. During the 17th presentation titled “Snowmobiles and Caribou:

Perspectives from the Revelstoke Snowmobile Club and British Columbia Snowmobile Federation”, Tom Dickson (Phone: 250-837-3541) of the Revelstoke Snowmobile Club and Pat Whiteway of the British Columbia Snowmobile Federation (Phone: 250-860-8020. Email: [pwhiteway@telus.net](mailto:pwhiteway@telus.net)) presented their views on this topic. No details were included in this document. Readers were advised to examine two websites. (<http://www.sledrevelstoke.com> and <http://www.snowmobilebc.ca>)

**DeGroot, L. 6 March 2007. E-mail interview.**

According to Leo DeGroot, a Wildlife Biologist with the BC Ministry of Environment based in Nelson, B.C., snowmobile closures within the South Selkirks were drawn up with consultation from local snowmobile clubs and are regulated by the Wildlife Act. Apparently snowmobile clubs have agreed to this approach and prefer to have snowmobile closures regulated. This is the first winter that these closures, which were put in place two years ago, have been covered by the Wildlife Act. Apparently the local snowmobile clubs, particularly the Creston club, have done an excellent job of informing their members of the closures. Compliance to the closures has been good. Monitoring occurs during monthly telemetry flights and by checking a main access point on Highway 3 near Kootenay Pass whenever DeGroot’s team is passing through the region. Conservation officers have undertaken at least one patrol of these closures.

**Duchesne, M., Cote, S.D., and Barrette, C. 2000. Responses of woodland caribou to winter ecotourism in the Charlevoix Biosphere Reserve, Canada. *Biological Conservation* 96: 311-317.**

In the Charlevoix Biosphere Reserve in Quebec, naturalists examined caribou behaviour changes as a result of visits by small groups (5-19 individuals) of ecotourists on skis and snowshoes during the winter. Naturalists observed the behaviour of the caribou prior, during, and after the arrival of the ecotourists. Overall, it appeared that yearling females spent the least amount of time resting when compared to other caribou demographics, although the impact of ecotourists was similar for all age-sex classes. Time that caribou spent vigilant in the presence of ecotourists increased with the number of observers present, however, this relationship was not statistically significant. Time spent engaging in activities such as foraging, resting, and ruminating was reduced in the presence of ecotourists due to the increase in vigilant behaviour of caribou. As time progressed in the study, the animals appeared to habituate to the presence of ecotourists. Caribou spent more time foraging and engaging in social interactions in the presence of ecotourists later in the study period. In areas where caribou were digging for lichens, it was noted that caribou may be prompted to abandon an area when 70% of the snow cover has been disturbed. Therefore tourists were advised to use existing trails and not disturb more snow cover than necessary. Caribou never left these wintering quarters in response to ecotourists. Researchers concluded that with proper precautions, caribou within the reserve could tolerate visits from ecotourists.

**Government of British Columbia. 2006. Wildlife guidelines for backcountry tourism/commercial recreation in British Columbia.**

[http://www.elp.gov.bc.ca/wld/twg/documents/wildlife\\_guidelines\\_recreation\\_may06\\_v2.pdf](http://www.elp.gov.bc.ca/wld/twg/documents/wildlife_guidelines_recreation_may06_v2.pdf)

This document outlines results, desired behaviours, indicators and limits as they pertain to all types of backcountry recreation. Expectations for backcountry snowmobilers would fall under the “Motorized>Alpine/Tundra and Forest>Winter” section. These guidelines are aimed towards limiting physiological and behavioural disruptions and minimizing changes in wildlife habitat use. Proper etiquette for backcountry users includes: recording wildlife encounters/responses of encountered animals, remaining on established trails, obeying all signs, not harassing wildlife, not handling wildlife, not allowing dogs to be near wildlife, packing out all garbage, turning off engines in the presence of wildlife, yielding to wildlife on trails and roads, placing activities on areas where wildlife are not likely to be disturbed and staying at appropriate distances from wildlife to minimize disturbance (at least 500m in open areas). Indicators used to determine whether wildlife disturbance has occurred include: proportion of encounters resulting in an alarm response and population abundance and distribution trends of wildlife species. These guidelines will help minimize occurrences of wildlife harassment and prevent abandonment of habitats as a result of disturbance.

**Grassland Conservation Council of British Columbia. 2003. Best management practices for motorized recreation on BC’s grasslands. Brochure.**

This booklet provides Best Management Practices (BMP’s) for grasslands and grassland related areas. Essentially this literature outlines the characteristics of good range management and healthy grasslands, species at risk, and BMP’s for minimizing soil disturbances, avoiding the spread of invasive plants, respecting native plants and wildlife, respecting sensitive environments and features, avoiding disturbance of livestock and damaging forage and respecting property and historical sites, including first nations cultural heritage areas. Finally this brochure outlines some guidelines for commercial operators and club organizers for educating both their members and the public. A guideline aimed at snowmobiles suggests avoiding snowmobiling when the snow pack is minimal, because compaction of the snow can reduce the insulating quality of the snowpack, thus damaging underlying vegetation and soils. Additionally, the underlying vegetation may be crushed or uprooted. This pamphlet recommends riding in at least 12 inches of snow and where vegetation is invisible. It also suggests that motorized vehicles may create access routes for predators.

This pamphlet suggests that BMP’s are ways in which the user can help sustain the environment while continuing to enjoy outdoor activities and recommends that everyone applies these practices. Like other literature included in this review, BMP’s outlined in this pamphlet recommend that motorized vehicles avoid using wildlife areas during particularly sensitive times of the year. Another recommendation includes maintaining equipment properly so that machines are properly tuned and muffled to reduce both exhaust and noise. Contrary to other literature, this pamphlet recommends motorized vehicle users “slow down, leave the engine running and stay on the machine” when encountering wildlife. It also recommends that when snowmobiling in deep snow, motorized vehicle users stay clear of animals so that “vehicle noise and proximity do not add stress to animals”. For clubs and commercial organizations, authors recommend that BMP’s get distributed at their events. In order to distribute information pertaining to BMP’s, authors in

this pamphlet recommend that clubs conduct youth outreach through youth clubs (even unrelated to motorized recreation), provide pre-packaged powerpoint presentations for speakers and provide BMP's in their trade shows or mall dealers. It is also recommended that BMP's are incorporated into "on-ground activities" such as the development of trail systems and signs. BMP's should also be distributed at events and mailed to club members.

**Gros Morne National Park of Canada Park Management. Last visited March 14, 2007. Last Updated Dec 13, 2006.**

[http://www.pc.gc.ca/pn-np/nl/grosmorne/plan/plan6a\\_E.asp](http://www.pc.gc.ca/pn-np/nl/grosmorne/plan/plan6a_E.asp)

This website outlines a snowmobile agreement within Gros Morne National Park. This snowmobile program was developed in part from suggestions by a working group comprising of a diverse array of interests within workshops. This website outlines goals of the group, values, key issues and concerns, and some scientific and historical background.

The most useful aspects of this article are included in Section 7 under "Characteristics of Managed Snowmobiling". Within the "Managed Snowmobiling" section this management program proposes to ensure that management will be adaptive to changing circumstances and that the precautionary principle will be employed in management decisions. In order to snowmobile within Gros Morne Park, snowmobilers must acquire free snowmobile permits available within a specific time frame. Permits include "dates of the snowmobile seasons, and other conditions of use including a map of open and closed areas for snowmobiling." Commercially guided operations will require a limited business license.

A monitoring program is included within the management plan and is aimed towards monitoring changes to the vegetation community and associated animals, including caribou. Part of the monitoring program would include developing thresholds for management decisions. It would also include assessing the numbers of people currently using the park and the type of snowmobiling occurring (resident, public, or commercial).

The management plan recommends using the best available technology to minimize disturbance and prevent excessively noisy snowmobiles from using the park. As soon as technology permits, only 4 stroke engines will be permitted to operate within the park. Furthermore, the snowmobiling activity referred to as "highmarking" is also banned within the park. Zones within the park will be changed in order to accommodate snowmobiles.

Snowmobiling will not be promoted within the park's boundaries; however snowmobile areas outside the park will be maintained and promoted in order to minimize traffic within the park. Although this report provides dates for the opening and closure of the snowmobile season, dates could change according to snowpack.

A snowpack monitoring protocol, which will analyze the snowpack in order to track snowpack conditions and develop appropriate closing dates for the snowmobiling season, is also proposed as part of the management plan. The park hopes to cap snowmobiles at current levels and to limit the number of clients that a commercial guide can take into the park. This plan was supposed to be

implemented for the 2005/2006 snowmobile season, although I found no indication on this website as to whether it had been implemented or not.

**Hart and Cariboo Mountains Caribou Recovery Action Group. 2003. Minutes and presentations from January 28, 29, 2003 conference. Unpublished report**  
<http://qhms.org/userfiles/crac.pdf>

This paper outlines the minutes for the Mountain Caribou Recovery Action Group Meeting which took place between various governmental, forestry, and backcountry interests on January 28<sup>th</sup> and 29<sup>th</sup> 2003 in Williams Lake. This meeting examined the status of caribou, particularly within the Kamloops, Cariboo, and Prince George regions. Among many other issues, it examined how backcountry recreation (and harvesting) impacted populations. According to one note from the Caribou-Chilcoltin Land Use Plan, caribou survival is dependent upon a perpetual supply of habitat without vehicle access. Snowmobiles were listed among activities of concern to caribou maintenance due to their potential to displace caribou. This committee hopes to identify sensitive areas where snowmobile restrictions are necessary and develop a snowmobile zoning strategy for mountain caribou range.

This paper provides a timeline of snowmobiling planning within the Cariboo region from 1995 to 2003. During revisions of zones within caribou mapping procedures, the extent of snowmobiling occurring within an area is used. One practice used to minimize snowmobile access to caribou habitat within this region is to design forestry roads to be fully recontoured and deactivated after harvesting and to locate them in areas that will minimize future snowmobile use. Overall, caribou are vulnerable to snowmobiling as a result of the sport's wide-ranging nature, thus creating the need to limit snowmobile access to certain areas.

This report suggests that at low levels caribou may tolerate snowmobiling or "simply move off a short distance." However radio-collar data appears to suggest that caribou are being displaced when snowmobile activity becomes intense. This paper suggests that predation may become more intense due to predator use of snowmobile tracks. Predators are better able to overcome the snow depth barrier when traveling on snowmobile tracks, giving them a greater advantage in deep snow conditions. This paper further implies that even infrequent snowmobile use to the alpine can provide wolves access to potential caribou habitat.

This report recommends promoting responsible club policies, self-policing, off-trail restrictions, and codes of conduct. It also recommends encouraging trail expansion and dispersed-use area development in areas without caribou. Furthermore, this paper recommends partnerships to develop plans between the government and other groups in areas with snowmobile/caribou interactions. "Actions include education, and local agreements or regulations designed to limit or prevent the impacts of snowmobile activity on caribou. Seasonal or geographic restrictions (such as specifying a travel corridor) and limitations on dispersed-use can all be effective." Enforcement is recommended as a means of achieving compliance within snowmobile closure areas.

**Hooge, J, Davidson, C. and McLellan, B. 2001. Implications of snowmobiling on mountain caribou annual report: year one.** (As found in Appendix C of the Revelstoke Snowmobiling Strategy.) (Original Document could not be found during an internet search).

This document outlines a study conducted on mountain caribou populations across BC, including the Columbia Forest District, the Silver Cup Ridge, and the Cariboo Forest District. This study suggests that the interactions between snowmobiles and mountain caribou within British Columbia is a unique phenomenon and cautions policy makers from extrapolating from studies conducted elsewhere. This study is a retrospective analysis of existing data from previous caribou habitat studies. Although several findings within this study were inconclusive (possibly due to the multitude of factors involved in caribou behaviour), the researchers conclude that caribou use appears to be shifting away from areas associated with snowmobiling, although some caribou on Frisby Ridge may have become habituated to snowmobile traffic. The rugged topography of the region, coupled with areas restricted to snowmobile traffic and the slow growth in snowmobile traffic over a 20 year period, may have allowed this small group of caribou to become gradually habituated to snowmobile traffic. Overall, the caribou population within the Frisby Ridge area appears to prefer the areas infrequently used by snowmobilers. Caribou within the nearby Keystone/Standard ridge system appear to have altered their habitat in order to avoid snowmobiles. Abandonment of caribou habitat at Boulder Mountain, Big Timothy Mountain and Yanks Peak during periods of increased snowmobile use, point to the incompatibility of caribou with snowmobiles. The investigators propose that caribou coming in contact with recreational vehicles can result in displacement, which may also decrease the fitness of these animals through physiological changes.

**Horejsi, B.L. 1981. Behavioral response of barren ground caribou to a moving vehicle.** *Arctic* 34 (2): 180-185.

[http://www.aina.ucalgary.ca/scripts/minisa.dll/144/proe/proarc/se+arctic,+v.+34,+no.+2,+June+1981,\\*?COMMANDSEARCH](http://www.aina.ucalgary.ca/scripts/minisa.dll/144/proe/proarc/se+arctic,+v.+34,+no.+2,+June+1981,*?COMMANDSEARCH) □

The study outlined in this paper was conducted along the Dempster Highway in the Yukon. This paper examines the behavioural response of mountain caribou to an approaching  $\frac{3}{4}$  ton pick-up truck. About 48% of the caribou reacted to the approaching truck by running away, while 38% of the caribou reacted to the approaching vehicle by trotting away. Female flight duration was longer than male flight duration. In forested habitat male caribou allowed a closer approach than females but in open habitat the sexes did not differ in how close they would allow the vehicle to approach. Many of the caribou exhibited excitement and fright in response to provocation by the vehicles, including the excitation jump; a behaviour designed to alert other caribou of danger. About 29% of the caribou reversed their direction of travel or split their group in response to the approaching vehicle. These behaviours have been noted before along the Dempster Highway. It was undetermined if caribou returned to previous activities after being disrupted.

The caribou appear to perceive the highway as a novel object in the same manner that they perceive an ice flow or a stream. The vehicle used in this study traveled anywhere from 56-86 km/h as it approached the caribou. Sound was not believed to be responsible for alerting the caribou since the vehicle used within this experiment was relatively quiet. Most caribou began to flee as soon as they saw the vehicle. The author proposes that movement alone was not

responsible for eliciting flight response, but the rate at which the object approached the caribou (a function of speed and direction) caused the response. During this process, known as looming, an accelerated magnification of an object is perceived by the caribou to precede a collision, triggering the caribou to move out of the way.

Speeds over 24 km/h seemed to evoke a large increase in the reactions of caribou to a moving object. About 6% reacted strongly to the vehicle moving at speeds of less than 24 km/h. Eighteen percent reacted strongly to a vehicle moving at speeds greater than 24 km/h. These findings suggest that a vehicle moving at speeds of 56-81 km/h can disturb caribou. The absence of differences in flight distance are attributable to the speed of the vehicle causing disturbance.

This research suggests that disturbed caribou will flee for a short period of time until the initial threat is thought to no longer exist. Caribou and reindeer have avoided areas in which they have experienced disturbance, leading the author to believe that caribou may begin to abandon the Dempster Highway corridor if frequency of traffic along it increases.

**Idaho Forest Service. 2004. Situation summary and management strategy for mountain caribou and winter recreation on the Idaho Panhandle National Forests.**

[http://www.fs.fed.us/kipz/library/wildlife/handouts/032904\\_caribou\\_summary\\_final.pdf](http://www.fs.fed.us/kipz/library/wildlife/handouts/032904_caribou_summary_final.pdf)

Interestingly, many passages included in this report are almost identical to those belonging to the 1997 report produced by Lara Webster in Williams Lake. This is a very thorough report outlining the current health and location of the mountain caribou within the Nelson region and the Idaho Panhandle. It outlines many of the hazards that snowmobiles present for caribou in great depth and also provides some recommendations for minimizing the impacts of snowmobiles on caribou. Caribou that have been previously chased or hunted by snowmobile are suggested to experience increased levels of stress in the presence of snowmobiles on their winter range. The presence of snowmobiles may result in increased energy expenditure when animals move away from the stimulus. Interesting information outside the realm of the previous studies suggested that caribou allow closer contact with snowmobiles when they can visually identify the machines, as opposed to when the source of sound is not visible. Catching scent of the operator caused caribou to “withdraw more quickly” regardless of whether or not animals identified the snowmachine visually. These findings suggest that the operator, as oppose to the machine, is responsible for causing the “high energy responses”. Recommendations presented in this report were similar to those presented in previous studies. Four primary elements exist in the Idaho Panhandle National Forest winter recreation management strategy: 1. Information, Education and Coordination. 2. Implementation and enforcement of existing management direction. 3. Monitoring of recreation use, habitat impacts and caribou use. 4. Incorporating caribou habitat management into a multi-species analysis in the Forest Plan revision.

Under the section devoted to Information, Education, and Coordination, the report recommends educating the public about mountain caribou and backcountry recreation closures. This includes public media announcements, trailhead signs, snowmobile brochures, websites, meetings with user groups and NGOs (in both Idaho and Washington), placing a forest service representative in groomer committee meetings so that information about the mountain caribou can be integrated

into new maps and plans, increasing border security with Canada, and increasing communication between various jurisdictions on this issue at both the inter-state and international levels. In terms of enforcing existing caribou management regimes, this report recommends that the Forest Service enlists various members of the snowmobiling community to monitor compliance with regulations and closures, engineer effective barrier placements (and vegetation) to discourage snowmobiling in certain areas, and maintains brush, saplings, seedlings, and pole-sized trees within 20 feet of the roadways in order to discourage access to caribou habitat. Under the monitoring section, this report recommends that the Forest Service monitor the effectiveness of closures by conducting aerial surveys in closure areas. During the Forest Plan revision, it is recommended that caribou requirements are incorporated into fire management plans as well as management plans for other species.

**Idaho Forest Service. 2004. Public comments regarding caribou issues. Idaho Panhandle National Forest.**

[http://www.fs.fed.us/kipz/library/wildlife/handouts/032904\\_response\\_to\\_comment\\_final.pdf](http://www.fs.fed.us/kipz/library/wildlife/handouts/032904_response_to_comment_final.pdf)

This website outlines public commentary on the "Report on mountain caribou and Winter Recreation on the North Zone of the Idaho Panhandle National Forests". Although some of the comments mentioned in this paper were contradictory, the paper effectively outlined public perception of the issue and revealed a number of cases of public misinformation. In many cases the public sees the government as being relatively inactive on this issue. This is a very dense information package, making it difficult to extrapolate ideas from the public commentary. The document consists of some public commentary with responses from the Forestry Service to the more pertinent comments.

**Element 1: Information and Education**

One public commentator recommended creating brochures for businesses regarding caribou. Another suggested that the Forest Service should educate recreational snowmobilers, outfitters, and shop owners regarding dangers facing caribou. One person suggests that improving signs while allowing increased snowmobile traffic will not protect the caribou. The Forest Service responded to these comments by adopting several of them and suggesting that they will actively monitor snowmobile use to evaluate if efforts have been successful.

**Element 2: Enforcement**

One commentator suggested that marketing of snowmobiles attracts individuals who are likely to defy regulations and have the technology to evade laws. According to another commentator, enforcement does not solve noise issues. One commentator suggested that monitoring should have a more significant evaluative component beyond the trailhead, and another suggested that restrictions were meaningless without enforcement. Another commentator suggested using snowmobile registration fees to pay for enforcement programs. In response, the Forest Service stated that it will increase enforcement partially by using interested volunteer groups in monitoring the closures. At the time of this report the effectiveness of enforcement was unknown, so the Forest Service proposed that aerial surveys be undertaken to identify and map the distribution of snowmobile activity in the region.

### **Element 3: Monitoring of recreation, caribou and habitat**

A couple of comments pertain to the use of Kelly-humps and vegetation screening. One comment suggested that Kelly-humps do not deter snowmobilers, while another asked for more to be constructed.

The Forest Service defined Kelly-humps and vegetation screening as tools to encourage vehicles to stay on roads and trails.

The Forest Service claimed to be developing a strategy which employs specific actions and schedules. The Forest Service stated it would delegate different tasks to different monitoring partners.

### **Element 4: Forest Plan**

In response to comments on an emergency closure of specific areas of the Idaho Panhandle, the Forest Service cites visible displacement of caribou by snowmobiles.

In other regions in various studies:

“Kinley (per comm.) indicated that the abandonment of caribou within eight areas of increasing snowmobile use would have been statistically unlikely to all have been the result of natural movements.”

Similar to other literature, factors responsible for population declines are believed to be predation, timber harvest, and snowmobile use. Like several other publications, this paper suggests that displacement of caribou as a result of snowmobiles may result in “increased mortality from avalanches, increased energy expenditure, isolation and use of lower quality habitats.” Caribou may become habituated to snowmobiles if “use is restricted to linear routes and is predictable in times and space.”

The Forest Service uses vegetation buffers in some areas to confine snowmobiles to linear routes. These buffers “confine snowmobiles to linear routes; this helps prevent displacement of caribou by providing secure habitats for caribou free from human disturbance away from snowmobile trails.” The Idaho Forest Plan will outline the appropriate locations and level of snowmobile use that can occur in caribou habitat, including areas where snowmobile use is limited to specific routes. The plan will also identify designated “play areas” where snowmobile use is unrestricted. The Forest Service indicated that no scientific data demonstrates that snowmobile tracks help caribou to conserve energy by enhancing their movement. According to this report, research has shown that predators generally use trails in areas where movement is hindered by the depth of non-compacted snow. Within this part of Idaho, logging is restricted to a few hundred acres each decade and is conducted in order to “enhance caribou habitat values.” According to some research in Alberta, vegetation may help to shield caribou from roads and allow animals to approach closer to roads. Caribou avoided roads within open forested habitats, but avoidance occurred to a lesser extent when roads were located in a closed canopy forest. Caribou preferred areas away from roads with marked preferences for areas greater than 100m from roadways. Researchers suggest that caribou may avoid roads because they are perceived as travel corridors for predators or other ungulates.

### **Species other than woodland caribou**

Predator control of wolves is not currently an issue in Idaho right now, since there has been no documented caribou mortality due to wolves in the state. Cougars are not identified as a significant threat to caribou as they are typically found at lower elevations than caribou during the winter.

### **Future snowmobiling decisions**

The public recommended using a lottery and a permit system to limit snowmobile traffic in the Idaho Panhandle National Forest. They also recommended restricting snowmobile use based on season, snow depth, and snow conditions. The Forest Service responded to these comments by suggesting that they needed to determine where snowmobiling was appropriate before programs such as these could be implemented.

### **Outside of the scope of the caribou summary and outside of the Forest Plan revisions**

According to this summary, climate change over the past century may not be a large factor in the decline of caribou populations. The Forest Service suggested that it has not significantly affected the arboreal lichen production in 80 year-old plus forests where lichen growth is controlled by microclimate factors.

One public commentator suggested that Washington law limits snowmobiles to 78 decibels at 50 feet, but this law is difficult to enforce. Another commentator suggests that enforcement of snowmobile regulations does not resolve noise issues caused by snowmobiles.

It was recognized that exposure to excessive noise from snowmobiles can cause declines in reproductive function of caribou. Attention was also directed towards the issue of caribou spooking once detecting scent from snowmobilers; however there was some debate amongst the public as to whether caribou are catching scent from humans or snowmobiles. The Forest Service indicated that research has not been conducted to clarify this issue; however, a study near Revelstoke in 1987, suggested that human scent, as opposed to snowmobile scent causes caribou to flee. Members further speculated as to what other types of human activities should be stopped if human scent was the largest factor in caribou fleeing. Penalties for people violating snowmobile regulations was outside of the summary. (Although I do not recall seeing penalties for violations of snowmobile regulations in other documents examining regulations on the Idaho Panhandle). It was recognized that there is no evidence indicating how far caribou need to be from a snowmobile to remain undisturbed when animals can hear the snowmobile but are unable to pick up the scent of the machine/operator or detect the machine visually.

The Forest Service is incorporating caribou habitat analysis into the Environmental Impact Statement in the new Forest Plan.

**Integrated Land Management Bureau. 2007. Mountain caribou science team documents. Last visited March 17, 2007. Last updated unknown date.**

[http://ilmbwww.gov.bc.ca/sarco/mc/mc\\_scienceteam\\_docs.html](http://ilmbwww.gov.bc.ca/sarco/mc/mc_scienceteam_docs.html)

This website outlines many of the latest recommendations that the government has received from the Mountain Caribou Science Team. These documents provide an excellent summary of current trends in mountain caribou populations across the province. Documents regarding snowmobiling include the Science Team Management Actions Summary (<http://ilmbwww.gov.bc.ca/sarco/mc/MC-ScienceTeam-Actions.pdf>), and the Science Team Management Actions Table (<http://ilmbwww.gov.bc.ca/sarco/mc/Caribou%20management%20action%20summary%20table.pdf>). Both of these documents outline proposed snowmobile closures and their associated programs as they pertain to specific areas and drainages within each region of BC.

**Integrated Land Management Bureau. 2004. Valemont to Blue River Winter Recreation Sustainable Resource Plan. Draft report.**

[http://ilmbwww.gov.bc.ca/lup/srmp/southern/valemont/plan/srmp\\_oct\\_04\\_draft.html](http://ilmbwww.gov.bc.ca/lup/srmp/southern/valemont/plan/srmp_oct_04_draft.html)

This paper outlines strategic directions for various types of backcountry recreation and outlines some cooperative management and implementation plans. The original draft of the Sustainable Resource Management Plan (SRMP) was revised to include less snowmobile closures using the Controlled Recreation Area (CRA) designation, replacing them with increased commitment to provincial education and an enforcement strategy for snowmobiles.

Within this plan, recreation zones are being implemented to “increase recreation opportunities, reduce conflict between recreation activities, and reduce risks to mountain caribou.” Within these zones, specific activities are promoted, managed or excluded. Snowmobiling is promoted within managed snowmobile zones. Within these zones snowmobile activities are supported and snowmobiling is managed with agreements between local organizations and the Provincial Government. Snowmobilers are charged fees that help support services like cabin and trail maintenance/construction and snowmobile patrol in these recreation zones. Sled Skiing/Boarding zones will also be created where emphasis is placed on skiing and boarding assisted by snowmobiles.

Snowmobile closure zones will also be included in this plan. These may include closures for either specific time frames or specific periods and may overlap with other zones. This report proposes expanding and enhancing management of previously managed snowmobile areas and the development of Snowmobile Destination Areas. In creating these areas, several management areas will be combined to become an integrated destination area. Snowmobile trails within managed areas will be improved and joined together to link management zones together and create regional trail networks. This plan also proposes developing the snowmobile industry further within the region.

Some intensively used ski areas will be closed to snowmobiling in order to enhance ski opportunities. Examples of mountains are provided where several activity zones co-exist. Snowmobile corridors will be provided through non-motorized zones. This plan proposes providing more tenured snowmobile guiding opportunities and exploring and considering underdeveloped recreation opportunities. Additionally, this report proposes snowmobile closures in key mountain caribou habitat, detailed commercial management, and cooperative research and monitoring. Closures should have the capacity to be modified according to the advent of new

information. Within snowmobile management zones snowmobilers will be provided with information regarding the location of closures to ensure compliance with closures and provide information regarding appropriate behaviour in areas used by caribou. Agreements with snowmobile groups are encouraged to promote public safety as well as management and enforcement of snowmobile management zones.

The SRMP is consistent with overlapping Land Use Plans. Community based development is promoted within this plan. Community groups would be responsible for snowmobile patrols and raising funds for snowmobile development. These groups will also be involved in promoting communication between government and interest groups as well as helping to qualify and promote snowmobile guides for visiting snowmobilers.

This report recommends placing caribou habitat and snowmobile closure maps at trailheads and cabins as well as snowmobile shops, restaurants, accommodations, and other facilities geared towards snowmobilers. One of the main goals of the SRMP is to expand the snow patrol. The SRMP has a target of two certified patrollers in each managed snowmobile area. The patrol is expected to provide assistance and information to the public, monitor snowmobile areas, facilitate communication and coordination with other backcountry users, work in conjunction with enforcement officials such as the RCMP and Forest Service Officers, and collect statistics and maintain records.

The SRMP hopes to implement Control Recreation Areas where the intensity of activity requires more concentrated management. CRA's place more management responsibility on commercial operators to ensure "safe and orderly" use of designated areas and are established within a commercial tenure. In this case CRA's will be used in snowmobile closure areas that coincide with high quality skiing. The SRMP hopes to use backcountry recreation to strengthen the economy within this region. Government is expected to work with local stakeholders to monitor the implementation of the plan and alter it according to new developments.

**Kinley, T. March 8, 2007. E-mail interview.**

According to Trevor Kinley the Recovery Action Plan for the South Purcell Subpopulation of Mountain Caribou (2001) was not implemented until March 2007. Correspondence with Trevor Kinley on this report is included below.

"Right now the provincial government is trying to decide what level of recovery to aim for in each population of mountain caribou. They are supposed to make an announcement in the spring. Right now, as part of the mountain caribou provincial Science Team, I and others have been trying to establish which areas would be open and closed to snowmobiling in the southern Purcell Mountains (as part of what will hopefully be a government-sanctioned recovery program). Nothing's final on that, although an access management plan (with caribou as a component) is semi-final in parts of the Purcells (west half of the former Cranbrook Forest District), and some signs requesting voluntary compliance have been put in place. In the meantime, we started documenting (mapping) areas of snowmobile use during last winter's aerial population survey, and will do so again this year if funding comes through for the survey. There's no formal monitoring or enforcement of compliance yet, since there is not yet any restriction on snowmobile

use in much of the southern Purcells, and only voluntary restrictions elsewhere (Cranbrook west). Again, this will likely change considerably if/when the provincial gov't makes a formal decision on the degree to which caribou recovery will occur in the Purcells.”

**Kinley, T. 2003. Snowmobile-mountain caribou interactions: a summary of perceptions and an analysis of trends in caribou distribution. Prepared for: BC Ministry of Water, Land and Air Protection, Victoria, BC. Unpublished manuscript.**

<http://www.qhms.org/userfiles/caribou.pdf>

This article contains some valuable primary research relating to snowmobile/caribou interactions. Members from a variety of interest groups, including snowmobilers and wildlife managers were interviewed on their knowledge of caribou/snowmobile interactions using a standardized set of questions. This paper also compares late-winter caribou census data to mapped snowmobile use areas to determine if proportions of caribou populations have declined in these areas over time. This paper does not provide “definitive” answers on the physiological effects that snowmobiles have on caribou, instead it examines the effect snowmobile activity has had on caribou populations. This approach is based upon the assumption that snowmobiling levels increased over the course of the study. Although there are issues regarding data quality used in this study, this research provided strong indications that caribou use of snowmobile areas have declined over time.

Perceptions on the affect of snowmobiles on caribou differed dramatically in this study. Some individuals perceived snowmobiles to be of little threat to caribou while other respondents viewed snowmobiles as a major conservation challenge towards the persistence of caribou. Variability in the responses of those interviewed was attributed to several factors, including: different people observing different responses by caribou, individuals filtering their observations through their own background and beliefs and consideration of the issues over several temporal and spatial scales. A missing common knowledge base may also be contributing to the varied responses.

Caribou have abandoned areas where snowmobile use has increased in extent and intensity; however, snowmobile use cannot be isolated from a host of other variables that may also be affecting distribution. Examples of caribou and snowmobile co-existence by some respondents were used as examples of displacement by other respondents, highlighting differences in individual perception. Direct encounters causing fleeing reactions appeared to occur in areas where snowmobile and caribou interactions were rare.

In some areas, direct encounters between snowmobiles and caribou were quite frequent. At some of these sites, (Frisby Ridge, Miledge/Chappell creeks, and Alan Creek) where few snowmobile restrictions occur, evidence of caribou displaying evasive behaviour was rare, thus implying: that caribou have become somewhat habituated to the regular, predictable snowmobile activity. Research also indicates that it is possible that less tolerant caribou from these areas have abandoned zones of high snowmobile use, while those individuals exhibiting a greater tolerance toward snowmobiles were not displaced from these areas.

Habituation is most likely to occur in areas with rugged terrain nearby, possibly because caribou have access to refuge areas that cannot be accessed by snowmobiles. This theory is supported by evidence of caribou abandonment in areas that have gentler, rolling topography including Wells/Gray North and Barkerville.

Results of interviews suggested that pioneering snowmobiles disturb caribou; however those animals not displaced by snowmobile activity can tolerate increased activity as the stimulus is usually predictable to the animals. Further increases in snowmobile activity will eventually cause disturbance to remaining animals, which usually constitutes a major shift in caribou activity. Kinley also acknowledges that caribou appearing habituated to snowmobile activity may have elevated levels of stress hormones. Research needs to be conducted to determine what sort of non-visible effects caribou may be experiencing as a result of disturbance. Kinley recognized that this information is currently lacking.

Barkerville and South Selkirk herds were among the herds with the largest population decline in snowmobile areas over time. Other major factors contributing to caribou avoidance of these areas may include road access, resource extraction activities, and recreation activities. This paper also suggests that snowmobile tracks may be useful to predators under very specific snowpack conditions and that more research is required on predator use of snowmobile tracks.

Kinley recommends studying the demographic and physiological effects of snowmobiles on caribou by monitoring levels of stress hormones in caribou feces. Additionally, he recommends studying potential cases of habituation and cases of recolonization whereby animals move into unused habitats. As well as mid-season displacement, Kinley also recommends examining how far caribou are found from snowmobile areas as opposed to simply determining whether they are inside or outside of the area boundaries. It is also noted that caribou habitat may need to be separated from snowmobiles by a greater distance to avoid further disturbance.

**Kinley, T. 2002. Recovery action plan for the south Purcells subpopulation of mountain caribou. Prepared for: BC Ministry of Water, Land, and Air Protection and Columbia Basin Trust Fish and Wildlife Compensation Program, Nelson, B.C.**

[http://wlapwww.gov.bc.ca/kor/wld/reports/pdf/CFI\\_caribou/rec\\_plan.pdf](http://wlapwww.gov.bc.ca/kor/wld/reports/pdf/CFI_caribou/rec_plan.pdf)

This paper outlines a recovery plan for the South Purcell subpopulation of mountain caribou that is based on a draft plan for the entire metapopulation in BC. The goals of this report are to increase the population of caribou from 18 to 100 by 2015 and to 200 by 2030. Additionally, this plan hopes to re-establish a population centre within the Purcell Wilderness Conservancy. All habitat data was collected in this region after the advent of extensive snowmobiling, thus making it difficult to correlate changes in the caribou population with snowmobile activity as various other factors are at work in this region.

The rounded shapes of many of the mountains within the Southern Purcell region combined with the extensive road networks, has allowed snowmobiles to access virtually all of the drainages in which caribou are present. When this paper was published, no areas within the region had been

closed to snowmobiles for the sake of caribou, although the Cranbrook snowmobile club had made some signs which requested avoidance of sensitive areas.

The combination of the factors listed above make the South Purcell population susceptible to disturbance in late winter. The author suggests that voluntary agreements in place with the Cranbrook snowmobile club should be a starting point for future agreements. Interim backcountry commercial licenses will apply to commercial tenures. The author proposes developing plans with snowmobile clubs and other recreation organizations to continue to build voluntary agreements within sensitive areas. This proposal will study the disturbance of mountain caribou that are currently under development elsewhere in BC, intending to evaluate whether the current guidelines are adequate to prevent significant disturbance. The author suggests that voluntary agreements have the potential to significantly reduce disturbance. The author recommends that backcountry recreation should be continuously monitored as areas occupied by caribou may change during recovery. This information will be used to make changes to backcountry recreation as needed. The author also recommends that indicators of disturbance situations for the caribou should be used to assess disturbance levels of recreation within the southern Purcell Mountains.

**Kinley, T. 2002. Population Survey for the South Purcell Subpopulation of Mountain Caribou. Prepared for: Columbia Basin Fish and Wildlife Compensation Program.**

[http://www.cbfishwildlife.org/reports/pdfs/2002\\_Population\\_Survey\\_for\\_the\\_South\\_Purcell\\_Mountain\\_Caribou.pdf](http://www.cbfishwildlife.org/reports/pdfs/2002_Population_Survey_for_the_South_Purcell_Mountain_Caribou.pdf)

This report examines the status of the South Purcell mountain caribou population. Snowmobile activity in mountain caribou habitat is a small component of this report and is provided in a section titled “Additional Anecdotal Evidence” regarding the expansion of backcountry recreation. Over a period of only 2 years the investigators noticed a major increase in snowmobiling and backcountry skiing/snowboarding within the region. Although there were very few areas associated with intensive snowmobile use, there were very few ridges on which snowmobiling was not evident. Snowmobiling was evident on ten times the amount of terrain that skiing/snowboarding was evident on. Snowmobiling was present in two drainages where it was not noticed in the first year of the study. No snowmobiling was observed in provincial parks. Greater road access, improved technology, and greater numbers of snowmobilers using the area were all factors that were believed to contribute to the patterns of increased use within the study area. Kinley found that there was greater overlap between late-winter caribou habitat and snowmobiling use than there ever was in the past. Extensive snowmobiling was recorded within all drainages connected to a central node for caribou in the region. One bull was apparently displaced by snowmobile activity, causing the animal to traverse a high alpine ridge into another drainage.

**Lewis, D. and McLellan, B. 2006. A review of mountain caribou-snowmobile interactions in the North Thompson and Columbia watersheds: A retrospective analysis of mountain caribou use of winter habitats relative to snowmobile activity. *Draft under review.***

Researchers examined existing data on caribou in order to determine caribou winter range use relative to snowmobile activity. Four hypotheses were examined, including 1). Whether “the proportion of time caribou use an area will decline as the amount of snowmobiling in the area increases.” and; 2). Whether caribou density would be less inside the snowmobile area than outside of it and furthermore, whether caribou densities would be less within intensively used portions of snowmobile areas when compared to use in less intensively used areas and; 3). Whether caribou used areas with higher amounts of snowmobile activity less often than similar areas which experienced less snowmobile use and; 4) Whether caribou used snowmobile areas less often “when snowmobilers are more active in the area, such as during daytime or weekends, than during times when they are less active.”

The first hypothesis, that the proportion of time caribou spend in an area declines as snowmobiling activity increases, was supported by the information available. The second hypothesis was supported by data from most regions, with the exception of Frisby Ridge near Revelstoke, where caribou were found more often within snowmobile areas than in other parts of the range. The third hypothesis was also supported by the data, suggesting that mountain caribou avoid snowmobile areas that are intensively used. An exception to this finding was the Frisby Ridge area, where caribou habitat destruction through fires may have confounded this aspect of the study. With respect to hypothesis four, researchers observed no significant difference in caribou use of snowmobile areas between different times of the day nor did they observe significant differences in caribou use of these areas when comparing weekdays to weekends,

Recent increases in snowmobile use throughout BC are not recognized as the main cause of caribou population declines in these regions. However, due to the low numbers of caribou and evidence for range abandonment in other areas due to snowmobiling, the authors recommend that managers adopt the precautionary principle when dealing with snowmobile closures. In particular, the authors recommend that plateau areas that have not had regular snowmobile traffic be closed to snowmobiles until caribou numbers increase. Plateau regions are targeted specifically because they offer fewer areas of refuge from snowmobiles, making it less likely that caribou will habituate to snowmobiles. To promote habituation, it is recommended that in the event of a caribou population increase, certain areas within plateau regions should be designated as snowmobile areas so that caribou become habituated to snowmobiles. The authors suggest that confining snowmobiles to specific areas will enhance spatial predictability and consequently allow caribou to become habituated to them more easily. However, according to these authors the best approach would be to develop snowmobile areas where there are no caribou, eliminating the potential for snowmobiles to come into conflict with caribou.

**Ministry of Water, Air and Land Protection. 2002. A Strategy for the Recovery of Mountain Caribou in British Columbia. Prepared by the Mountain Caribou Technical Advisory Committee. Version 1.0 September 2002.**

[http://wlapwww.gov.bc.ca/wld/documents/mtn\\_caribou\\_rcvrystrat02.pdf](http://wlapwww.gov.bc.ca/wld/documents/mtn_caribou_rcvrystrat02.pdf)

This paper outlines a series of recommendations presented by a technical advisory committee on mountain caribou and incorporates views from various interest groups. This report recommends working with user groups to develop recreation/snowmobile access plans for both “no harvest

zones” and “special caribou management zones”. This report suggests that disturbance through backcountry recreation could lead to decreased fitness and potential population-level effects.

This paper suggests that many commercial and non-commercial snowmobile clubs recognize the role they can play in directing backcountry snowmobiling. According to this report, tremendous potential exists for these commercial and recreational clubs to work with government biologists to voluntarily improve their activities within the backcountry. Working together within this capacity “requires flexibility, but provides better representation of different interests.”

This report suggests that stress may be experienced by caribou when approached by snowmobiles (e.g. Yellowstone study showed stress hormone levels increased in Elk in response to snowmobiles), however, this stress may not have an effect on the population dynamics of the species. This report presents evidence indicating that stress induced in caribou may increase the likelihood that caribou will relocate into terrain where mortality risks are higher. This report recommends redirecting snowmobile use through sub-regional planning to areas without sensitive caribou habitat. This report further recommends that encouraging initiatives (such as research proposals and trail mapping) be incorporated for various backcountry groups, including snowmobilers, to “improve interactions between caribou and recreationists in the backcountry.”

**Ministry of Forests and Range-Columbia Forest District. Snowmobiling in Caribou Country - Revelstoke area special notes on Frisby Ridge, Sale Mountain and Keystone/Standard Basin. Last visited March 17, 2007. Last updated March 9, 2004.**

<http://www.for.gov.bc.ca/dco/caribou.htm>

This government website describes signs of caribou activity and provides an image of the animal, their footprint and their feces. The website also provides a list of procedures that snowmobilers should follow when encountering evidence of caribou activity. Snowmobilers are advised to never follow caribou tracks or approach animals. Additional recommendations include, taking photographs from a safe distance, turning off snowmobiles in the presence of caribou and allowing animals to move away before starting engines. After the animals have left, this report recommends that snowmobilers leave the area. Overall, this report recommends that snowmobilers make every effort to minimize disturbance towards caribou. This website outlines the Frisby Ridge and Sale Mountain closure agreements and provides maps of the closures. No restrictions other than a “motorized restriction” exist at Keystone/Standard Basin according to this website; however snowmobilers are expected to follow the guidelines listed above when presented with evidence of caribou activity.

**Morris, M. July 2004. Parks Canada. Mountain caribou information sheet. Columbia Mountains Institute of Applied Ecology. <http://www.cmiae.org/mtncaribou.htm>**

A brief summary describing mountain caribou habitat, migration, and feeding regimes are included in this document. This article also briefly describes some of the potential causes of the mountain caribou decline including: earlier hunting regimes, fragmentation of the landscape at the lower reaches of feeding areas and helicopter and snowmobile disturbance within late winter habitat. One of the main causes of mortality of radio-collared caribou is avalanches. The document states that the Revelstoke herd has declined from 373 to 176 animals from 1994 to 2004.

**Mountain Caribou Science Team. 2005. Situation analysis: Mountain caribou in British Columbia. Species at Risk Coordination Office, BC Ministry of Agriculture and Lands, Victoria.**

<http://ilmbwww.gov.bc.ca/sarco/mc/Mountain%20caribou%20situation%20analysis.pdf>

A concise summary of many of the factors that are negatively affecting survivorship of mountain caribou are contained in this document. Snowmobiling is listed as one of many human-related disturbances currently affecting caribou. Although the short-term behavioural response to backcountry recreation activities may be minimal, biologists are concerned with the long-term effects of these activities on caribou, including displacement from preferred habitat. Consistent with other research, this study suggests that snowmobiling has increased in key areas of mountain caribou habitat, causing decreases in caribou activity within these areas. Similar declines have been noted in response to other backcountry activities as well.

Caribou displacement to lower quality habitat can potentially lead to increased rates of predation and exposure to avalanche-prone terrain. To avoid displacement to poor habitats, it is recommended that backcountry recreation, including commercial activities, be managed to a greater degree as this type of activity is one of the easiest factors to manipulate. Controlling commercial activities may involve developing regulations and guidelines which can be included as legal requirements in land management plans. This report recommends voluntary closures and guidelines for activities by individuals on Crown land. In critical areas, access restrictions are recommended. In comparison to “predation and the direct and indirect effects of habitat change” human related disturbance is considered to be a “less significant (although additive) threat to the viability of mountain caribou.”

This report concludes that caribou populations will continue to decline if the status quo is maintained. The probability of survival will vary across caribou ranges and will be dependent on several management actions. Increasing the survival of adult female caribou and calves is crucial to facilitate population recovery.

**Nellemann, C., Jordhoy, P. Stoen, O-G. and Strand, O. 2000. Cumulative impacts of tourist resorts on wild reindeer (*Rangifer tarandus tarandus*) during winter. *Arctic* 53 (1): 9-17.**

<http://pubs.aina.ucalgary.ca/arctic/Arctic53-1-9.pdf>

This investigation occurred in and around Rondane National Park in Norway. The research was designed to determine whether wild reindeer were avoiding tourist resorts during the winter. Nearly all caribou avoided the area 5 km around the resort. Female caribou with calves avoided an area 10 km around the resort. Yearlings and bulls were generally found closer to the resort and accounted for 92% of the sightings within 5-10 km of the resort. Measured variables, including lichen distribution and snow hardness did not differ in the 0-5 km region in comparison to the surrounding region. This unused distance likely represents a critical tolerance distance of caribou to areas of relatively high human disturbance. Higher sensitivity of maternal groups to anthropogenic disturbance may be a result of female caribou avoiding predation on calves. It is suggested that Norwegian reindeer may still associate humans with predation. Lichen biomass

decreased as distance from the tourist resort increased suggesting that caribou were overgrazing areas outside the tourist resort area.

As a consequence of human avoidance, caribou may experience reduced intakes of forage and decreased productivity within the herd. Caribou may also make use of a smaller proportion of available habitat to avoid human-caused disturbance. Overall, the carrying capacity of the region may decrease as a result of caribou being disturbed by anthropogenic activities. Such findings suggest that the effects of anthropogenic disturbance may be more extensive than once thought

Reindeer densities varied dramatically year to year within the study area. According to this article wildlife may travel through zones of development but often minimize use of areas surrounding a disturbance. This may decrease reindeer access to forage, however the extent of lost forage is unknown. Overgrazing forage may result in reduced energy intake of individual reindeer. If conditions are not optimal, reduced body condition may affect the growth of the fetus and lactation. Consequently Rondane has experienced low average calf production in ten years prior to this study. This study concludes that year-round tourism, coupled with fragmentation of caribou habitat by roads and powerlines, is reducing reproductive success and causing caribou range to be depleted of forage.

**Oberg, P.R. 2001. Responses of mountain caribou to linear features in a west-central Alberta landscape. M.Sc. Thesis, University of Alberta, Edmonton, Canada.**  
[http://www.rr.ualberta.ca/research/Caribou/pdf%20files/Oberg\\_2001.PDF](http://www.rr.ualberta.ca/research/Caribou/pdf%20files/Oberg_2001.PDF)

This article contains information that was frequently cited in literature from Idaho. This study examined the response of woodland caribou to linear features including roads, seismic lines and streams. Research took place within the foothills region of west-central Alberta. This study examined telemetry data from twelve mountain caribou and examined their positions on a GIS base map of linear features. Overall, researches found that caribou distanced themselves from linear features. Caribou avoidance of streams was recorded up to a maximum distance of 250m while avoidance of roads occurred at distances of up to 500m. Caribou may not be simply responding to human activity as indicated by the avoidance of inactive roads to distances of 250m. There was no significant avoidance of seismic lines, although caribou were found to occur more frequently around relatively older seismic lines.

The author of this study suggests that linear features may be affecting caribou distributions and may be facilitating “functional habitat loss.” However the “type, width, surrounding vegetation and replanted vegetation” help to determine how much habitat may be lost. The extent of habitat alterations associated with linear features depends on the characteristics of the situation. The roads examined in this study were generally greater than 30m in width, while the seismic lines averaged between 5 and 15m wide. Additionally, new seismic lines are revegetated and attempts are often made to reduce the line of sight down the seismic line.

**Powell, T. 2004. Réponse comportementale des caribous des bois au harcèlement par les motoneiges. M.Sc. Thesis, Université De Sherbrooke, Sherbrook, Québec, Canada.**  
<http://www.cmiae.org/compendium/reference177.pdf>

Roughly Translated: Behavioural response of woodland caribou to snowmobile disturbance.

This paper outlines experiments where the effects of snowmobiles on caribou activity were tested in the Coast Mountains in the Yukon. According to this report, the speed, approach angle, and size of the snowmobile group did not influence the reaction that caribou had towards snowmobiles. The effects of these factors may have been negated by vegetation and varied topography within the study area which may prevent the “looming” effect from occurring.

Groups of mature male caribou allowed the snowmobiles to approach more closely than maternal groups (cows, calves, and yearlings). Mean distance for closest approach was 189m for male groups and 289m for female groups. Initial flight distance did not vary between groups. In addition to being twice as likely to run from approaching snowmobiles, female caribou were also more likely to remain vigilant and spend more time moving than males. Female groups also spent more time running than male groups (mean 117 seconds vs. 20 seconds). This may be due to increased anti-predator behaviour within maternal groups. These types of responses increase female energy expenditure by 1.2%. Overall, female groups were expected to experience greater energetic losses due to disturbance since males returned to “fitness-maintaining” activities more rapidly after a disturbance.

No habituation was noticed within these caribou herds over a one day period, nor was there any evidence of habituation occurring during the entire season of research. The investigators felt that habituation probably occurs over longer periods of time than that in which this study took place.

Wolves were shown to frequently use the snowmobile trails, leading researchers to suggest that, predation upon caribou might increase as snowmobile trails offer no advantage to caribou. There was no evidence, however, to suggest caribou avoided snowmobile trails. In this study “strong and lasting” effects on caribou behaviour were not noted when snowmobiles were no longer present in high-use recreation areas.

The effects of disturbance were significantly shorter when caribou did not run during an encounter with a snowmobile. These investigators prescribe a distance of at least 500m between caribou and snowmobiles to minimize disturbance. Stopping a snowmobile mid-approach was shown to diminish flight initiation distance for male caribou only. Male caribou also displayed less of a reaction to snowmobiles as their group size increased.

Overall, the authors of this report recommend that low use snowmobile areas within the Yukon should not be promoted, but should continue to be monitored. Conversely, high use areas should have voluntary agreements implemented to avoid off-trail use and encourage non-disruptive wildlife viewing. “Facilities, such as viewing stations, maintained trail networks, and signage will likely be required to accomplish this.” Confining more snowmobiling to established trails is expected to increase the potential for habituation and buffer the caribou from disturbance.

**Price, G. and Roorda, L. 2006. Four year summary of the Quesnel Highland snowmobile-mountain caribou project, Cariboo region: December 2002-April 2006. Prepared for the Ministry of Environment, Environmental Stewardship Division, Cariboo Region.**

[http://wlapwww.gov.bc.ca/car/env\\_stewardship/ecosystems/reports/SnowCaribou4yrfinal.pdf](http://wlapwww.gov.bc.ca/car/env_stewardship/ecosystems/reports/SnowCaribou4yrfinal.pdf)

In this study, aerial surveys were used to identify potential caribou/snowmobile conflict areas in the Quesnel Highland study area. In total, 708 snowmachines and 241 caribou were observed. The average compliance with voluntary closure zones across the four years was 92.5%, with compliance varying between 78.3% and 98.2%. Caribou and snowmachine activity was recorded within 500 m of each other twenty one times throughout the study period (but the actors did not necessarily occupy the same space simultaneously). Three mountains received over 10 snowmobile visits per survey day. Detailed reports are available that summarize this study's findings for each year of the project and provide a more comprehensive review of the study than the summary report listed above.

**Quesnel Highlands Management Society (QHMS). Copyright 2006. Homepage. Last visited March 17, 2007. No indication as to when this website was last updated. Board of directors list dated January 2005. <http://qhms.org/index.php?page=2>**

This website outlines the goals of the Quesnel Highlands Management Society. This group of snowmobiling clubs is "united in addressing mountain caribou recovery issues and concerns directly involving mountain snowmobiling". This group is actively involved in management planning in partnership with the Ministry of Sustainable Resource Management and the ministry of Water Land and Air Protection in Williams Lake. The group is committed to maintaining and expanding snowmobile areas within levels that are compatible with caribou sustainability. Their area of concern encompasses Wells and Barkerville in the north to 100 Mile House in the south. This group participates in signage programs, snow patrol, and information programs. This website provides a list of directors (as of January 2005), maps of several mountains within the region, a list of links devoted to some websites related to caribou and/or snowmobiling, and a library comprised of reports completed by the QHMS and government.

**Quesnel Highland Management Society. 2003. The Importance of objective risk assessment when implementing management policy "Controversy stemming from "don't know" risk assessment and combining "Play-safe" management policies" Unpublished report (Found on Quesnel Highlands Management Society website) <http://qhms.org/userfiles/adressing.htm>**

This report was produced by the QHMS to support their position regarding snowmobiling in mountain caribou habitat. No references were included within this report. In this paper the QHMS suggest that MWALP should be an advisory group for independent bodies who should sift through available information in order to produce management solutions. The QHMS suggests that MWLAP is making all of the rules and conducting all of the studies on this particular issue. This report suggests that MWLAP idealism is getting in the way of objective risk assessment. The authors suggest that this type of approach could lead to poor management and unending controversy.

This paper outlines some of the historical agreements regarding this red listed species. The QHMS was involved in access management (snowmobiling) within the Mountain Caribou Strategy (2000), however they experienced disagreements regarding the meaning of the term “Degree of Risk,” which was often used in the strategy.

Controversy has erupted over caribou and recreation, due to difficulties quantifying the effects of backcountry recreation. This report suggests that good data needed to evaluate the effects of snowmobiling on mountain caribou is not available. Due to this dearth of data, management solutions are solely based on perceived threats and precautionary management approaches.

Although this report concedes that snowmobiles have the potential to displace caribou, it also requests a detailed analysis of the extent of safety net required to prevent displacement of mountain caribou so that unnecessary restrictions are not forced upon snowmobilers. The report suggests that conservation measures may have been drawn out too hastily to implement proper scientific rigour. It suggests that critics of this overly extensive conservation program are often seen as enemies of mountain caribou in light of “Precautionary Management”.

This report suggests that the government’s position in the matter may be unreasonable and highlights a few facts to back up this argument. It suggests that some of this controversy stems from the different socio-economic backgrounds of biologists and snowmobilers, prejudice towards snowmobilers within the ministry, and the “redneck” image snowmobilers are often associated with. It also suggests that emotional dogma associated with wildlife conservation may be colouring the discussion of caribou/snowmobile interactions. This paper recommends placing the conservation of caribou foremost in this discussion, while maintaining socio-economic benefits for stakeholders. The report further suggests that QHMS volunteer activities have been an asset to the communities that they represent in the face of insufficient government representation.

**Revelstoke Snowmobiling Club. February 2007. Are you ready to lose more riding areas? Newsletter Issue 4. <http://www.sledrevelstoke.com/newsletter.pdf>**

This newsletter outlines many of the proposed snowmobile closures in the Revelstoke region due to the caribou distributions within the region. The authors propose that 75% of their remaining snowmobiling area will be closed. They outline several arguments that members are expected to present to government including claims that evidence regarding the deleterious effects of snowmobiles on mountain caribou populations is inconclusive and that caribou are better able to access their food sources using snowmobile tracks. Furthermore, members argue that snowmobiles are being restricted unfairly in comparison to helicopter and skiing operations and that the option of predator control has not been properly addressed.

**Roorda, L. 2006. Quesnel Highland snowmobile-mountain caribou monitoring report Cariboo region. Prepared for Ministry of Environment, Environmental Stewardship Division, Cariboo Region. [http://wlapwww.gov.bc.ca/car/env\\_stewardship/ecosystems/reports/SnowCaribouFinal2006.pdf](http://wlapwww.gov.bc.ca/car/env_stewardship/ecosystems/reports/SnowCaribouFinal2006.pdf)**

Below are excerpts from my e-mail interview with Lara regarding this report on March 13 and 14, 2007.

*“The Revelstoke area has/had a similar voluntary closure/caution agreement in effect (Frisbee Ridge, Sale Mountain, Keystone/Standard Basin).... I'm also not certain if the Revelstoke project is still monitoring. ...Our monitoring project wrapped up last winter and none has been done this winter due to a lack of funding. Although, depending on what decisions SaRCO (the Species at Risk Coordination Office) makes regarding caribou recovery some sort of monitoring may occur in the near future within the Cariboo Region.”*

*“There are similar reports for our monitoring program from 02/03, 03/04 and 04/05. You can contact Geoff Price at [[Geoff.Price@gov.bc.ca](mailto:Geoff.Price@gov.bc.ca)] if you would like a copy of these or the four year summary report. To the best of my knowledge these are the only closures to snowmachines in the Cariboo Region [the closures outlined in the report below]. SaRCO has proposed the conversion of some caution zones to closure zones and consultation is underway.”*

During this study, snowmobile caution areas were surveyed over the course of nine fixed-wing flights between January 8th and April 30<sup>th</sup>, 2006 in the Quesnel Highland area (several locations near Quesnel Lake). These flights located 367 snowmobiles and 100 caribou which were located either within or adjacent to caution or closure zones. On twelve occasions caribou and snowmobile activity were located within 3 km of each other. Twenty-two snowmobiles were located in five separate closure areas. The author recommended one area (Grain Creek) be switched from a caution zone to a closure zone as a result of caribou numbers in this area. They also recommend that the government works with snowmobile clubs to ensure that signs outlining proper etiquette within closure zones and caution zones are maintained at all access points and within areas of concern. Additional recommendations include fostering self-policing within the snowmobile clubs and periodic monitoring of the caution areas by the MOE.

**Seip, D.R, Johnson, C.J. and Watts, G.S. 2006. Displacement of mountain caribou from winter habitat by snowmobiles. <http://www.bcnorth.ca/atvdamage/seipMar06.pdf>**

This academic article outlines the findings of a study conducted on the Hart Mountains in central British Columbia, east of Prince George, BC. The investigators used a RSF (Resource Selection Function) to examine habitat quality among census blocks. Previously, the authors had recorded caribou on 5 census blocks with little or no snowmobile activity, but observed no caribou activity on a census block experiencing intensive snowmobiling use. The RSF was used to determine whether or not the absence of caribou on the intensively used census block could be explained by differences in habitat. According to these investigations, the habitat found on this census block could support 53-96 caribou within a 95% confidence interval. Therefore, the authors of this study concluded that intensive snowmobiling had displaced caribou and recommended that snowmobile activity be “restricted from all or most of high quality mountain caribou habitat as part of the recovery planning process.”

On his research project web page Dr. Chris Johnson indicated he is working in co-ordination with Dr. Dale Seip on a project regarding the displacement of mountain caribou by recreational snowmobilers.

**Seip, D., Hatter, I., Surgenor, J., Prince, C., Marshall, B., Vold, T. 2000. Snowmobile.ca. Snowmobile interactive news magazine: mountain caribou and sledding in BC. Last visited February 15, 2007. [http://www.snowmobile.ca/mha\\_internal/article.php?sid=120](http://www.snowmobile.ca/mha_internal/article.php?sid=120)**

This paper outlines the problems currently facing mountain caribou and suggests that high-density snowmobile use may be responsible for some mountain caribou displacement. The website indicates that evidence of displacement exists in several areas historically inhabited by caribou that have recently been abandoned following increases in snowmobile activity. Some novel recommendations presented on this include: developing an educational program regarding caribou disturbance for recreational snowmobilers, promoting responsible snowmobile club policies, (including off-trail restrictions code of conduct and self-policing), focusing trail expansion in areas experiencing significant snowmobile use, securing dispersed snowmobile use in specific areas, developing local agreements including seasonal and geographical restrictions (such as travel corridors and restricted dispersed use) with snowmobile clubs and legal closures of sensitive areas, including early and late winter foraging areas

**Simpson, M. 2003. CAM 521 reflective practicum in conflict analysis and management snowmobile use in mountain caribou habitat in the Cariboo Mountains final paper. Unpublished report. (Found on Quesnel Highlands Management Society website). <http://qhms.org/userfiles/final.html>**

This paper outlines and analyzes the conflicts occurring between government officials and snowmobilers within the Quesnel Highlands region due to the imposition of more regulations on snowmobile activities in the region. For snowmobilers, part of the conflict appears to stem from the imposition of regulations, even when the effects of snowmobiling on mountain caribou are unclear and only having the potential to occur. These clubs have an interest in ensuring that caribou regulations are supported by science.

Increased snowmobiling within this region is attributed to improved technology and increased access through expanded industrial activities. This paper outlines some of the potential problems that snowmobiles cause within mountain caribou habitat.

According to this report, snowmobiling offers small BC communities a chance to diversify their economy. Part of the caribou/snowmobiling conflict stems from the inability of government employees to relate to snowmobilers. Accordingly, government employees are less interested in concerns and interests of snowmobilers than they are with preserving caribou. Solutions to this problem are presented using Allport's contact hypothesis, recommending increased contact between government officials and snowmobilers. The author takes Allport's theory further, suggesting that the positive effects of intergroup contact could only be achieved if both parties cooperate, share equal status, share common goals and have support from authorities.

According to this article snowmobilers are perceived as "rednecks" of lower socio-economic status than government biologists. Government biologists are often drawn to their positions

because they have an altruistic attitude towards the environment. These individuals are attracted to self-propelled recreation and have “disdain” for motorized recreation. The author further suggests that, according to government employees, snowmobilers are perceived as only caring about their sport and do not understand the importance, or care about mountain caribou.

This report suggests that the Ministry of Sustainable Resource Management, with its mandate to examine environmental issues in addition to economic ones, was more qualified to address the caribou/snowmobile conflict issue than the Ministry of Water Land and Air Protection, whose mandate focuses exclusively on the environment. Snowmobilers do not believe that they share equal status with the government on this issue; they perceive the relationship as a “David and Goliath” scenario.

This paper suggests that snowmobilers and the government share a goal of maintaining healthy caribou populations into the future. According to this report, one of major sources of conflict between the two parties involved in this conflict “is that government biologists recommend precautionary measures of closing all areas to snowmobiling, and snowmobilers believe that they do not adversely affect mountain caribou sufficiently enough to warrant total closure.”

Due to their common goal, intergroup cooperation was eventually achieved between the government and snowmobilers over the course of several years. This paper suggests that if more government officials went snowmobiling with the local clubs then they could better comprehend the impacts that snowmobiling has on mountain caribou. Apparently representatives for both MSRM and MWALP spent a day in the field with the QHMS. Both parties feel that “both feel that the government representatives increased their understanding of the snowmobilers impacts on mountain caribou habitat, the limitations to snowmobiles in alpine areas, the nature of the sport, and the enjoyment of the sport.” Although the head of QHMS experienced a greater respect for the individuals involved within the government, he did not understand the government’s approach in greater depth.

Relations between these groups were seen to be improving at the time of this report; “each group finds the other more cooperative, and that they have moved beyond positions and are discussing interests”. A two year voluntary agreement between government and snowmobilers was signed on 27 March 2003, with both parties being relatively happy with its contents. Snowmobilers were eager to ensure that their members complied with this agreement.

The author of this article suggests that instead of QHMS producing its own documents, which can often be perceived as non-academic, QHMS resources could be better spent critiquing existing documents in collaborative meetings. Apparently a working relationship has been developed between QHMS and the government.

**Simpson, K., and Terry, E. 2000. Impacts of backcountry recreation activities on mountain caribou – management concerns, interim management guidelines and research Needs. B.C. Ministry of Environment, Lands and Parks, Wildl. Branch, Victoria, BC. Wildl. Working Rep. No. WR-99. 11pp. <http://wlapwww.gov.bc.ca/wld/documents/techpub/wr99.pdf>**

Potentially valuable sections of this paper include “Potential Impacts of Backcountry Recreation Activities on Mountain Caribou”, “Management Concerns for Each Caribou Sub-Population”, “Interim Management Guidelines”, and “Research Needs”. This paper suggests that the literature pertaining to caribou and snowmobile interactions is fairly limited.

Prior to this report, only one study specifically addressed the interactions between mountain caribou and snowmobiles. According to this report, the relative impacts on ungulates vary in relation to several factors, including “species, the frequency of snowmobile traffic, noise levels, rate of travel, human scent, and terrain type (open vs. forested).” Snowmobiles may pose the greatest threat to caribou due to the propensity for overlap between high quality snowmobile terrain and high quality caribou habitat. It is also acknowledged that snowmobilers have the ability to access and affect large areas of subalpine terrain.

Of particular concern is the displacement of caribou from their late winter range, which is usually occupied from January to April. Displacement from these areas may decrease the capacity of caribou to survive due to reduced intake of forage and increased energy expenditure while searching for forage. This displacement may force caribou into steeper terrain, which is more prone to avalanches. Another concern is that compacted trails left by snowmobiles will increase predators’ access to mountain caribou. One of the greatest concerns stated in this report is that accessibility to the sub-alpine is increasing for snowmobilers and powder snowmobiling is becoming increasingly popular.

This paper outlines some interim management guidelines based on the precautionary principle. The authors recommend that snowmobiles stay out of highly sensitive areas which typically include late-winter foraging areas, but may also include early-winter forage areas. It is also recommended that snowmobiling be regulated with zoning and timing restrictions and that trail expansion be prohibited in sensitive areas. Responsible policies should be promoted within snowmobile clubs and monitoring should take place in areas experiencing high snowmobile use. Furthermore it is recommended that helicopter use be restricted to altitudes above 300m and along designated paths that avoid caribou habitat.

**Simpson, K. 1987. The effects of snowmobiling on winter range use by mountain caribou. Wildl. Working Rep. No. WR-25. B.C. Ministry of Environment, Lands and Parks, Victoria, BC. <http://wlapwww.gov.bc.ca/wld/documents/techpub/wr25.pdf>**

This is a seminal article that appears to be one of the most widely cited within subsequent literature. This article outlines primary research conducted by Keith Simpson in popular snowmobile use areas near Revelstoke, BC. During his investigation, Simpson examined snowmobile activity on Frisby Ridge and Boulder Mountain and its potential impacts on caribou dispersal on these ridges. In addition, Simpson took a snowmobile onto adjacent alpine areas that did not experience snowmobile traffic in order to investigate caribou reactions to snowmobiles (approaching caribou up to a distance of 100m away). Simpson observed how caribou reacted to visual detection of the snowmobile versus auditory detections. The response of caribou to the scent of the occupant/snowmobile was also examined and compared to visual and auditory reactions displayed by the animals. The research hypotheses of this study included: determining whether snowmobiling affected the range of Caribou in Revelstoke, what factors influenced the

response of caribou to snowmobiling (sight, smell, or sound), and what level of snowmobiling might be acceptable to caribou.

According to this article, significant snowmobile activity can decrease useable caribou range and negatively impact reproduction and survival of caribou on winter ranges. Disturbance caused by snowmobiles may cause “delayed death” in large mammals or may disrupt bonds between cows and calves. Caribou may be more vulnerable to predators and may experience greater difficulty finding food due to decreased range as a result of snowmobiling. Due to snowmobile activities, caribou may attempt to cross steep slopes and may experience more avalanche-related mortalities as a consequence. The study area encompassed the preferred late-winter habitat for caribou, which is characterized by open terrain interspersed with clumps of trees.

For this study, Simpson divided Frisby ridge into three sections roughly equivalent in size. One section was heavily used by snowmobilers, another moderately used by snowmobilers, and the other rarely used by snowmobilers. During this study, Simpson monitored a voluntary closure of the middle and northernmost sections of this ridge (the sections experiencing moderate and little use). Weekly aerial surveys and questionnaires placed at the base of the trails were used to quantify snowmobile use on Frisby Ridge in 1984 and 1985. He compared caribou movements between sections of varying snowmobile use in order to assess the effects of snowmobiles on caribou.

On Frisby ridge the 15 animals that used this area each year exhibited a distinctive shift northwards between February and April. By the end of the season 50% of them occupied the northernmost part of the ridge. However, during the 1984-85 closure most caribou remained on the middle portion of the ridge, while occupancy of the busy southernmost section decreased to zero. Overall, the number of caribou seen per aerial flight appeared to increase in the middle and northernmost sections after the closures had occurred. At this point, caribou had all but abandoned Boulder Ridge where a snowmobile cabin had been built.

In the second part of this study, Simpson approached groups of caribou on snowmobiles to test the reactions of the animals to the machines. Caribou that caught Simpson’s scent ran away on every occasion,. Visual and auditory detections caused caribou to walk away on most occasions; however three groups did not react and six ran away. Three of the groups that ran away had also caught Simpson’s scent. Sight elicited the shortest flight distance and scent and sound had successively longer flight distances. Spooked caribou generally moved less than 1km and continued using areas within 2km of where the disturbance occurred. According to the author, sighting a snowmobile may elicit the smallest flight response because caribou may derive security from being able to sight a snowmobile since they can assess the movements of the “intruder” and determine the potential danger. It is suggested that caribou withdrew more rapidly when they could catch human scent because, as a hunted population, they have learned to avoid human scent. Sound in combination with scent caused caribou to run away, while sound in combination with sight caused little reaction. This response suggests that caribou do not associate the sight or sound of snowmobiles with bad experiences. Human scent and the high mobility of snowmobiles probably caused caribou to avoid areas heavily used by snowmobiles. Being surrounded by snowmobiles may disturb caribou as they are unable to locate multiple threats. According to this

research, caribou are able to deal with limited numbers of snowmobiles, although excessive snowmobile use may cause animals to panic and abandon areas.

This report suggests that the decreased use of Boulder Mountain by caribou was a result of human activity since the few caribou sighted on this ridge were located on the margin of the snowmobiling area. On Frisby Ridge, increased snowmobiling within this area seemed to be the main reason that caribou were displaced northwards along the ridge. When the middle section of Frisby Ridge was closed to snowmobiling, caribou stayed away from the frequently used southern portion of the ridge (i.e., southern portion had an average of 22 snowmobilers/day). One citation within this report suggests that caribou must experience persistent harassment to abandon ranges. The author suggests that this level of harassment had been achieved at Frisby Ridge and Boulder Mountain, thus causing the observed patterns of distribution.

The author indicates that due to previous capture events, helicopters are often associated with threat and have much more potential to disturb caribou than snowmobiles. Heli-skiers are suggested to have less of an impact on caribou than snowmobiles as skiers are usually in tight knit groups and spend limited time in an area.

The author suggests that “the present levels of snowmobile use on Boulder and Frisby Ridges are incompatible with continued occupancy of the areas by caribou.” Simpson also suggests that caribou tolerance of snowmobiles will increase if they are not harassed by snowmobilers. It is recommended that human use of caribou habitat should be minimized during times when caribou are present. However, caribou may continue to use areas that are as close as 0.5km to areas with intensive human activity and may become habituated to low levels of non-harmful activity that is “gradually increased.” The author recommends that the partial closure on Frisby Ridge should stay in place and that the marked access-trail no longer be maintained. He recommends that only 10 snowmobiles should be used on the ridge per day and that there should be less than 100 machine hours per month between February and April. He also recommends erecting signs describing the closures and the protocol for behaviour when caribou are encountered.

Simpson recommends that the majority of snowmobiling activity should occur on Boulder Mountain and that trail maintenance and construction activities should be directed toward this area. He further recommends that a remote part of the Boulder Mountain area should retain its rustic access so that if caribou access this area they may become habituated to snowmobiles. Unlimited access to Boulder Mountain, however, contradicts the Specific Use Permit which suggests that snowmobile use does not interfere with caribou migration. It is also recommended that ridges occupied by caribou around Revelstoke should not be promoted as destinations for snowmobilers and that riders should be diverted into regions that are unoccupied by caribou. Simpson also recommends that the Specific Use Permits are incorporated to help quantify use within the region and determine acceptable levels of use. Simpson suggests that if caribou remain confined to the closed portions of Frisby Ridge then the south portion should also be closed. He recommends that an impartial third party should monitor caribou and snowmobile use on these ridges.

**Snowmobile Revelstoke Wildlife Conservation Society. Last visited February 8, 2007. Updated in 2007, (possibly on February 8, 2007).**

<http://www.sledrevelstoke.com/wildlife.htm>

This webpage outlines how snowmobilers should behave in the presence of mountain caribou. These are the general rules presented by the club:

- *If caribou tracks are observed, do not follow them*
- *If you see caribou, do not approach*
- *Only take photographs from a safe distance*
- *If caribou are close, turn off your snowmobile and allow the animals to calmly move away. Make every effort to minimize disturbance.*

This website also outlines the rules and restrictions associated with the Frisby Ridge and the Sale Mountain snowmobile agreement. Specific areas within Frisby Ridge have been closed to snowmobile traffic from December 15th until April 15th in order to preserve important foraging habitat for caribou. This website displays the signs associated with closure areas and includes a map detailing closures along the Frisby Ridge snowmobile area. According to this agreement, if snowmobilers fail to comply with the restrictions then the whole mountain will be closed down. These are the rules outlined by the club in the Frisby Ridge Snowmobile Agreement.

A few simple rules include:

- Respect the animals and their habitat, do not approach them or follow tracks. If you come upon animals, try to go around at a safe distance or shut your machine down until they leave the area.
- Stay out of restricted areas and use only the trails marked in the open areas. This allows the animals to avoid or adapt to the use areas and the travel corridor. The club had worked hard to keep this mountain open and depends upon your cooperation for it to remain open for snowmobiling.
- The trap line trail through the Fire Pit area is for use only by the registered trapper who owns the line. Do not follow any tracks into this area.
- All snowmobilers must comply with the recommended guidelines if this program is to continue to be successful and the areas to remain open.

This agreement was developed with co-operation between the Revelstoke Snowmobile Club, the Ministry of Environment and the BC Snowmobile Federation.

The Sale Mountain trail agreement addresses the needs of various users of the mountain, including nordic and heli-skiers and outlines how each of the groups should use this area. According to the agreement, snowmobilers are expected to respect the land used by other users and refrain from entering Mount Revelstoke National Park. In order to keep this area open to snowmobilers, they are also expected to respect the mountain caribou herd by following the general guidelines presented above.

There is no indication on this website as to whether or not these agreements are successfully protecting caribou. As a result, these agreements might not represent a set of best-practices. This website also provides additional educational material about mountain caribou ecology for snowmobilers.

**Species at Risk Coordination Office: Integrated Land Management Bureau. 2007. Snowmobile (1st Edition) guide for the Columbia and Rocky Mountains of British Columbia: openings, closures, trails, clubs.**

The purpose of this document is to suggest ways in which conflict between wildlife and backcountry users (including snowmobilers) can be minimized. The document maps out voluntary and legal closure agreements and snowmobile opportunity areas. According to this brochure, it is the responsibility of the snowmobiler to be aware of closures. Failure to comply with the closures and regulations in place may result in “fines, equipment seizures, and ultimately closure of areas to everyone.” Each rider is expected to be an ambassador for the sport and is expected to be considerate of the environment during each ride. Riders are further expected to communicate their “experiential preferences” to different user groups to minimize conflict. This brochure recognizes the importance of backcountry recreation to BC’s economy. According to a section on backcountry etiquette, snowmobilers may be responsible for disturbing sensitive ecosystems, wildlife, and other backcountry users. This section suggests that backcountry activities should be separated in time and space in order to diminish the amount of disturbance caused by them.

Although snowmobiling is permitted on Crown Land, this brochure recommends that snowmobilers concentrate use on opportunity areas mapped out in the brochure. Opportunity areas may be illustrated on a recreation map reserve as an established site or trail and usually have signs in place at the site or trailhead. Opportunity areas may also have groomed trails and warming huts to accommodate users. Furthermore, these areas are usually promoted by “local user groups” and are usually identified in brochures, or on the Ministry of Tourism Sports and the Arts Recreation Sites and Trails website (<http://www.tsa.gov.bc.ca/publicrec/>). Local dealers are recognized as an additional source of information for opportunity areas.

Mapped closures included in this brochure are based on legislation pertaining to the Wildlife Act, and Land Act. The brochure also maps out snowmobile closures relating to Cross Country Ski Areas, Provincial/National Parks and Non-Motorized Resources Management Zones (RMZs), Guidelines for snowmobile conduct are focused towards eliminating conflicts between different backcountry user groups and ensuring that sledding is conducted in a safe manner. Guidelines for snowmobile etiquette in caribou habitat include: keeping an appropriate distance from wildlife and tracks and shutting down machines if caribou are encountered. Another section outlines why mountain caribou are endangered and how the mountain caribou are affected by the presence of snowmobiles within their habitat. Disturbance may cause caribou to be forced into less suitable habitat or dangerous terrain and can deplete energy reserves during critical times. Additionally, trails created by backcountry users can increase the ability of predators to access caribou habitat. The brochure recommends that snowmobilers ride in permitted areas and avoid areas that are marked as “environmentally sensitive” or protected.

This brochure also indicates that riders should be responsible for knowing where caribou habitat is located and where closures may exist within that habitat. Generic rules pertaining to snowmobile/caribou interactions are outlined again in this brochure. Environmental Stewardship tips and Emergency Contacts are also provided. Enlarged maps of closures and opportunity areas are provided for southeastern BC regions stretching from Valemount to the international border.

**Tender loving caribou. 2006. Grist: environmental news and commentary (US). Last visited February 15, 2007. Last updated in 2006.**

<http://grist.org/news/daily/2006/09/27/6/>

This article summarizes a recent court decision intended to conserve mountain caribou populations in Idaho. A “470-square mile recovery zone in the Idaho Panhandle” was designated as a caribou reserve until it is demonstrated that snowmobiles and caribou can peacefully co-exist. This decision was supported by evidence suggesting snowmobiles scare caribou from feeding and calving grounds and increase predation rates as compacted snowmobile trails provide predators easier access to caribou habitat.

This ruling was later overturned according to the BCSF website. Currently snowmobile use is restricted to on-trail use only.

**Webster, L. 1997. The effects of human related harassment on Caribou. Unpubl. Rep. B.C. Ministry of Environment, Lands and Parks, Williams Lake, BC. 33pp.**

<http://srmwww.gov.bc.ca/car/resinv/wldinv/inventory/caribou/mtncar/harass/impacts.pdf>

Included within this report is information pertaining to “caribou harassment” by snowmobiles and a list of recommendations for preventing caribou harassment. Similar to other literature, this report suggests that caribou expend more energy in the presence of snowmobiles than they would otherwise. In the presence of snowmobiles, caribou may run through deep snow or leave optimum foraging/cover areas. Large numbers of machines may cause a group of caribou to abandon a home range and move into areas with less suitable habitat. Contrary to some beliefs, caribou tend to avoid snowmobile tracks and do not likely use tracks to access alpine areas. It is also noted that caribou are digging for lichen expend more energy digging through a snowmobile track than digging through crusty snow.

Recommendations pertaining to proper snowmobile etiquette in caribou habitat include: not attempting to habituate caribou to “human related disturbance”, limiting the visibility of areas surrounding active roads so that caribou are screened from vehicular disturbance, and timing caribou surveillance activities so as not to interfere with calving or rutting and other times when the caribou may be particularly sensitive to disturbance (in addition to maximizing the surveillance aircraft’s altitude).

**Welsh, T.E. 2002. Impacts of snowmobiling and cross-country skiing on ungulates: a literature review. Final Report for Scientific Approaches to Environmental Problems And Wildlands Center for Preventing Roads.**

<http://www.wildlandsepr.org/databases/bibliionotes/index.html>

This report was produced for an American environmental group and investigates impacts of snowmobiling and cross-country skiing on ungulates. A few spelling and grammatical errors undermine the credibility of this article a little bit, although the author seems to do an excellent job of summarizing and deriving conclusions from the literature. By providing several examples of how ungulate and snowmobile interactions have been studied, this article summarizes relevant information relating to the effects of snowmobiles on ungulates.

The author concludes that, on a per capita basis, cross-country skiing should have a greater impact on ungulates than snowmobiles, particularly if ungulates encounter cross-country skiers in unpredictable locations. Snowmobiles are suggested have the greatest impacts on ungulate populations due to their speed, power, and indirect impacts on the environment.

During the winter, energy conservation is of paramount importance to ungulates since this season may result in an “energetic bottleneck”. Possible responses to these types of disturbance include “elevated heart rate, increased alertness and vigilance, a slow retreat, fleeing, or avoidance of portions of their habitat”. Stress may cause “lower birth rates, amplification of the effects of competition, a weakened immune system” and in some cases death. Effects of disturbance may not be evident until years after the disturbance has taken place. Prolonged exposure to disturbance may lead to a number of physiological changes that can contribute to increased risk of mortality and reduced reproductive output.

In one study examined by this report, reindeer were not adversely affected by one snowmobile visit per day. A “moderate” response to snowmobiles caused reindeer to consume 0.4% of the daily energy expenditure, and sacrificed 0.4% of the reindeer’s grazing time. This study only examined visible behaviour of caribou and did not incorporate physiological changes that caribou may experience when disturbed by a snowmobile. It can therefore be assumed that rates of energy expenditure may be underestimated in this study.

Another study found that deer did not alter their home range in response to snowmobile activity, however, activity did increase in response to the presence of snowmobiles. Elk approached directly by cross-country skiers moved away from the skier, expending an estimated 5.5% of their daily energy expenditure in doing so. During this study elk noticeably changed their home ranges even when snowmobiles were not present, thus making it difficult to demonstrate that changes in home range were a result of snowmobile activity.

Deer heart rates were shown to increase in response to snowmobile activity, although it was impossible to demonstrate that other factors were not affecting these rates. In studies measuring glucocorticoid hormones in elk and bison, greater amounts of this hormone were produced in response to off-trail recreational activity as oppose to recreation taking place on trails. Elk stress hormone levels were shown to fluctuate daily in response to snowmobile activity.

“Various factors such as topography, weather, differences within and between species, time of day, vegetative cover, angle of approach, elevation of approach, whether an animal is alone or in a group, the sex of the individual or members of the group, frequency of disturbance, number of disturbances, and duration of disturbance” can all influence the manner in which an animal is impacted by disturbance. According to this report, unpredictable cross-country skiers may have more of an impact on animals than predictable snowmobile activity. Additional factors such as pollution and snow compaction caused by snowmobilers and skiers may affect wildlife adversely. The author recommends restricting recreationists to established trails and keeping these trails out of ungulate habitat. The author also recommends education of recreationists to minimize disturbance and minimize occurrences of intimate contact with wildlife. Additionally, the author would like to see multiple groups participating in trail building exercises to ensure user compliance to trail systems.

According to the author, almost every study reviewed suggested backcountry recreation was causing some negative impacts on ungulates. Cross-country skiers may have a more immediate impact on ungulates due to their unpredictability. One of the solutions to this unpredictability may be to further restrict human activities to trails, where skier presence would be more predictable to ungulates. The noise produced by snowmobiles may contribute to their predictability as ungulates are able to hear snowmobiles at greater distances than skiers, reducing the likelihood that animals will startle upon hearing a snowmobile.

On average, snowmobiles produce 73 decibels of sound recorded at 50 feet away (similar to the noise produced by a busy city street); however when a snowmobile is accelerated the output may be 5 to 10 decibels more

This article suggests that the short duration and narrow scope of many studies have left these studies deficient. The author recommends that ungulate populations be monitored for many seasons to better determine long-term effects of recreation on ungulates. Apparently the strongest impacts of recreation on wildlife occur within areas where animals are unfamiliar with recreationists. Although snowmobiling is more predictable to ungulates than cross-country skiing, snowmobiling can cause major disturbances to wildlife when animals are chased with machines. Managing behaviour of snowmobile users is thus recognized as an important measure to minimize winter disturbance of ungulates.

**White, P.J., Davis, T., Borkowski, J.J., Garrott, R.A., Reinhart, D.J., and McClure, D.C. 2006. Review Draft. Behavioural responses of wildlife to snowmobiles and coaches in Yellowstone. [http://www.nps.gov/vell/parkmgmt/upload/2006wildliferpt\\_finaldraft.pdf](http://www.nps.gov/vell/parkmgmt/upload/2006wildliferpt_finaldraft.pdf)**

This study took place in central Yellowstone in the northern Rocky Mountains of Montana and Wyoming. Within Yellowstone park, it is required by law that all groups of recreational snowmobilers be guided by a trained operator. Snowmobile fleets must also make use of the quietest and cleanest machines available. This study was conducted during December-March

winters between 2003 and 2006. In this study investigators observed interactions between “Over-Snow-Vehicles” and animals.

In this study 48% of elk showed no response to passing snow vehicles and only 7% either traveled or took flight. The odds of invoking a response in elk increased with interaction time. The odds of observing a response were 3-4 times greater for each minute increase in reaction time. The threshold for eliciting a change in elk response was 6 minutes of interaction time. Distance from the road and the size of elk groups mitigated the effects of increased interaction time. The effects of group size at reducing the odds of a response reached a maximum for bison and elk when groups consisted of 7-8 animals. Movements of elk were found to be highest if humans approached elk, and lowest if humans showed no reaction in response to the presence of elk. Vigilance activities increased with increasing group size. Elk populations remained relatively stable despite significant increases in visitation from 1967 to 2002.

Low intensity responses of wildlife to snowmachines suggest that wildlife have become habituated to their presence. “Habituation occurs when an animal learns to refrain from responding to repeated stimuli that are not biologically meaningful.” Habituation was noticed in bison within seasons, however changes in predicted movements of elk across the winter were negligible. Habituation is likely facilitated in Yellowstone since snowmachines “traveled through the study area in predictable ways, remaining confined to roads and typically without humans threatening or harassing wildlife.” Few animals moved away from roads, trails or areas of concentrated human presence. Additionally, risk of mortality due to humans was minimal. Elk vigilance was found to increase with increasing snowmachine activity during the winter.

Animals may be able to habituate to specific types and degrees of human disturbance; however if disturbance magnitude or type changes above this threshold, the probability and magnitude of animal responses may be drastically altered. Animals may be displaced from a site if the disturbance has high fitness costs, or if there is a large amount of habitat elsewhere for animals to access. This report recommends that winter recreational activities should continue in a predictable manner.

Human disturbance occurred over the short-term and was not a primary factor in the distribution of wildlife within the park. While snowmobiles may have not elicited an observable response throughout the study, the authors noted that snowmobiles can “cause physiological responses such as elevated heart rate, blood pressure, breathing rate, and release of adrenaline.” The secretion of glucocorticoids can benefit the animal in the short-term, however if secretion occurs over long periods of time this hormone may inhibit digestion and growth, resulting in decreased resistance to disease. Long term secretion of glucocorticoids can also cause animals to produce an array of pathologies, including reproductive suppression, ulcers, and muscle wasting.” Prolonged exposure to human activity can thus result in decreased levels of survival reproduction in the animal.

During one year of the study, concentrations of this hormone in elk feces varied significantly with changes in environmental conditions, but overall results suggested that levels of these hormones increased as the daily number of snowmachines increased. Levels of cortisol are, however, influenced by a number of other factors, making it difficult to prove that increased secretion of cortisol levels was a result of elevated stress levels. In the case of this population it appears that

negative effects of snowmobiling are being “compensated for at the population level.” No evidence suggests that snowmachine traffic has adversely affected the population dynamics within this park. This paper suggests that restrictions during recent years have been successful at reducing disturbances of wildlife below levels that cause “deleterious fitness effects”, however, the authors recommend that snowmachine activity remain at or below current levels of use.

The authors recommend studying pregnancy and nutrition in order to examine potential physiological effects of snowmachines on animals. Overall, this study found that the likelihood of vigilance and movement responses increased if animals were near roads. Smaller group sizes and approach of humans by foot also facilitated increased movement and vigilance responses. Further increases in these behaviours were observed when numbers of snowmachines per group and interaction times increased.

**Wilson, S.F., and Hamilton, D. 2005. A strategy to manage backcountry recreation in relation to wildlife and habitats. Ecologic Report Series No. 28.**

[http://www.env.gov.bc.ca/wldtwg/documents/wilson\\_hamilton\\_strategy.pdf](http://www.env.gov.bc.ca/wldtwg/documents/wilson_hamilton_strategy.pdf)

This document outlines the objectives of a new strategy to manage both commercial and recreational users of backcountry resources. This strategy is designed to ensure that backcountry activities do not interfere with animal distribution and habitat integrity. This strategy will focus on three broad policy tools commonly used to regulate disturbances caused by backcountry activities including prohibition, limits on inputs, and limits on outcomes. Operational plans of operators are expected to be guided by matrices comprising of issue categories, desired results, desired behaviours, indicators of whether a desired behaviour is being achieved and limits for the upper and lower bounds of indicators. Although best-management practices for backcountry snowmobiling are not mentioned within this document, these management practices would most likely be developed using the strategy outlined within this document.

**Wilson, S. F., and Hamilton, D. 2003. Cumulative effects of habitat change and backcountry recreation on mountain caribou in the Central Selkirk Mountains. EcoLogic Report Series No. 10. Prepared for; BC Ministry of Sustainable Resource Management, Nelson, Canadian Mountain Holidays, Banff AB, and Pope & Talbot Ltd., Nakusp BC.**

The goal of this study was to determine how various land uses within the Central Selkirks may be affecting caribou population levels and to determine where highest-priority conservation efforts should be directed. Although logging and heli-skiing activities were the primary focus of this report, the spatial relationship between snowmobiling and caribou locations was also examined.

Snowmobiling data was collected through interviews with local users. According to this report snowmobiling activities were increasing within the region. Telemetry points were examined in relation to areas of frequent snowmobile use. Unfortunately insufficient data were available to include snowmobiling in the cumulative effects analysis, however maps of snowmobile use in relation to telemetry points and home ranges were developed.

This study examines the potential application of a zonation strategy to this region. In a zonation strategy landscape unit planning strategy links “higher level plan direction with operational practices.” Successful implementation of a zonation plan is dependent upon various landscape

users respecting the strategy. One area of concern in the Central Selkirks is unregulated and intense snowmobiling activity on Silvercup Ridge which is also included in a heli-ski tenure.

According to this report there are growing concerns regarding the impacts of backcountry recreation activities on caribou. These types of disturbance are likely to cause medium to short-term displacement of mountain caribou, occurring over a shorter interval of time than industrial activities.

Of all backcountry activities, snowmobiling has the greatest potential to impact mountain caribou as snowmobiling areas often overlap with late-winter mountain caribou habitat. This paper suggests that new snowmobile areas are becoming popular in the region. Snowmobiling is recognized as a difficult backcountry activity to manage because it involves private owners operating on Crown land. Management recommendations provided in this report include negotiating agreements with all land users, including snowmobilers, to ensure that caribou zonation strategies are not compromised. This report also recommends further research on the caribou range use in response to snowmobile activity. It recommends examining both locations and intensities of snowmobiling activities.

**Woods, G, Dowdy, F.G, and Raven, D. 2001. Agreement between the Ministry of Water, Land and Air Protection, Wildlife Branch, and the Revelstoke Snowmobile Club, regarding snowmobile areas in the Revelstoke area.** (Appendix D in the Revelstoke Snowmobiling Strategy.) (Original document was not found during an internet search).

This document outlines agreements for snowmobile area restrictions in the Revelstoke area.. The agreement exists between the Revelstoke Snowmobile Club, Ministry of Water, Land and Air Protection (MWLAP), Wildlife Branch, Nelson, British Columbia, and the Ministry of Forests, Columbia Forest District, Revelstoke BC. Site-specific agreements include Frisby Ridge, Sale Mountain, Keystone and Standard Peak, Standard Basin, Caribou Basin, and Carnes Ridge. The larger agreements outline restrictions for the Monashee Mountains north of Frisby Ridge, and the Selkirk Mountains north of Goldstream River. With respect to restrictions on the larger snowmobile areas, snowmobiles are forbidden to snowmobile between 1300m and 2100m between December 15th and April 15th with the exception of a couple of small areas outlined in the agreements. Meanwhile, the site-specific agreements highlight a mixture of areas restricted to snowmobile traffic between December 15th and April 15th and those that remain unrestricted. According to a unique set of restrictions, use of Caribou Basin is restricted to a specific area on statutory holidays and weekends.

**Appendix 2: List of Contacts**

**A. Information regarding snowmobile/caribou management practices.**

**BC Snowmobile Federation.**

Executive Director: Les Auston.

Phone: Toll Free 1-877-537-8716 or 250-860-8020

website: [www.bcsf.org](http://www.bcsf.org)

e-mail: [office@bcsf.org](mailto:office@bcsf.org)

**SARCO**

Species at Risk Coordination Office  
Integrated Land Management Bureau  
Ministry of Agriculture and Lands  
780 Blanshard St. Victoria, B.C.  
Phone: 250-356-9518

**B. Individuals who were contacted for information for this project.**

**Leo DeGroot**

Wildlife Biologist

Fish and Wildlife Nelson

**Trevor Kinley**

Wildlife Biologist

Sylvan Consulting Ltd. Invermere

**Cory Legebokow**

Ecosystem Officer (Revelstoke)

Ecosystem Section Nelson

**Bruce McLellan**

Senior Wildlife Habitat Ecologist

Wildlife Habitat & Range Ecology Revelstoke

**Geoff Price**

Ecosystem Officer

Ecosystem Section Williams Lake

**Lara Roorda**

Caribou researcher

Williams Lake