

Co-management of Woodland Caribou in the Sahtu Settlement Area

Workshop on Research
Traditional Knowledge
Conservation and Cumulative Impacts

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On the cover

Photograph of woodland caribou courtesy of Richard Popko (Resources Wildlife and Economic Development, GNWT)

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SUMMARY

The Sahtu Renewable Resources Board held a workshop on woodland caribou (*Rangifer tarandus caribou*) conservation and management in December 2000. The purpose of the workshop was to discuss issues concerning woodland caribou population status and habitat protection in the Northwest Territories, primarily within the Sahtu Land Claim Settlement Area. Community, government and co-management representatives provided information on traditional and scientific knowledge of woodland caribou. This paper is a summary of presentations, information gathering activities and discussions that took place.

The meeting disclosed the following information regarding woodland caribou:

- There are two ecotypes of woodland caribou in the Northwest Territories known as boreal and mountain caribou. These caribou have different habitat requirements, but are otherwise the same. Barren-ground caribou (*Rangifer tarandus groenlandicus*) are the most abundant and wide spread caribou species in the region.
- Throughout most of northern Canada, boreal caribou are believed to be sensitive to disturbance from aircraft, vehicle traffic, industrial activity and habitat alteration. Population declines have occurred in areas where disturbance to caribou and caribou habitat is excessive. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is considering changing the status of northern boreal caribou to "Threatened of Endangerment" as a result of extensive habitat change in the boreal forest.
- Although boreal caribou are known to occur throughout the Northwest Territories, there is very little information on their distribution and ecology here. Even the traditional knowledge of this species is not well known because most communities rely primarily on barren-ground and mountain caribou for subsistence.
- Boreal caribou may become important for subsistence if the numbers of barren-ground caribou decline. They are an important part of the ecosystem and should be conserved. Research needs to be done in order to determine where they occur so that land use activities do not have a negative impact on those caribou and their habitats.
- Much more is known about mountain caribou than boreal caribou. These caribou have always been important because they do not migrate long distances every year like the barren-ground caribou. People know exactly where to find them from year to year. Fewer mountain caribou are harvested today than in the past. Their migration routes may be changing, and research needs to be done in order to ensure that these caribou and their habitats are conserved for future generations.
- What happens to the land will eventually affect wildlife. Land use planning and wildlife management need to be coordinated so that development can proceed without compromising traditional activities such as hunting and trapping. This integrated approach will allow for multiple land use activities without compromising wildlife and wildlife habitat.

1.0 INTRODUCTION

In the Northwest Territories, research on barren-ground caribou (*R.t. groenlandicus*) has been extensive, management plans have been developed and the population status of most herds is known. In comparison, woodland caribou (*R.t. caribou*) have been basically overlooked in terms of research and management, yet woodland caribou are found throughout the Northwest Territories and are harvested by subsistence, resident, and non-resident sport hunters in many areas.

Woodland caribou occur in both the boreal and mountain ecotypes in the Northwest Territories. In the mountains, several herds have been identified based on known seasonal ranges. However, little is known about the genetic relatedness and movement patterns of the mountain herds. It is likely that some, if not all of the mountain caribou herds are shared between the Northwest Territories and Yukon and yet there is no co-management plan in place and few studies involving inter-territorial cooperation have been initiated.

In the boreal ecotype, even less is known about woodland caribou distribution and ecology. Forest fires, oil and gas development, logging and road construction create habitat conditions presumed to be unfavorable for woodland caribou. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is considering changing the status of boreal caribou to "Threatened of Endangerment" based on documented population declines and extensive habitat alterations throughout most of the boreal forest in Canada. In the Northwest Territories, habitat change has not reached the point where direct or indirect impacts are detectable. However, there is currently insufficient baseline information to measure or predict cumulative impact effects including habitat change, which is occurring at an accelerating rate.

The status of woodland caribou in the Northwest Territories must be determined so

that wildlife managers can comment on the national status. Secondly, co-management boards, governments, and renewable resource councils need to know the status of woodland caribou so that informed decisions can be made regarding land use, conservation and wildlife management within different regions and land-claim settlement areas.

2.0 PURPOSE

The purpose of this workshop was to bring together representatives from wildlife management organizations and various communities in the north to share information about woodland caribou distribution and ecology. Discussions focused on conservation, land use, protected areas, local knowledge, research and co-management. Input from the various aboriginal and scientific advisors was used to evaluate existing research and discuss the scope and methods for conducting future studies.



Mountain Caribou

3.0 TRADITIONAL AND CONTEMPORARY LOCAL KNOWLEDGE

For centuries, caribou have been an important component of northern culture and social fabric. In the old days, hunting required intimate knowledge of the local environment and distribution of resources. Knowledge about the animals was gained through oral tradition and by ones own experience from being on the land. Wildlife management consisted of deciding

where to hunt and how many animals to harvest. Medicine was sometimes used to bring the animals closer to the people or to ensure a successful hunt.

Today, caribou are still important to the socio-economy of many northern communities. Barren-ground herds that migrate south in winter make up most of the subsistence caribou harvest in the Sahtu Settlement Area. Woodland caribou are, for the most part, non-migratory and many people know where to find them at different places throughout the year.

Workshop participants were asked to provide information about woodland caribou from their

own experience, or the experience of others whom they have communicated with. Maps were used to illustrate where people have seen woodland caribou, or where woodland caribou have been harvested. Individuals worked in groups of 3-5 people from the same or neighboring communities. One person in each group recorded the information and presented a summary after the activity. Each group was asked to discuss the significance of woodland caribou to hunters in their community, approximate number of animals harvested annually, and the optimal time of year for harvesting woodland caribou in their opinion.

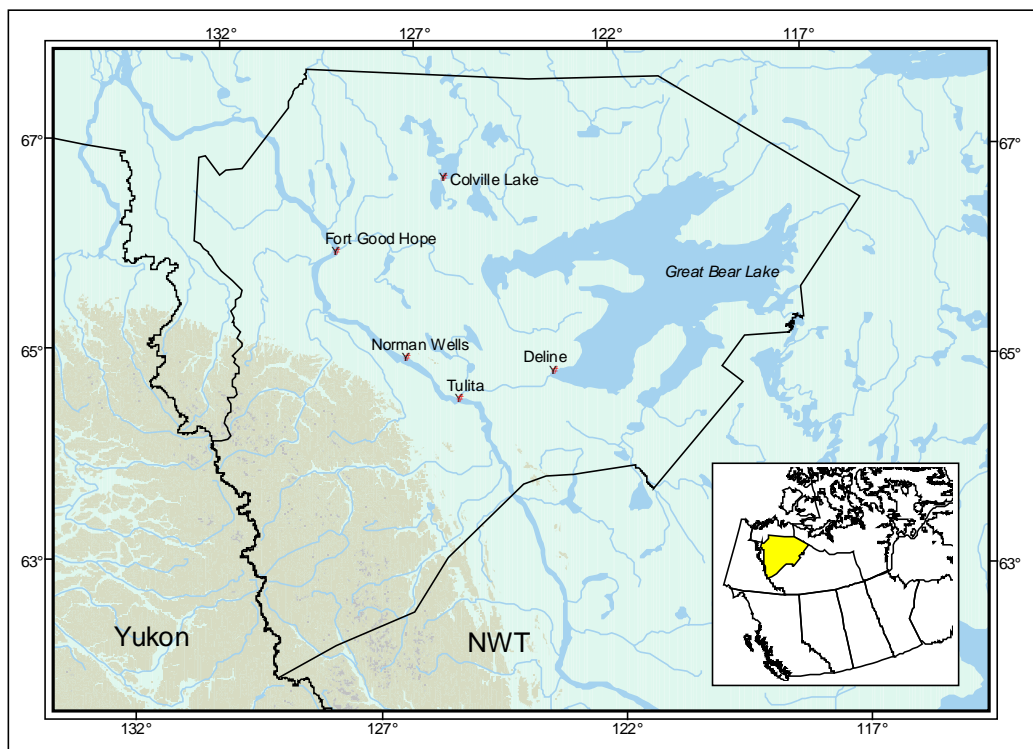


Figure 1. Sahtu Settlement Area

3.1 Tulita/Norman Wells

The Tulita/Norman Wells working group consisted of Fred Andrew, Maurice Mendo and Margaret MacDonald. Alasdair Veitch (RWED) recorded the information presented a summary. Tulita/Norman Wells indicated that many hunters harvest woodland caribou whenever they can (Table 1), more than 100 animals are harvested annually (Table 2), and woodland caribou are harvested at any time of the year (Table 3). The following comments were recorded:

There are woodland caribou in the Mackenzie valley near Oscar Pass and Turton Lake and around Bosworth Creek

There is a small herd at Clark Mountain south of Tulita

There were lots of caribou around Canyon Creek in 1985-1986

Lots of caribou west of Willow Lake, not so much lately

Caribou tracks have been seen on the Bear River, but not much lately

A few woodland caribou have been seen near Tulita, Norman Wells and Fort Good Hope during moose surveys

Less woodland caribou in the [Mackenzie] valley now than in the past

More moose in the valley today than before

Some woodland caribou leave with the barren-ground caribou when they move back north

Last year seismic activity occurred on caribou range near Stewart Lake, this mountain has lots of lichens and gophers

Mountain caribou winter at Drum Lake, an important hunting area for Mountain Dene

In the old days, people lived in the mountains and depended on caribou for survival

Dene people harvest both moose and caribou, and don't like to say that one is more important than the other

Woodland caribou are really important because they are always there

There is no difference between boreal and mountain caribou, basically they are the same

Sometimes there are many small caribou in the mountains that come in from the Northwest [Porcupine herd]

There are lots of caribou along the Redstone River in August

There is probably more than one herd of caribou in the Redstone area

Tulita has a community hunt at Caribou Flats in the fall

Tulita doesn't harvest as much woodland caribou as before so the numbers have increased

Grizzly bears follow cutlines out of the mountains, and now we see them on the Mackenzie River

In the 1950's 300 wolves were seen near Caribou Flats

More wolves in the mountains than before because few people hunt wolves these days

Resident hunters are taking moose, sheep and caribou in the mountains, and nobody knows anything about it

Sport hunting for trophy bulls is not balanced

Sport hunting – pressure on male caribou might not be good, needs to be more balanced

Need for more local benefit from sport hunting

Less concern about the numbers of animals taken by sport hunters, but what is done with the meat?

Protected areas are needed, but not National Parks



Drying caribou meat

Table 1. Number of woodland caribou hunters in each community

	Ross River	Fort Good Hope	Tulita / Norman Wells	Deline	Colville Lake
Not many people hunt woodland caribou					✓
Some people hunt woodland caribou				✓	
Lots of people hunt woodland caribou	✓	✓	✓		

Table 2. Approximate harvest of woodland caribou by each community annually

	Ross River	Fort Good Hope	Tulita / Norman Wells	Deline	Colville Lake
Few (< 50)		✓			✓
Several (50-100)				✓	
Many (> 100)	✓		✓		

Table 3. Seasonal variation in the harvest of woodland caribou

	Ross River	Fort Good Hope	Tulita / Norman Wells	Deline	Colville Lake
Winter (Dec- Feb)					
Spring (Mar -May)					
Summer (Jun -Aug)					
Fall (Sep -Nov)	✓				
Any time of year		✓	✓	✓	✓

3.2 Ross River

The Ross River working group consisted of Dorothy Dick and Ted Charlie. Jan Adamczewski (YRR) recorded the information presented a summary. Douglas Tate (NNPR) also participated in the Ross River working group discussions. Ross River indicated that many hunters harvest woodland caribou (Table 1), more than 100 animals are harvested annually (Table 2), and woodland caribou are mostly harvested in the fall (Table 3). The following comments were recorded:

Woodland caribou are really important to the community

Everyone depends on them for food

Staple of the diet, especially for people who are not working

Caribou are also important to our culture

Drums are made from caribou hides (moccasins from moose)

Still a lot of people who live a traditional life, but some have taken jobs

Moose and sheep are also important

There are two hunts, fall and spring

Access to hunting areas is an issue, there are 4 major routes and most of the hunting is along roads

Significant resident hunt in the area, mostly the Finlayson herd, but less than it used to be

Resident hunt is on a permit and draw system

A staking rush in the area of the Finlayson herd (1995-1996) caused caribou to move away

3.3 Colville Lake

The Colville Lake working group consisted of Fred Rabisca, Alexis Blanco and Sarah Kochon. Richard Popko (RWED) recorded the information presented a summary. Colville Lake indicated that very few hunters harvest woodland caribou (Table 1), less than 50 animals are harvested annually (Table 2), and woodland caribou are harvested at any time of

the year (Table 3). The following comments were recorded:

Colville Lake is a small community with no road access; there will be a winter road this year [2000-2001]

Subsistence is mostly barren-ground caribou

There are some woodland caribou towards Fort Good Hope and in the Mackenzie valley, but most of this area doesn't have woodland caribou

Many young hunters these days wouldn't know the difference between woodland and barren-ground caribou

1953 – a small group of caribou near Lac La Jacques

1968 – a few near Colville Lake

1980 – a small group near Island Lake and Tadek Lake

Caribou are sometimes seen near Hare Indian River

Sahtu harvest study reports that there were woodland caribou near Horton Lake, but these are probably barren-ground caribou because Horton Lake is above the tree line

Some oil and gas development is planned near Colville Lake in 2001

The community is concerned about disturbing barren-ground caribou feeding areas and also woodland caribou feeding areas if there are any

3.4 Fort Good Hope

The Fort Good Hope working group consisted of Evert Kakfwi, Karen Caesar, Michel Lafferty, Ben Olsen (SRRB) recorded the information presented a summary. Bryon Benn (GRRB) participated in the Fort Good Hope working group discussions as well. Fort Good Hope indicated that many hunters harvest woodland caribou whenever they can (Table 1), less than 50 animals are harvested annually (Table 2), and woodland caribou are harvested at any time of the year (Table 3). The following comments were recorded:

There are woodland caribou along the Mackenzie River, and in the mountains

Woodland caribou are much larger than barren-ground caribou, and males have bigger antlers

In winter caribou come out of the mountains along the Arctic Red River and Ramparts River

Sometimes there are tracks around Manuel Lake in fall before the barren-ground caribou come through

Woodland caribou from the mountains rarely ever cross the Mackenzie River to the east side, and barren-ground caribou don't cross over to the west side

Woodland caribou in the valley are very smart, sometimes you see their tracks but you rarely ever see the caribou

3.5 Deline

The Deline working group consisted of Andrew Kenny, Dophus Baton, and Raymond Taniton. Anne Gunn (RWED) recorded the information and presented a summary. Deline indicated that some hunters harvest woodland caribou but most harvest barren ground caribou (Table 1), more than 50 animals are harvested annually (Table 2), and woodland caribou are harvested at any time of the year (Table 3). The following comments were recorded:

In the last 5 years, barren-ground caribou have been around so there have been fewer woodland caribou taken but woodland caribou are important when barren-ground caribou aren't around

Barren-ground caribou taste better and are easier to hunt

Woodland caribou, like moose, are smart and move away quickly when they hear hunters

Woodland caribou are different than barren-ground caribou



Barren-ground caribou

4.0 BOREAL CARIBOU

4.1 Woodland caribou of the boreal ecotype in Northwest Territories

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Little is known about boreal ecotype woodland caribou (*Rangifer tarandus caribou*) that occur along the Mackenzie River Valley from the NWT/Alberta border in the South Slave Region to the Mackenzie Delta in the Inuvik Region. These caribou have not been the focus of any biological studies in the NWT and it is also apparent that even traditional knowledge (TK) about these caribou is much less than for mountain ecotype woodland caribou, barren-ground caribou, or for Peary/Arctic Island caribou in the far north. Recently, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has proposed to upgrade the status of boreal woodland caribou in the NWT to 'threatened' from 'vulnerable' in 1995 and 'rare' in 1984. It is expected that the recommended change in status for boreal woodland caribou will receive approval by the end of 2001. Then, as a threatened ecotype of this caribou sub-species, a Recovery Team will need to be established and a Recovery Plan developed. That plan will require sound baseline scientific knowledge about this caribou ecotype, as well as collection of all available TK from across the NWT.

In the NWT, substantial changes over the past century have likely had an impact on boreal caribou. Development and disturbances have increased throughout the Mackenzie River Valley, such as seismic oil and gas exploration, development of all-season and winter-use roads, and there has been a dramatic increase in the use of snowmobiles and aircraft. Studies elsewhere have demonstrated such activities rarely benefit caribou. However, the situation in the NWT is still considerably better than for woodland caribou elsewhere across their range in Canada

where populations have either been extirpated or seriously reduced, primarily as a direct result of habitat alteration and degradation.

In 1999-2000, wildlife biologists with the Department of Resources, Wildlife & Economic Development (RWED) and co-management boards worked together to evaluate the status of all vertebrate species that occur in the NWT, including boreal woodland caribou. It was felt that a rough estimate of density (1 to 3 boreal woodland caribou per 100 km²) obtained within a surveillance zone for wood bison south of Great Slave Lake could be applied to the 433,504 km² of known and likely habitat for boreal woodland caribou in the NWT. By so doing, we obtained a rough estimate of 4000 to 6400 boreal woodland caribou for the territory. However, it must be emphasized that there is a low level of confidence in those figures because of the method we used. The overall trend in numbers was thought to be 'possibly stable' based on local knowledge (from harvesters, biologists, Renewable Resources Officers), but it is unknown.

Boreal caribou largely exist within old-growth (over 100-years-old) coniferous forests with abundant arboreal lichens and an extensive mat of lichens ('caribou moss') on the forest floor. The natural fire cycle within the boreal forest of the NWT - with an estimated 1% annual burn rate - has been significantly altered over the past 40 years. From the 1960's through the mid-1990's there was a policy of vigorous suppression along the Mackenzie River and the annual percent of forested area burnt was substantially less than 1% as a result. This policy was to the benefit of caribou and other species that live in old-growth forests, since those are the forest types most likely to burn during the fire season - therefore, fire suppression maintained those forest habitats where they'd have otherwise burned.

In recent years, the Government of the NWT has greatly reduced its fire fighting efforts as a result of necessary fiscal restraint and increasing awareness of the beneficial role forest fire plays

in forest regeneration. The majority of fires that start are now left to burn where there is no perceived threat to communities and other 'values-at-risk'. For example, over 50% of the area burned by fire in the Sahtu over the last 30 years has burned since 1995. This has created favourable conditions for moose and other species that prefer the deciduous shrub/tree species that grow rapidly for about 30-40 years after a fire. It has also reduced the amount of current and potential habitat for boreal woodland caribou and for wintering barren-ground caribou.

In addition to habitat loss, another potential impact of increasing moose populations in the NWT is a concurrent rise in wolf, grizzly bear, and black bear numbers because of an increase in prey availability. More predators on the land can lead to increased predation on woodland caribou. Research on boreal woodland caribou in Labrador - where moose were expanding into areas previously unoccupied (a natural range expansion) - documented a high level of adult caribou mortality, primarily as a result of wolf and bear predation. Annual mortality rates were equal to, or greater than, recruitment rates and the population eventually underwent a substantial decline. We felt that caribou were in trouble largely because of increased predator numbers as a result of the expanded moose population and were in a 'predator pit' from which the population could not escape. Conversely, other studies in the Yukon have shown that woodland caribou can actually benefit from higher moose densities.

It is expected that an application to construct a natural gas pipeline along the Mackenzie River Valley - the Mackenzie Valley Pipeline (MVP) - will be received by the end of 2001. The MVP may use the existing right-of-way between Norman Wells and northern Alberta along the east side of the Mackenzie River with an extension to the Delta along a route previously surveyed in the 1970's, or it may be developed along the west side of the river along an as-yet unsurveyed route. Under either scenario, the proposed MVP's route will traverse current or potential habitat for boreal woodland caribou

along its entire 1300 km length in the NWT. It is also possible that the MVP project could include an extension from the Colville Lake gas fields to the main MVP near Norman Wells.

The NWT has considerable proven and expected oil and natural gas reserves. Past exploration in the territory has resulted in the discovery of over 1.5 billion barrels of oil and 11 trillion cubic feet of natural gas (excluding Arctic Island discoveries). The estimated total recoverable oil and gas reserves in the NWT are even larger. A moratorium was imposed in 1977 on the issuance of exploration rights for oil and gas along the Mackenzie River Valley and was lifted in 1994. Since then, there has been significant increase in permits and licenses for oil and gas exploration in the Deh Cho, Inuvik, and Sahtu regions. For example, approximately 15,000 km², or 5.3% of the total area of the Sahtu, had Exploration or Significant Discovery Licenses granted in 2000. These exploration parcels are in addition to an extensive existing network of seismic lines and well sites - particularly along the Mackenzie River Valley. Recent research by the Boreal Caribou Research Program (BCRP) in northeastern Alberta has demonstrated significant negative effects of oil and gas activity in that area on caribou. Those impacts come primarily through habitat displacement, since caribou avoid cutlines to try to avoid the increased predation risk (primarily by wolves) associated with those lines, particularly during summer. The seismic lines did not form a barrier to caribou movement; however, radiocollared caribou seemed more reluctant to cross roads.

Climate change, or global warming, is occurring more rapidly in the Mackenzie Basin than most other areas of North America. It has been suggested that continued warming will change the forest cover of the NWT, will lead to an increase in the length of the forest fire season and to more and larger fires, will see the incursion of new forest pests and parasites of wildlife, and will lead to increased winter snowfall. All these factors have the potential to negatively impact boreal woodland caribou, but their magnitude is as yet unknown.

The MVP application, the proposed upgrading of boreal woodland caribou by COSEWIC, increasing oil and gas exploration activity, and realization of the need to study and monitor the effects of climate change have combined to shift the level of importance that the GNWT and co-management boards should put on research on boreal woodland caribou. It has already been

suggested that boreal caribou will be a 'keystone species' in the Environmental Impact Assessment that will need to be done as a result of the MVP proposal. Therefore, it is essential that sound baseline ecological information about boreal woodland caribou be obtained, in addition to an extensive effort to collect additional TK across the range of these caribou.

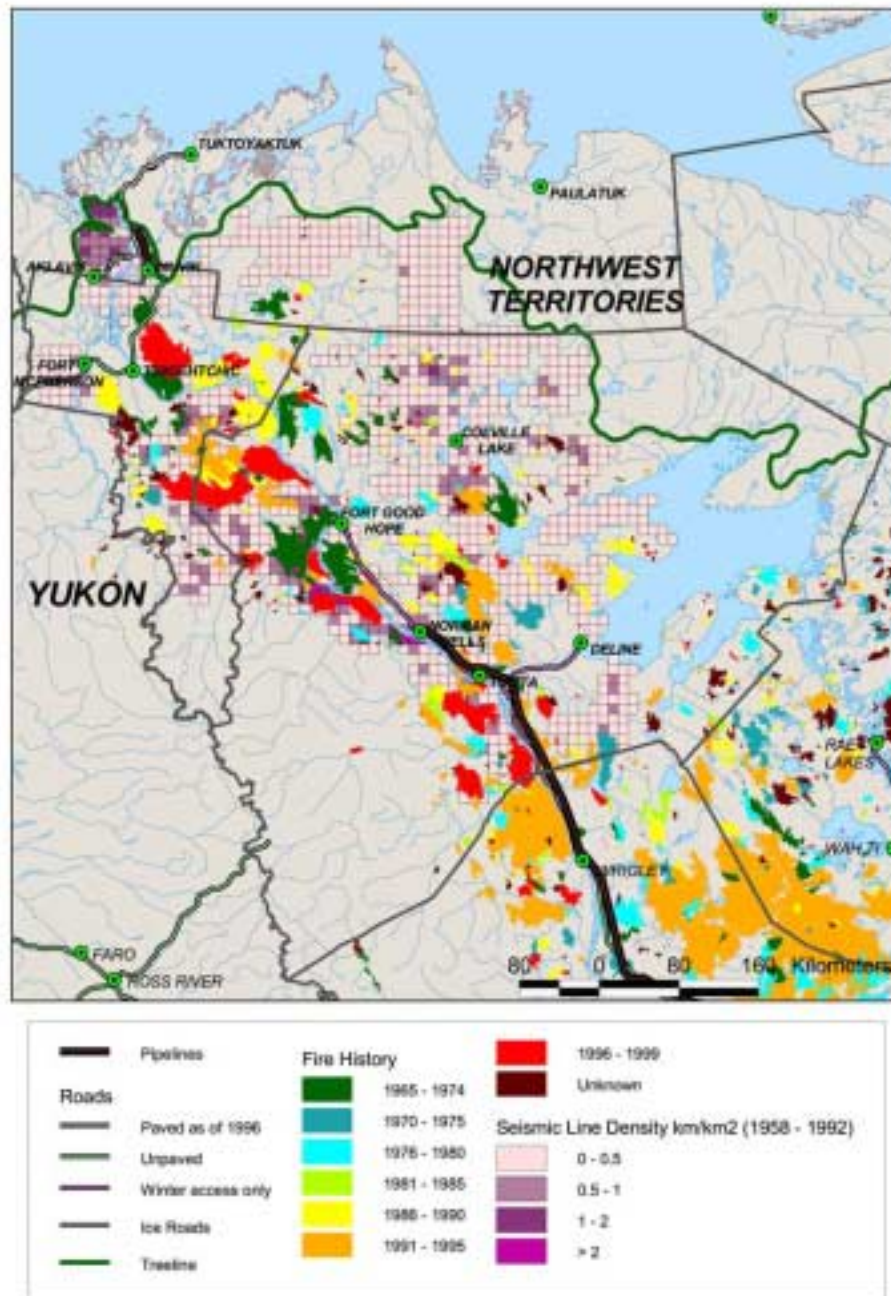


Figure 2. Seismic line density and fire history in the Sahtu Settlement Area.

4.2 Boreal caribou research, conservation and management in Alberta

Bob Wynes, Research Co-ordinator, Boreal Caribou Research Program, 15810-114 Avenue, Edmonton AB, Canada T5M 2Z4

Woodland caribou occur throughout west central and northern Alberta. There are two "ecotypes" of this species, mountain caribou in west central area, and boreal in northern Alberta. Population levels are generally low and there is a considerable amount of area (a quarter to a third of northern Alberta) where caribou occur at relatively low density compared to moose.

Woodland caribou have been a management issue for the oil and gas industry and timber industry in Alberta for more than 20 years. The Alberta government has allocated a large portion of caribou range to oil and gas, and timber industries. The government has placed a lot of the onus on industry to deal with resource management issues. In 1991 Alberta Environmental Protection issued a letter to the oil and gas industry indicating that they could continue to operate in caribou range providing the integrity of the habitat was maintained. From this letter, several committees comprised of government biologists, forestry staff and industry representatives were established across northern and west central Alberta. The committees in the north have since amalgamated into the Boreal Caribou Committee, of which the Boreal Caribou Research Program (BCRP) is the research subcommittee. The BCRP is not a wildlife management board. The objective of the BCRP is to integrate caribou and industrial activity.

In west central Alberta there is a direct conflict with habitat selected by caribou and the stands needed for fiber supply to local pulp and saw mills. Caribou habitat is predominantly old stands of spruce and pine. Conventional forestry practices are to select the oldest stands first for logging to maximize fiber production. Also, in long term planning of fiber supply, managing to have older stands on the landscape reduces the

cut levels. When doing the allocations, the government did not allow enough flexibility to manage for caribou habitat.

In northern Alberta, Anderson (1999) found that caribou in many ranges are selecting large peatland complexes (bogs and fens), many of which are treed with black spruce. In these ranges there is not a direct affect of habitat loss. However, logging on adjacent uplands may improve moose habitat, and subsequently increase wolf populations in proximity to caribou and increase incidental predation on caribou. Logging practices need to change within caribou ranges so they do not advantage moose any more than the natural process of fire. In the past there was a lot of emphasis on trying to improve moose habitat due to hunter demand for moose.

James (1999) studied the movement of wolves in relation to linear corridors (roads, pipelines and seismic lines) in NE Alberta. James found that wolves were found closer to linear corridors than random, and wolves traveled faster (2.8X) on lines than in the surrounding forest. Adam also looked at caribou mortality locations from our radio collared caribou and found that wolf caused mortalities were closer to linear corridors than the live locations of the caribou. James concluded that linear corridors increased wolf-hunting efficiency.

Dyer (1999) demonstrated that GPS collared caribou avoided roads, seismic lines and well sites. Many industrial partners have found this hard to believe because they have seen caribou on roads or well sites. However, Dyer's research showed that there was reduced use of habitat near roads, wells and seismic lines, not total avoidance. There is some evidence that caribou are attracted to clover, which is planted on some roads and wells, which increases the risk predation. Dyer also found that caribou were reluctant to cross roads, suggesting that high-grade roads were creating a partial barrier to movement. The avoidance of roads was expected since the study was done at a time of very high activity on roads while the field was being developed. The response of caribou to

seismic lines was not expected. Many of these lines were old and unused during the course of the study, yet statistically significant avoidance consistently of up to 250m was observed. Seismic lines are prolific in northern Alberta (one range has over 70% of the habitat within 250 meters of a seismic line). Unlike high-grade roads, there was no barrier effect associated with seismic lines. The avoidance occurs in all seasons of the year, while most human activity occurs during the winter. Avoidance relates to several factors including human and predator activity on linear corridors.

The caribou committee is currently working on new industry operating guidelines to address these research findings. Progress has come slowly. The challenge now is to speed the recovery of the existing footprint of human activity on caribou range, while allowing new development.

In the Northwest Territories, development has not occurred at the same rate or extent as it has in Alberta. There are opportunities now to address these issues at the early stage of development. A certain level of industry can co-exist with caribou, however effective land use planning is necessary before any allocations are made, and clear expectations of industry before they invest in the rights to development. A good working relationship and communication with industry is critical so that all parties understand what the concerns and limitations are. They are in the best position to come up with solutions to problems that arise. Development should proceed slowly, considering the status of caribou. Protected areas should also be dealt with first and foremost.

4.3 Cumulative Impacts

Various factors are known to have an impact on boreal caribou. Some of these factors are directly related to caribou while others are indirect such as habitat loss, fragmentation of habitat and functional habitat loss through avoidance. The workshop participants were asked to state their opinion about several of

these factors. Each respondent was asked to indicate which factors have a major impact, minor impact, or no impact on boreal caribou. Responses from 21 individuals were obtained. The distribution of responses was as follows: Fort Good Hope RRC (3), Deline RRC (3), Colville Lake RRC (2), Tulita RRC (3), Norman Wells RRC (1), Ross River (1), YRR (1), RWED (3), BCRP (1), NNPR (1), AMMO (2).

The percent of responses in each category was calculated (Table 4). Over half of the respondents (52%) indicated that animal predators have a major impact on boreal caribou. Seismic exploration and development was identified as having a major impact by 43% of respondents. Pollution and contaminants as well as climate change were considered to have a minor impact. Hunting was considered to have no impact by 48%. Tourism was also considered to have no impact (43%). For pipeline construction, forestry and logging, and highway construction, the results were inconclusive. Besides answering the survey, participants also provided comments on the topic (see Section 4.3.1).

Table 4. Cumulative impacts and boreal caribou (% responses)

	Major Impact	Minor Impact	No Impact	Unknown
Hunting	29	19	48	5
Predators	52	19	19	10
Contaminants	14	48	29	10
Climate Change	33	43	14	10
Forestry	38	29	29	5
Pipelines	24	38	24	14
Seismic	43	24	24	10
Highways	38	33	24	5
Tourism	14	33	43	10

4.3.1 Comments

Exact impact [of animal predators] is not known, there are wolves, black bear, grizzly and lynx

Harvest [of woodland caribou] seems to be important, but the level is unknown because we don't know the harvest rate

If highway access and oil and gas development proceeds without adequate cumulative effects assessment, mitigation and monitoring, the effects will likely be major based on experiences in Alberta. Those activities will likely increase predation to having a major impact

Many of these things are unknown such as climate change, predator pressure, pipeline and road construction. We need more information on these topics before any of this can be substantiated. Forestry and logging isn't done here...very little occurs in pollution...we don't have data for pipeline/highway

The biggest impact [on boreal caribou populations] will be from habitat change. Hunting levels are relatively easily regulated. Predation increases appear to be a result of habitat change, not a problem in itself...address habitat changes first

Get the impression [there is a] low potential for logging. Over-hunting increases as access increases. As linear corridors increase the 'predation balance' can be affected. Pipeline [causes] bigger effects from the resulting corridor (hunting, predators) than the construction phase

Boreal caribou are affected very little by the operations of Mackenzie Mountain Outfitters

Wolves have a major impact and bears have a minor impact

Oil and gas development is a fairly broad industry...new exploration (seismic) has the potential to have a major impact on caribou populations. However, in areas where exploration has already taken place I feel that production (drilling) would have only a minor impact on caribou populations

Yukon probably has no boreal caribou...we don't really know how northern boreal caribou will be affected [by different types of disturbance]

We don't have boreal caribou in our region [Yukon]

4.4 Research Opportunities

Given the concern over protection of caribou and caribou habitat, researchers must be able to provide information that can be used for

conservation and management. Based on what is currently known, and what needs to be done, participants were asked to state which of the following research studies are high priority and which are low priority. Responses from 21 individuals were recorded. The distribution of responses was as follows: Fort Good Hope RRC (3), Deline RRC (3), Colville Lake RRC (2), Tulita RRC (3), Norman Wells RRC (1), Ross River (1), YRR (1), RWED (3), BCRP (1), Parks Canada (1), AMMO (2).

The percent of responses was calculated (Table 5). The survey results indicated that 90% of respondents felt that traditional knowledge studies were a high priority. Research on the effects of development was considered to be a high priority by 86%. Information on movement patterns and habitat use was given high priority by 76%. Population size and composition, genetic relatedness, and causes of mortality received scores of 71%, 67%, and 57% respectively. Many respondents did not indicate a priority for studies on the causes of mortality. In addition to answering the survey questions, participants also provided comments regarding research studies of boreal caribou (see Section 4.4.1).

Table 5. Research priorities for boreal caribou (% responses)

	High Priority	Low Priority	No Response
Traditional knowledge study	90	5	5
Population size and composition	71	24	5
Migration routes, calving Areas and habitat use	76	24	0
Causes of mortality	57	29	14
Effects of development	86	14	0
Herd delineation and relatedness	67	33	0

4.4.1 Comments

The people know [where the caribou herds are]

The more information we have the better we understand (woodland caribou)

Causes of mortality [are important to know] only where problems noted

Do not reinvent the wheel [in terms of studying the effects of development]

Traditional Knowledge [study] should be done right away to capture knowledge of elders before it is lost

Since so little is known, all needs to be done

Herd delineation may not apply to boreal caribou, which probably have a different social/genetic structure

Also could to do ground based composition counts

Don't know if they [boreal caribou] have migration routes. Might not be herds, but DNA work would be very good to do

4.5 Methods for Research and Management

Wildlife research and management often requires using techniques that are perceived to be invasive or harmful. Most of the techniques used today have gone through rigorous scientific testing to determine if they are safe, and measures are taken to ensure that all studies are conducted humanely. The following survey was intended to find out which methods were perceived to be acceptable and which were unacceptable, according to public opinion. The results can be used to identify areas where more public education is needed, as well as areas where there may be concerns that need to be resolved before proposing further studies. Responses from 20 individuals were recorded. The distribution of responses was as follows: Fort Good Hope RRC (2), Deline RRC (3), Colville Lake RRC (2), Tulita RRC (3), Norman Wells RRC (1), Ross River (1), YRR (1), RWED (3), BCRP (1), NNPR (1), AMMO (2).

The percent of responses was calculated (Table 6). The majority of respondents indicated that all of the methods listed were acceptable, in their opinion. Pellet/track counts, the least invasive method, were considered acceptable by 90%. Aerial surveys and radio collaring received scores of 70% and 65% respectively for acceptable, and 30% felt these methods were unacceptable. Nearly one third had no response

for culling, indicating that the question was either not well defined or misunderstood in most cases. In addition to answering the survey questions, participants also provided comments on the topic (see Section 4.5.1).

Table 6. Methods for conducting research on boreal caribou (% responses)

	Acceptable	Not Acceptable	No Response
Aerial Surveys	70	30	0
Radio Collaring	65	30	5
Pellet/track counts	90	10	0
Culling	60	15	25

4.5.1 Comments

I feel that aerial surveying is acceptable as long as it does not interfere with any traditional activity, which may take place in that area

Should ask in community before putting any radio collars on. Few are ok – limited to where absolutely necessary

Radio collaring...would have to be brought to a public meeting

Work with hunters [if culling is necessary]

Acceptability [of any project] depends on consultation with and acceptance with all the communities and stakeholders using those particular caribou

Must have full and detailed examination [of caribou killed for research purposes] and necropsy done with wildlife veterinarians



Caribou radio-collar

5.0 MOUNTAIN CARIBOU

Lortie (1982) tentatively defined three herds of woodland caribou ranging in the Mackenzie Mountains in the Northwest Territories, referred to as the Bonnet Plume, Redstone, and South Nahanni caribou herds. Until recently, little was known about the distribution and ecology of the mountains herds. Concern about population status, harvest levels, and habitat protection have resulted in a renewed interest in mountain caribou research. These studies will provide information that is critical to the understanding of mountain caribou herd dynamics, population status and range use.



Mountain caribou and Dall's sheep

5.1 Mountain caribou studies in the Redstone Watershed

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Woodland caribou in the central Mackenzie Mountains, currently referred to as the Redstone herd, are believed to be one of the largest mountain caribou herds in the NWT, numbering between 5,000 – 10,000 animals (Caribou Management Team 1996). The Redstone herd is presumed to occupy summer ranges along the Yukon-NWT border near MacMillan Pass, moving down to lower elevation habitats along the Keele, Moose Horn, and Redstone River basins to the winter range on the eastern slopes of the Mackenzie Mountains. However, recent aggregations of up to 5000 caribou near the winter range in July and August have been observed (Veitch et al. 2000), suggesting that

either caribou movement patterns have changed in recent years, or perhaps there is more than one herd within the presumed range of the Redstone population.

In 1998, 1999, and 2000 the Sahtu Renewable Resources Board and the Department of Resources Wildlife and Economic Development proposed a study of woodland caribou in the central Mackenzie Mountains (Adamczewski and Veitch 1998, MacDonald and Veitch 1999, Olsen et al. 2000). The objectives of the study were to: (1) document traditional knowledge, (2) conduct an October rutting ground survey, (3) interview outfitters working in the area, and (4) collect DNA samples to determine if the Redstone herd is comprised of sub-populations that have overlapping ranges (Adamczewski and Veitch 1998, MacDonald and Veitch 1999, Olsen et al. 2000).

In August 1999, RWED staff classified 2659 mountain caribou from a group of over 5000 animals near Hook Lake, NWT (Veitch et al. 2000). That aggregation of woodland caribou was the largest ever recorded in the Mackenzie Mountains. Classification results yielded a ratio of 28 calves per 100 cows, below the threshold needed to ensure a stable or increasing population (Caribou Management Team 1986). A recruitment survey was planned for the following spring to determine the number of calves that survive over winter to reach their first birthday.

In March 2000, we planned to coordinate our field research with the Tulita community hunt. The intent was to travel with hunters to the caribou wintering ground near Drum Lake, a traditional hunting area of the Tulita Mountain Dene. The community hunt was cancelled due to warm weather, so a crew was sent by fixed wing to do the recruitment survey and collect animals for necropsy. Robert Horassi and Ricky Andrew were hired as guides and permitted to hunt caribou for necropsy and sample collection. A reconnaissance flight in late March with David Etchinelle confirmed that there were over 100 caribou in the vicinity of Hook Lake.



Mountain Caribou winter habitat

We classified 233 caribou including 29 bulls, 82 cows, and 18 calves (Olsen 2000a). The classification results yielded ratios of 35 bulls and 22 calves per 100 cows. Compared to fall composition estimates done by RWED in August, over winter calf survival was better than expected. However, sample sizes for the recruitment survey were considerably smaller than the fall composition survey.

The hunters harvested 15 adult females and 3 young bulls. Necropsies were performed on 13 caribou. Teeth samples were collected to determine the age distribution of the harvest. Hide samples were collected in order to compare the genetic uniqueness of caribou wintering near Drum Lake with samples from Caribou Flats and MacMillan Pass. 93% of the females harvested were pregnant.

Post-calving aerial surveys of the Redstone herd were unsuccessful. Three attempts were made to find aggregations of caribou reported by outfitters and pilots in July. We used a Cessna 172 (Ursus Aviation) in August to find the caribou and possibly do a classification. We found only 98 caribou on those surveys and were only successful at classifying 17% of the animals observed. The surveys were postponed until late fall when the caribou would be more concentrated on the rutting ground. In late October we used a Helio-Courier to locate and classify groups of mountain caribou on or near their rutting areas (Olsen 2000b). We observed 1081 caribou and classified 665 (62%) by age and sex. The classification results were as

follows, 199 males, 389 females, and 77 calves. The sex ratio was 51 bulls per 100 cows. Juvenile composition was 20 calves per 100 cows. As expected, the composition was biased towards bulls because of the time of year. Many of the cows with calves were alone, away from the larger aggregations, so it is possible that the number of cows with calves was underestimated. However, the trend is consistent with previous reports suggesting that fall composition estimates are below the threshold for mountain caribou. The survey also revealed information on fall caribou distribution. Hunters from Tulita are reporting fewer animals at Caribou Flats in the fall compared to previous years. This is consistent with the fall distribution surveys, which showed that caribou are staying closer to Drum Lake than expected, supporting the local opinion that caribou in the mountains could be “changing their route”.

The objective for 2001 will be to determine the movement patterns of caribou in the Redstone watershed. We are planning to use satellite collars to determine caribou locations, movement patterns and timing. The information will determine whether or caribou move between the Yukon and NWT as presumed. Once the movements are better understood, we can test to see if there are genetic differences between caribou in the different ranges, making them separate breeding populations. The herds must be defined so that future studies of population size and composition can be conducted. This information is necessary for determining population status and trend.



Post-rut aggregation near Redstone River

5.2 Seasonal range use and demography of the South Nahanni caribou herd

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Relatively little is known about the northern mountain ecotype of woodland caribou (*Rangifer tarandus caribou*) in the Northwest Territories. Of the four possible herds that the NWT and Yukon share in the Mackenzie Mountains, the South Nahanni herd winters in the Nahanni National Park Reserve. Parks Canada started baseline research in 1995 (Gullickson and Manseau 2000) and used radio-collared cows to describe seasonal ranges and to locate the caribou for sex-age composition counts. Those fall counts revealed low calf

survival raising the possibility of a decline in herd size. In October 1998, The Yukon Department of Renewable Resources (YRR) in co-operation with the Department of Resources, Wildlife and Economic Development (RWED) removed most collars, which were at the end of their battery life. Four of the original cows were recollared and a further 16 cows were collared on the rutting areas north of Tungsten. Three more VHF collars were fitted to cows in March 1999 and in March 2000, five cows were given satellite collars to determine the relationship of herds wintering in or south of Nahanni National Park. Two cows collared together in the Park rutted either on the South Nahanni herd's area and the other in the southeast Yukon on the La Biche herd's range. One cow was in an area previously unrecognized as a herd's range and the other two cows were close to the known range of the Coal River herd. In October 2000, the calf to cow ratio was 15:100 cows, which is the lowest recorded but it did follow a late spring.

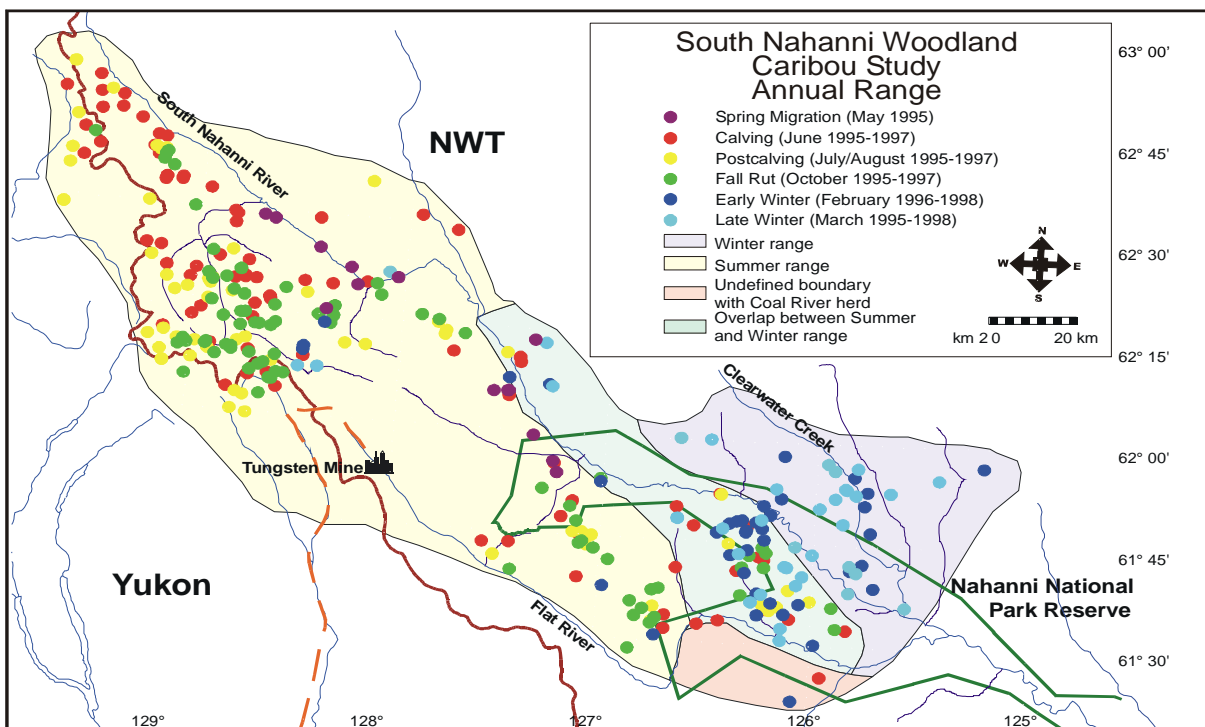


Figure 3. Summer and winter range of the South Nahanni Caribou Herd

5.3 Woodland caribou studies in the northern Mackenzie Mountains

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The Bonnet Plume caribou herd occupies the northern Mackenzie Mountains around the Arctic Red River and Bonnet Plume watersheds. The population demography of this herd is not known, and the herd has not been identified based on genetic relatedness or movement patterns. However, population of the herd has been estimated at 5000. The harvest of mountain caribou from this area by resident and sport hunters is approximately 50-55 caribou per year. Harvest levels are low, however, there is not enough information on the status of this herd to

determine if the sustainability of the harvest. In September 2000, the Gwich'in Renewable Resources Board conducted a fall composition survey between the Cranswick and Ramparts River in the northern Mackenzie Mountains (Shaw and Benn 2001). Surveys were done from fixed wing aircraft and from the ground. A total of 546 caribou were observed, and 360 were classified according to age and sex. Excluding caribou of unknown age and sex, composition was estimated at 45 calves per 100 cows, and 200 bulls per 100 cows. By including the unclassified cohort, composition estimates of 19 calves per 100 cows and 88 bulls per 100 cows were obtained. Criteria for using unclassified animals in estimating composition were discussed.

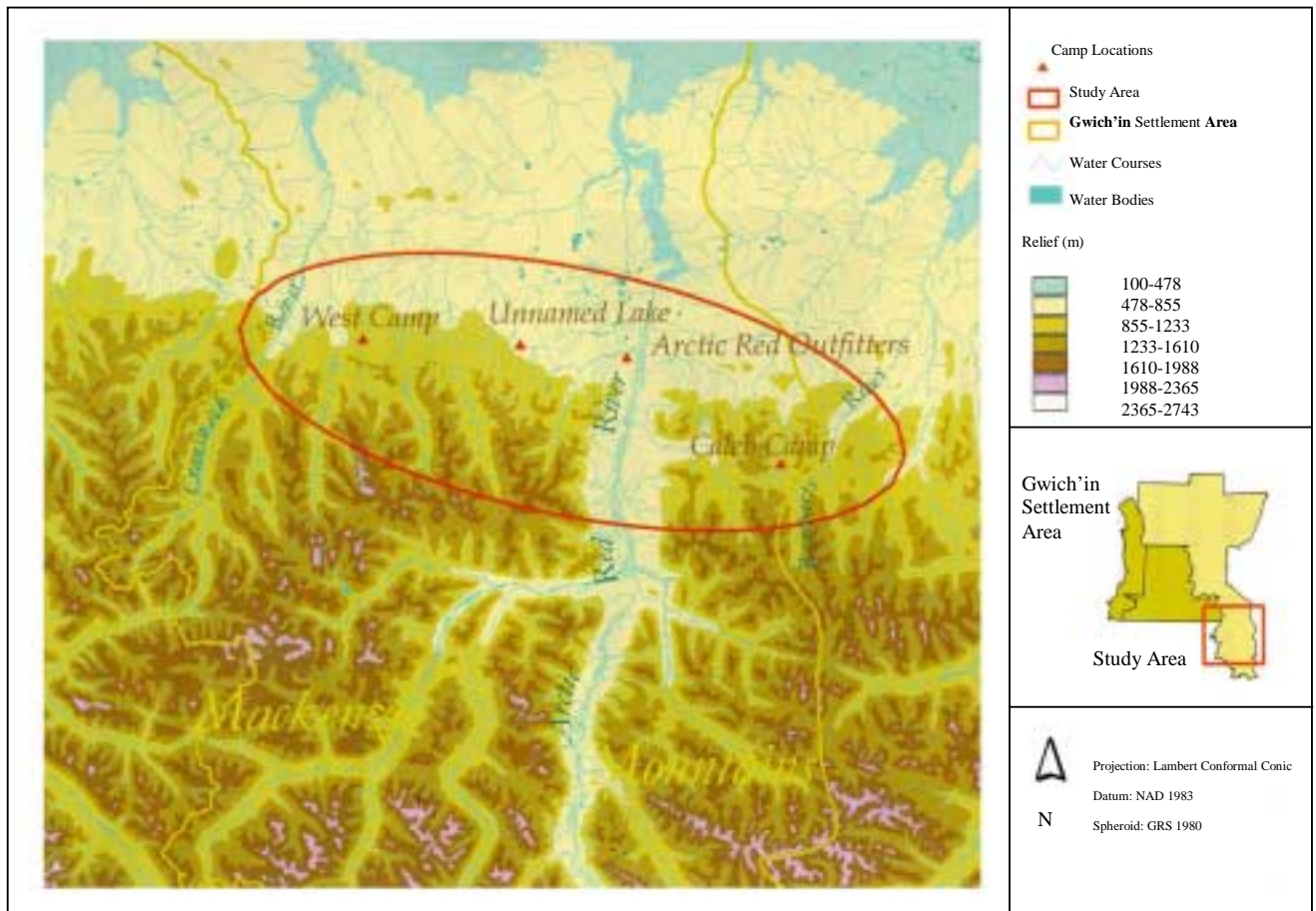


Figure 4. Arctic Red River study area

5.4 Cumulative Impacts

Various factors are known to have an impact on mountain caribou. Some of these factors are directly related to caribou while others are indirect such as habitat loss, fragmentation of habitat and functional habitat loss through avoidance. The workshop participants were asked to state their opinion about several of these factors. Each respondent was asked to indicate which factors have a major impact, minor impact, or no impact on mountain caribou. Responses 14 individuals were recorded. The distribution of responses was as follows: Fort Good Hope RRC (2), Deline RRC (1), Colville Lake RRC (0), Tulita RRC (2), Norman Wells RRC (2), Ross River (1), YTG (1), RWED (3), BCRP (0), NNPR (1), AMMO (1).

The percent of responses in each category was calculated (Table 7). Half of the respondents (50%) indicated that animal predators have a major impact on mountain caribou. Tourism was identified as a minor impact by 64% of respondents. Climate change was considered to be a major impact by 36% and a minor impact by 43%. Contaminants were considered to have a minor impact by 57%. Half of the respondents (50%) indicated that pipeline construction was considered to have a minor impact. Forty-three percent indicated that forestry and logging have no impact. There was no consensus on hunting, with responses of 36% for major impact, 36% minor impact, and 29% no impact. Participants also provided comments on the topic (see Section 5.4.1).



Mountain Grizzly on a caribou kill

Table 7. Cumulative impacts and mountain caribou (% responses)

	Major Impact	Minor Impact	No Impact	Unknown
Hunting	36	36	29	0
Predators	50	29	14	7
Contaminants	14	57	7	21
Climate Change	36	43	0	21
Forestry	14	36	43	7
Pipelines	14	50	29	7
Seismic	29	29	21	21
Highways	36	21	29	14
Tourism	0	64	21	14

5.4.1 Comments

Most impacts [on mountain caribou] to date are relatively small, but potential impacts are high, much depends on management

Less potential for oil and gas, and associated pipelines in mountain areas. Also somewhat less forestry potential, but some in Fort Liard and Nahanni areas. Climate change is suspected to dramatically alter fire regimes which could impact winter ranges. Mining activity an associated roads have high impact potential.

A lot of Dene people get very little information on development having an impact on land and wildlife so I support any study

There are some major impacts and some minor ones, mostly because of the amount of development nowadays

5.5 Research Opportunities

Given the concern over protection of caribou and caribou habitat, researchers must be able to provide information that can be used for conservation and management. Based on what is currently known, and what needs to be done, participants were asked to state which of the following research studies are high priority and which are low priority. Responses 14 individuals were recorded. The distribution of responses was as follows: Fort Good Hope RRC (2), Deline RRC (1), Colville Lake RRC (0),

Tulita RRC (2), Norman Wells RRC (2), Ross River (1), YRR (1), RWED (3), BCRP (0), NNPR (1), AMMO (1).

The percent of responses was calculated (Table 8). The survey results indicated that 71% of respondents felt that traditional knowledge was a high priority. Research on herd identification and genetic related was also considered a high priority by 71%. Sixty-four percent stated that studies of population composition and causes of mortality were both high priority. The majority also felt that studies of movement patterns and the effects of development were high priority. In addition to answering the survey questions, participants also provided comments regarding research studies of mountain caribou (see Section 5.5.1)

Table 8. Research priorities for mountain caribou (% responses)

	High Priority	Low Priority	No Response
Traditional knowledge study	71	14	14
Population size and composition	64	29	7
Migration routes, calving Areas and habitat use	57	29	14
Causes of mortality	64	21	14
Effects of development	50	36	14
Herd delineation and relatedness	71	21	7

5.5.1 Comments

Outfitters have over 30 years of data/observations for mountain caribou

TK should be caught before it is lost. Habitat use and development effects are the highest priority [for research]

Quite a few studies [on the effects of development] already, now need management

5.6 Methods for Conducting Research

Wildlife research and management often requires using techniques that are perceived to be invasive or harmful. Most of the techniques used today have gone through rigorous scientific testing to determine if they are safe, and

measures are taken to ensure that all studies are conducted humanely. The following survey was intended to find out which methods were perceived to be acceptable and which were unacceptable, according to public opinion. The results can be used to identify areas where more public education is needed, as well as areas where there may be concerns that need to be resolved before proposing further studies. Responses 13 individuals were recorded. The distribution of responses was as follows: Fort Good Hope RRC (1), Deline RRC (1), Colville Lake RRC (0), Tulita RRC (2), Norman Wells RRC (2), Ross River (1), YRR (1), RWED (3), BCRP (0), NNPR (1), AMMO (1).

The percent of responses was calculated (Table 9). The majority of respondents indicated that all of the methods listed were acceptable, in their opinion. Pellet/track counts, the least invasive method, were considered acceptable by 92%. Culling was also considered acceptable by 92%. Aerial surveys and radio collaring were acceptable to 77% of the respondents. In addition to answering the survey questions, participants also provided comments on the topic (see Section 5.6.1).

Table 9. Methods for conducting research on mountain caribou (% responses)

	Acceptable	Not Acceptable	No Response
Aerial Surveys	77	23	0
Radio Collaring	77	15	8
Pellet/track counts	92	8	0
Culling	92	8	0

5.6.1 Comments

Radio collaring is acceptable nowadays. It is easier for hunters and trappers to know where the caribou herds are and movement

[Necropsy] has to be done under the right circumstances so that the maximum amounts of information are gathered from each animal

I feel aerial surveys are acceptable as long as it does not disturb any traditional activities on the ground

6.0 DISCUSSION

Woodland caribou occur throughout the Northwest Territories. There are two forms recognized by biologists known as mountain and boreal caribou. These caribou have different habitat requirements but are otherwise the same. Boreal and mountain caribou are distinguished from barren-ground caribou by their larger body size, migration patterns, habitat and behavior. Woodland caribou tend to be more secretive compared to their barren-ground counterparts. Hunters know that these caribou are around because they often see tracks, but rarely see the animals. Woodland caribou are harder to approach because they are more afraid of hunters. These caribou often travel in small groups, and large aggregations are uncommon. Generally, there are fewer woodland caribou and caribou tracks seen today than in the past. There are more wolves now because few people are hunting them these days. The number of roads, cutlines and pipelines has increased, and now people have an easier time harvesting caribou. Grizzly bears are also using the cutlines to come out of the mountains. Oil and gas exploration and development has also increased in recent years. Some communities are concerned that these activities disturb caribou feeding areas, especially in the winter when the barren-ground caribou herds are around.

Several communities indicated that woodland caribou are an important resource, but that the subsistence harvest is mostly from barren-ground caribou herds. However, if barren-ground caribou herds decline or change their migration routes, woodland caribou will become very important to those communities.

Hunting pressure on boreal caribou is light. Native hunters take boreal caribou whenever they can, but most communities in the Sahtu harvest less than 50 animals per year. There are no outfitters harvesting boreal caribou in the Sahtu. The resident harvest of boreal caribou is not significant. However, given that boreal caribou herds are typically small and fragmented, any increase in harvesting could have a major impact on boreal caribou in a

particular area. Furthermore, it would be more difficult for these herds to recover after over harvesting, because of their known sensitivity to disturbances and the compounding effects of habitat loss resulting from increased development and forest fires.

There have been few studies on boreal woodland caribou in the Northwest Territories. Workshop participants indicated that, in their opinion, animal predators have a major impact on boreal caribou, whereas hunting was perceived to have only a minor impact. Concerns were raised over recent increases in oil and gas development in the region including exploration, extraction and transport. These activities can result in a net loss of habitat as well as increased predation by wolves and added hunting pressure through the provision of access into remote areas. Given that development in the Northwest Territories has not reached its full potential, the opportunity exists to conduct studies that will be important for establishing a baseline for which to compare future conditions, evaluate current land uses and develop mitigation strategies for proposed activities. Traditional knowledge was identified as having a major role in future studies. Native communities feel that there is a lot to be learned from the experience and knowledge of their elders. Groups such as community-based Renewable Resource Councils, co-management boards, big game outfitters and other users expect that studies address issues of local concern and incorporate local knowledge and observations into applied research. Other research priorities for boreal caribou included studies on the effects of development, movement patterns and habitat use, population size and composition, herd delineation, and causes of mortality. All of the proposed methods for conducting research and managing caribou were deemed as acceptable.

Mountain caribou are important to those communities closest to the Mackenzie Mountains, namely Ross River, Tulita, Norman Wells and Fort Good Hope. The annual harvest of mountain caribou is in excess of 100 animals for both the communities of Tulita and Ross

River. Non-resident clientele of the big game outfitters harvest approximately 170 caribou per year, on average in the Mackenzie Mountains. The resident harvest of mountain caribou is not known.

Several areas have been identified as important seasonal range of mountain caribou, including the wintering ground at Drum Lake, a traditional hunting area of the mountain Dene that is still used today by the community of Tulita. Another important area for mountain caribou is the Artic Red River and Ramparts River. In winter, caribou move out of the mountains along these rivers, into lower elevation areas accessible by hunters from Fort Good Hope.

Many of the mountain caribou herds in the Yukon have been defined based on seasonal distribution and range use. More recently, DNA typing using microsatellites has proven effective in identifying genetically distinct caribou populations in the Yukon (Zittlau et al. 2000). Samples of genetic material collected from different areas along with information on total and seasonal movements of caribou are required to test hypotheses about herd dynamics and relatedness. To date, few studies have examined mountain caribou ranging between the Yukon and NWT. Although caribou herds in these areas have been tentatively defined based on distribution, very little is known about their movement patterns and genetic relatedness. However, several studies, some of which are on going, and some of which have been proposed, intend to determine the movements of mountain caribou in these areas using satellite telemetry. Once the herds have been defined, estimates of population size can be obtained, and populations can be monitored using composition surveys. Studies in the South Nahanni, Redstone, and Bonnet Plume watersheds have been initiated by Parks Canada and RWED, the SRRB and the GRRB respectively.

7.0 CONCLUSION

The workshop provided a venue for sharing information on caribou ecology and discussing different natural and anthropogenic factors affecting caribou today, and in the future. Researchers were given the opportunity to present their findings, and propose new studies. Representatives from five communities in the Sahtu and one in the Yukon participated by providing information on caribou distribution, hunting activity and traditional knowledge. One outcome of the workshop was the need for a coordinated approach to land use planning and wildlife management. Secondly, research studies and management strategies should proceed with the co-operation of communities, industry, district land corporations, wildlife committees and co-management boards, as well as input from the public. The conservation of caribou and protection of caribou habitat is a top priority in the north. Development and conservation must be balanced to provide for economic growth without compromising the integrity of environment.

8.0 ACKNOWLEDGEMENTS

I would like to thank everyone who participated in the workshop, particularly those who had to wait for good weather to return home from Norman Wells. Jody Snortland, Lori Anne Lennie and Janet Bayha deserve recognition for helping with the last minute preparations. Wendy Wright prepared the map showing seismic density and fire history in the Sahtu. Jeff Truscott provided a map on behalf of the GRRB. I also thank everyone who provided written abstracts and comments on the summary report. Mahsi Cho.



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