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Woodland caribou population decline in Alberta: fact or fiction?

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Abstract: We re-assessed the view of a major woodland caribou (*Rangifer tarandus caribou*) population decline in Alberta. Several historical publications and provincial documents refer to this drastic decline as the major premise for the designation of Alberta's woodland caribou an endangered species. In the past, wildlife management and inventory techniques were speculative and limited by a lack of technology, access and funding. The accepted trend of the decline is based on many speculations, opinions and misinterpretation of data and is unsubstantiated. Many aerial surveys failed to reduce variance and did not estimate sightability. Most surveys have underestimated numbers and contributed unreliable data to support a decline. Through forest fire protection and the presence of extensive wetlands, the majority of potential caribou habitat still exists. Recreational and aboriginal subsistence hunting does not appear to have contributed greatly to mortality, although data are insufficient for reliable conclusions. Wolf (*Canis lupus*), population fluctuations are inconclusive and do not provide adequate information on which to base prey population trends. The incidence of documented infection by parasites in Alberta is low and likely unimportant as a cause of the proposed decline.

Key words: history, surveys, population trend, hunting, predation, habitat loss, pathology

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Introduction

In this paper we analyse the view that a major woodland caribou (*Rangifer tarandus caribou*) population decline has recently occurred in Alberta (Edmonds, 1986), and we offer a re-assessment of the limiting factors supporting this speculation. Many provincial documents refer to this decline as the premise for the designation of Alberta's woodland caribou as an endangered species (Alberta Department of Environmental Protection, 1994), and Edmonds (1986) states, "*Caribou in Alberta have severely declined since the early decades of this century and presently the viability of the remaining herds is either threatened or unknown.*" Fig. 1 shows the Alberta caribou population trend as outlined in the 1986 draft Woodland Caribou Provincial Restoration Plan for Alberta (Edmonds, 1986). The form of the decline is derived from many province-wide estimates that are analysed in this review. Brown *et al.* (1991) re-iterate Edmonds' (1986) views: "*Numbers of woodland caribou in Alberta are estimated to have declined from approximately 9 000 in the mid-1960s to currently less than 2 000.*". Others have reported declines in woodland caribou populations in Canada (Anderson, 1938; Edwards, 1954; Bergerud, 1971; Bloomfield, 1980b; Miller, 1982; Bergerud & Elliot, 1986;

Williams & Herd, 1986; Edmonds, 1991; Rock, 1992).

The management of any species requires at least 2 levels of assessment: change in population size and the factors causing the change. The former can often be determined semi-quantitatively within broad limits, while the latter are considerably more difficult to assess. Speculation often serves as the basis for management regulations, so it is important to continually re-assess data and re-interpret trends.

We examined all known historical estimates of woodland caribou abundance in Alberta. We also re-assessed aerial surveys for woodland caribou to examine the validity of provincial population estimates and the rate of decline suggested by Fig. 1. We examined changes in several potential limiting factors that could have caused fluctuations in caribou abundance. Have one or more limiting factors varied enough to cause and maintain a woodland caribou population decline? Human recreational and subsistence hunting and the potential role that natural predators, namely wolves (*Canis lupus*), have played in altering caribou abundance in Alberta were examined. We also discuss the effects of fire, fire suppression, timber harvest and parasites on woodland caribou abundance.

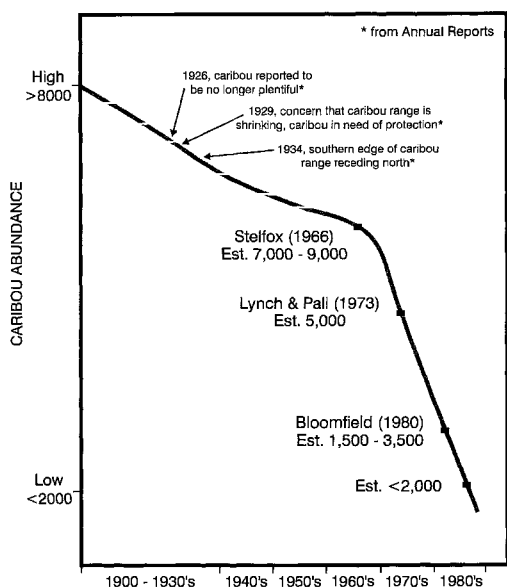


Fig. 1. Proposed woodland caribou population decline for Alberta from 1900-1986 as originally presented in Edmonds (1986).

Two, relatively distinct varieties of woodland caribou (Banfield, 1961) are found in Alberta: (1) a mountain variety in the Rocky Mountains of west central Alberta and foothills near the town of Grande Cache and (2) a woodland, or forest-dwelling, variety found throughout northern Alberta as well as near Grande Cache (Edmonds & Bloomfield, 1984; Edmonds, 1986).

Re-evaluating the Supposed Decline

In the past, wildlife inventory techniques were often speculative. Limited by technology, access and funding, provincial wildlife management decisions often were based on "guesstimates" (Webb, 1959) of a species' status. This is especially true of woodland caribou due to their relatively elusive behaviour, low densities and use of inaccessible habitat. The trend and magnitude of the proposed decline of woodland caribou in Alberta is based on many speculations and is unsubstantiated. The decline (Fig. 1) is also based on the better understanding of caribou in west central Alberta, and the extrapolation of habitat use and population density data from this region to the boreal forest populations.

Early History

Preble (1908) reported that woodland caribou occurred sparingly across northern Alberta in 1900-1901. Although the present distribution of caribou in northeastern Alberta does not extend much further south of the 55th Parallel, some 170 km north

of Edmonton, Preble (1908) reported unconfirmed observations of caribou along the North Saskatchewan River near Edmonton. This suggests a change in distribution since this time, at least along the southern range of the boreal forest. Others have described woodland caribou distribution in Alberta as scattered or sparse (McCaig, 1919; Hewitt, 1921), and despite the observation that caribou distribution was limited compared to other native ungulates, they were not considered to be in any immediate danger of extirpation (Lawton, 1923; 1926; 1927; 1928; 1929). Soper (1942) stated that woodland caribou were not a common sight in Wood Buffalo National Park in 1931 (northeastern Alberta), but suggested that they were formerly much more abundant in the park. Others such as Clark (1934) and Anderson (1938) concurred that caribou density was low and their distribution limited.

Banfield (1949) and Cahalane (1947) described the mountain variety of woodland caribou as numerous, and Stelfox (1955; 1956a; 1956b) suggested that 200 - 300 caribou were in the foothills east of northern Jasper National Park in the mid-1950s. Cringan (1957), Webb (1959) and Soper (1964) suggested that Alberta had a stable population of 500 - 1 000 woodland caribou.

In 1965 a crude survey of the north-east region of Alberta was done to determine whether caribou abundance warranted a hunting season. Kerr (1966) concluded that despite low numbers, a hunting season would not be detrimental because hunters would find the area difficult to access.

None of these early estimates are based on conclusive data. In fact, many estimated the provincial population much lower than the 7 000 - >8 000 suggested by Fig. 1.

Early Estimates

The first provincial population estimate was 6 860 - 9 060 (Stelfox, 1966), evaluated from data compiled by aerial and ground surveys, and from reports of Forest officers, Fish and Wildlife officers, hunters, guides and outfitters. Without reliable inventory techniques, this estimate is questionable. Burgess (1970) believed the 1966 estimate was "subject to error", and that 4 000 - 5 000 caribou was a more realistic estimate. Lynch and Pall (1973) also re-evaluated the 1966 estimate and suggested that 4 800 - 5 200 was more realistic.

Most publications or reports on woodland caribou in Alberta refer to the 1973 estimate as a significant decline from the 1966 estimate (Bloomfield, 1980a; Edmonds & Bloomfield, 1984; Edmonds, 1986; Holroyd & Van Tighem, 1983), even though it was a re-evaluation. However, Edmonds (1988)

mentions that the Lynch & Pall (1973) estimate of 600 - 700 caribou in the mountains and foothills of Alberta was an adjustment to the Stelfox (1966) estimate of 1 200 - 1 600.

In the late 1960s, a noticeable decline in caribou numbers was reported for Jasper National Park (Stelfox & Bindernagel, 1978), although abundance estimates from 1915 - 1973 were based largely on incidental sightings by park wardens. Soper (1970) upheld the view that a decline had occurred in the Alberta Rockies since sometime in the 1800s.

Bloomfield (1980) recommended a closure of recreational hunting on Alberta's woodland caribou based on the population estimates quoted above and on the apparent decline. His new estimate of the provincial population was 1 500 - 3 500, although he did not support this with data.

Consequently, the proposed decline (Fig. 1) is established from uncertain population estimates and some misinterpretation. Despite the lack of confidence in the estimates, no other data exist to refute the general perception of a decline. Speculative estimates should not be strung together to set up trends.

Recent Estimates

Edmonds (1986) estimated the provincial population at 1 324 - 1 868 based on aerial surveys of certain areas of the province, woodland caribou sighting card returns and regional biologists' opinions. To assess the validity of these numbers, we re-analysed each regional estimate and the surveys on which they were based (Table 1). Most of the aerial surveys from which the Edmonds (1986) estimate was evaluated do not lend themselves to a calculation of density. Many areas of the province capable of supporting caribou were not surveyed, and some estimates of population size were approximated from sighting card returns or radio-telemetry data on two or three individuals (e.g., Arbuckle, 1983; 1984a; 1984b; 1985). Moreover, none of the surveys included estimates of sightability (i.e., the probability that an animal within an observer's field of search will be seen by that observer - Caughley, 1974). Edmonds (1986) arbitrarily provided a sightability estimate of 70% for Keillor (1982a) and 50% for other estimates, but no sightability calculations were provided for the other surveys in Table 1. Under counting animals in relatively dense vegetation is common; for example, a woodland caribou survey in northeastern Alberta in late 1993 provided a sightability estimate of 40% based on the probability of sighting radio-collared individuals (Stuart-Smith *et al.*, in press). As well, the variance associated with the estimates was typically high (Table 1), making many of the estimates meaningless.

Subsequently, Edmonds (1991) put the provincial population at 3 350 animals, with 650 residing in west central Alberta and Jasper National Park. The west central population appeared to be stable and the remainder was of unknown status. Ferguson and Gauthier (1992) placed the provincial population at 3 000 - 3 500, and the 1992 provincial estimate was 4 100 (McFetridge, pers. comm.), which is a re-evaluation of past estimates and is based on potential habitat availability and population density. The most recent estimate, also based on potential woodland caribou habitat availability and estimates of population density, is 3 300-6 200 (Alberta Woodland Caribou Conservation Strategy, in prep).

The Human Predator

Although Bergerud (1974) claims that caribou are more vulnerable to hunting than any other cervid in North America, this may not apply to woodland caribou. Caribou in Alberta live in small groups in forested habitats (Fuller & Keith, 1981; Edmonds, 1988) and, with the exception of the mountain variety (Edmonds & Bloomfield, 1984), they rarely show traditional movements (Fuller & Keith, 1984; Stuart-Smith *et al.*, in press). These behaviours and the use of largely inaccessible habitat reduce the human predation risk.

Fig. 2 shows the estimated recreational harvest of male caribou in Alberta from 1909-1981. No data are available from 1925-1947. The yearly kill is small (Smith, 1962; Lynch, 1973; Bloomfield, 1980), even though it is likely that the numbers from the early half of the century are underestimated since many hunters were without a licence and failed to report to provincial authorities (Edmonds, 1986). Moreover, woodland caribou comprise a modest portion of the Alberta Chipewyan, Cree, Déné Tha and Métis diets; moose (*Alces alces*) are a more important food source (Wein *et al.*, 1992; Desjarlais *et al.*, 1993; Janvier *et al.*, 1993; Poelstra *et al.*, 1993).

Natural Predation

Historically, most ungulate population declines supposedly resulted primarily from habitat degeneration (Leopold & Darling, 1953; Edwards, 1954; Scotter, 1967; 1970; 1971), but the effects of a variety of other factors on woodland caribou populations have been debated for several decades (Edwards, 1954; Bergerud, 1983). Recent research tends to support wolf predation as a leading mortality factor for many woodland caribou populations in North America (Bergerud, 1974; 1978; 1980; 1983; Doerr, 1980; Fuller & Keith, 1980; Fuller & Keith, 1981; Gasaway *et al.*, 1983; Bergerud & Elliot, 1986; Gauthier & Theberge, 1986; Seip,

Table 1. Overview and re-assessment of population estimates originally compiled in Edmonds (1986).

Region	1986 Est.	Source	Recalc. density	Pop. range ^a
Bistcho Lake (north-west)	620 - 800	Hall <i>et al.</i> (1974a)	0.0202	0 - 948
Caribou Mtns. (north central)	200 - 400	Keillor (1982a)	NCP ^b	NCP
		Hall <i>et al.</i> (1975a)	0.0383	0 - 737
		Brebber & Hall (1979)	0.3306	1312 - 4235
		Keillor (1980a)	0.1905	261 - 789
		Keillor (1981a)	0.1115	0 - 398
		Holton (1985)	0.2574	291 - 891
Chinchaga River (north-west central)	19 - 28	Arbuckle (1984a)	NCP	NCP
Dixonville (north-west central)	48 - 72	Keillor (1980b)	0	0
		Moller (1982)	0	0
		Arbuckle (1983)	NCP	NCP
		Arbuckle (1985)	NCP	NCP
Red Earth (north central)	41	sighting card returns	NCP	NCP
Birch Mtns. (north-east)	44 - 88	Bibaud (1972)	0.0196	180 - 1530
		Hall <i>et al.</i> (1974b)	0	0
		Hall <i>et al.</i> (1975b)	0.0858	0 - 1328
		Smith (1979)	0.0151	NCP
		Dielman <i>et al.</i> (1979)	0.0593	15 - 242
		Fuller & Keith (1981)	0.0313	239 - 346
Lesser Slave Lake (central)	49 - 149	Hall <i>et al.</i> (1975b)	0	0
		Keillor (1981b)	NCP	NCP
		Keillor (1982b)	0	0
		Arbuckle (1984b)	NCP	NCP
		Holton (1986)	0.0552	150 - 282
Cold Lake (east central)	114	sighting card returns	NCP	NCP
Swan Hills (central)	0	no recent sightings	NCP	NCP
Grande Cache (west central)	214 - 290	Edmonds & Bloomfield (1984)	NCP	NCP
Jasper & Banff National Parks (south-west)	89 - 115	Kemp (1967)	NCP	NCP
		Hall & Bibaud (1975)	NCP	NCP
		Bibaud (1979)	NCP	NCP
		Bibaud & Hall (1981)	NCP	NCP
		Goski <i>et al.</i> (1982)	NCP	NCP
		Rhude (1982)	NCP	NCP
		Holroyd & Van Tighem (1983)	NCP	NCP

^a 95% confidence interval of population estimate calculated using equations from Krebs (1989); population figures are calculated using the total area covered in each survey.

^b NCP = No Calculation Possible.

1989), although other mortality sources may be more important for certain populations (Shideler *et al.*, 1986; Van Ballenberghe, 1986). Wolves have been identified as the principal predator, but grizzly bear (*Ursus arctos*), black bear (*U. americanus*), cougar

(*Felis concolor*), lynx (*F. lynx*) and coyote (*Canis latrans*) have also been implicated (Miller, 1982). Seip (1991) further suggested that forest-dwelling caribou populations are more vulnerable to predation because wolf populations are maintained by a

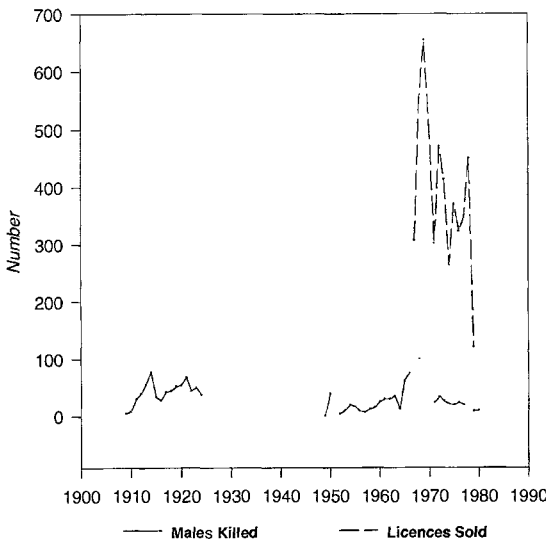


Fig. 2. Yearly human kill of male woodland caribou in Alberta from 1909-1981 and woodland caribou hunting licences sold from 1967-1979. No kill data are available from 1924-1948. Only big game licences required prior to 1967 (Edmonds, 1986).

variety of prey species. As well, many woodland caribou populations do not have long-distance migrations to space themselves from wolves, an important behaviour for reducing predation (Bergerud *et al.*, 1984).

Because Alberta wolf population data are even more speculative than those of woodland caribou, it is impossible to estimate caribou population trends based on these data. One must assume that wolves significantly limit caribou and that the wolf trend data itself is reasonably accurate. Although some have attempted to describe this century's wolf population trend (Stelfox, 1969; Gunson, 1991), no reasonable conclusion concerning the overall effect of wolves on Alberta's caribou abundance can be made.

Habitat Loss

Habitat loss has been postulated as a major limiting factor on caribou (Edwards, 1954; Cringan, 1957; Bloomfield, 1980; Seip, 1990), but Bergerud (1983) stated that there was little evidence to support a cause and effect relationship between habitat loss and population decline. The majority of Alberta's caribou depend on wetlands that have undergone little human-caused disturbance until recently (Edmonds, 1991), although habitat alteration may have influenced the mountain variety of woodland caribou (Bjorge, 1984; Edmonds & Bloomfield, 1984; Edmonds, 1988).

Fire plays a crucial role in the regeneration of certain plant communities and is the primary cause of the complex mosaic structure of the boreal forest (Rowe & Scotter, 1973; Johnson & Rowe, 1975; Schaefer & Pruitt, 1991). Some believe that fire can destroy lichen availability to the point of reducing caribou range (Scotter, 1967), although many have renounced this view (Bergerud, 1971; 1974; Johnson & Rowe, 1975). Schaefer & Pruitt (1991) found a woodland caribou population to decrease by 50% following a fire, but they also suggested that long-term range conditions may actually improve due to fire. Those who support the fire-influence hypothesis also suggest that as a result of increased settlement of the forested zone during the last 200 years, fire frequency and the resulting habitat loss have increased.

Fig. 3 shows that the total area burned in Alberta has decreased since the onset of effective fire suppression in the 1950s (Murphy, 1985), although the total area burned per year in Alberta from 1918-1979 has never exceeded 1.2% of the total forested area (Goff, 1979; Murphy, 1985). In addition, fire suppression is thought to have shifted the coniferous age class structure to older stands (Fig. 4), suggesting that more potential caribou habitat has become available within the last 40 years.

Pathology

Disease may have caused declines or extirpation of small woodland caribou populations (Miller, 1982;

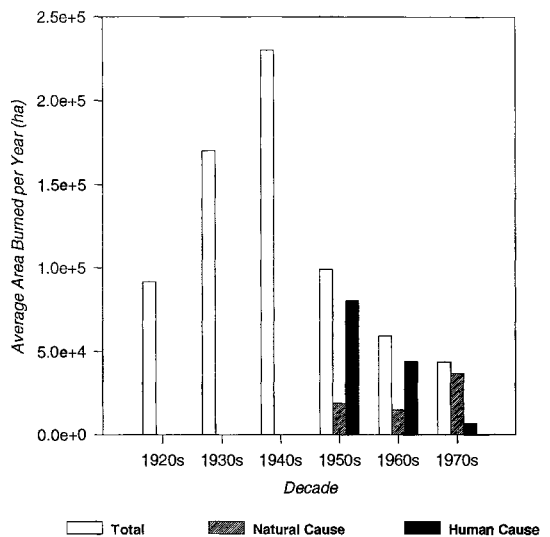


Fig. 3. Total forested area burned annually in Alberta from 1919-1979. Data represents 10-year running averages.

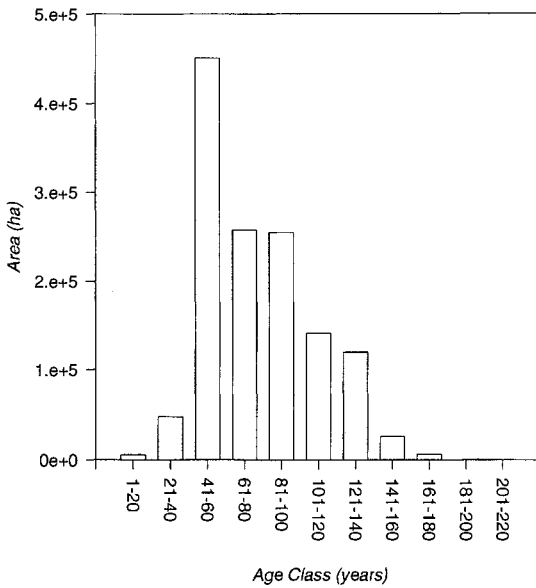


Fig. 4. Age class distribution of coniferous stands in northeastern Alberta (Alberta-Pacific Forest Industries, Inc. 1992).

Bergerud, 1983; Bergerud & Mercer, 1989). *Parelaphostrongylus tenuis*, fatal in caribou (Anderson, 1971; Trainer, 1973; Dauphiné, 1975), has not been reported west of the Manitoba-Saskatchewan border (Lankester & Fong, 1989; Samuel, pers. comm.) and there is no evidence that *P. tenuis* occurs in Alberta.

Larvae of a related nematode, mule deer muscleworm (*Parelaphostrongylus odocoilei*), were found in 28% of caribou faeces collected in west central Alberta (Gray & Samuel, 1986). Severe debilitation and perhaps death occurs in some hosts such as mountain goat (*Oreamnos americanus*) (Pybus *et al.*, 1984), but few larvae were found in caribou faeces suggesting that few adult worms of *P. odocoilei* were established in muscle tissue. Therefore, the potential severe pathology is remote (Gray & Samuel, 1986). The apparently benign muscleworm, (*Parelaphostrongylus andersoni*), occurs in caribou elsewhere (Lankester & Hauta, 1989), but there are no reports of this parasite in Alberta.

The tissue worm (*Elaphostrongylus rangiferi*), is generally found in the Old World, but there is recent evidence that it is established in Newfoundland caribou, the probable result of reindeer from Norway introduced there in 1908 (Lankester & Fong, 1989). Gray & Samuel (1986) found a few large larvae similar to those of the genus *Elaphostrongylus* in the faeces of woodland caribou in northeastern Alberta, perhaps the result of captive Newfoundland caribou escaping in

northeastern Alberta in 1908 (Lankester & Fong, 1989).

The infestation of the winter tick (*Dermacentor albipictus*), a common ectoparasite of moose (Samuel, 1989), found on captive reindeer from the Edmonton Valley Zoo prompted the search for this parasite in Alberta's wild woodland caribou. Welch *et al.* (1990) examined caribou hides from 2 locations in Alberta and found an extremely low prevalence of *D. albipictus*. Their presence on caribou is likely a new phenomenon and therefore, not a source of past mortality (Anderson & Lankester, 1974).

The epizootic, besnoitiosis, was reported as morbid in captive caribou and reindeer at the Assiniboine Park Zoo in Winnipeg, Manitoba in 1985 (Glover *et al.*, 1990). This led to studies by Lewis (1989; 1992) to determine its distribution and pathology in wild woodland caribou in British Columbia. He found a high incidence of infection by *Besnoitia* sp. (23%) with minimal or no detrimental effects. Only two cases of woodland caribou with besnoitiosis have been reported in Alberta (Pybus, pers. comm.).

Discussion and Conclusions

We agree with Seip (1991) that woodland caribou, in Alberta and elsewhere in similar ecoregions, have evolved to exist at relatively low densities. We also concur with the hypothesis of Bergerud & Page (1987) that this cervid has co-evolved with its predators by forming small groups and existing at low densities possibly to reduce predation risk. Because low densities appear to be the norm for woodland caribou across the boreal range (Seip, 1991), the major environmental variable permitting caribou to co-exist with predators is space (Bergerud *et al.*, 1984).

Woodland caribou may not have suffered a decline in Alberta because the estimates supporting the presumed decline originated primarily from anecdotal information and misinterpretation. As well, much of Alberta has not been surveyed effectively to estimate total caribou abundance (Fig. 2). There is not enough evidence to claim that Alberta's woodland caribou population has either decreased or increased significantly during the last century. We suggest that the difference in population estimates during the last decade is evidence of refined knowledge rather than true fluctuations in abundance.

It is doubtful that a single-factor hypothesis could explain a caribou population trend, although it is important to analyse the trend of individual limiting factors. Recreational hunting of woodland caribou in Alberta appears low, but insufficient data regarding poaching and aboriginal harvests preclude any reliable conclusion. Without the necessary data

to corroborate the hypothesis that hunting could have caused a decline, it is impossible to weight this source of mortality in terms of its effects on abundance. Nonetheless, woodland caribou are found largely in relatively inaccessible habitat, the exception being the populations of west central Alberta (Edmonds & Bloomfield, 1984; Edmonds, 1986). Woodland caribou there represent a small proportion of the total provincial population and are prone to higher hunting pressures and collisions with highway vehicles given their use of more accessible range (Edmonds, 1986). These factors are not well-documented for the remainder of Alberta's woodland caribou populations.

Data on wolf abundance in Alberta during the past century are inconclusive and cannot be used to predict trends in prey abundance. Further research is required to demonstrate the true relationship between woodland caribou and wolves, especially in the boreal forest region.

The abundance of potential woodland caribou range and the typical burning rate of Alberta's boreal forests suggest that although caribou may be limited ultimately by forage availability, the low densities at which they exist in a seemingly habitat-abundant range suggests that other factors may be responsible for their low numbers. However, the recent expansion of the forest industry into the northern boreal forest (Edmonds, 1991) may indirectly contribute to future population declines. Land-use authorities must therefore maintain contiguous regions of woodland caribou habitat such as black spruce (*Picea mariana*) stands, bogs and fens and certain uplands (Fuller & Keith, 1981; Darby & Pruitt, 1984; Bradshaw *et al.*, 1995).

Habitat alteration resulting in increased moose, or deer, productivity and subsequent wolf population increases (Bergerud, 1974) may have the most detrimental effects on the survival and distribution of northern Alberta's caribou. Canopy closure and tree density are high and understorey shrub growth is low in forests dominated by mature tree stands, a result of intensive fire suppression during the last few decades (Hebert, 1993). Moose population density and distribution may respond to timber harvesting practices in the near future, so land-use managers should attempt to reduce the predicted changes in moose and wolf densities in order to maintain caribou numbers.

The low incidence of infection of caribou parasites precludes this reason as one which could explain a major population decline. We should not, however, be quick to renounce parasite-induced mortality as an important future limiting factor. The increasing range expansion of parasite vectors, such as white-tailed deer (*Odocoileus virginianus*), into

caribou range highlights a need for further research in this area.

Management Implications

Imprecise survey data from different years should not be used to establish historical trends. If our ultimate objective is to ensure the healthy continuance of a given species in spite of increasing development in the northern forests, we must have reliable information (Romesburg, 1981) on which to base our management decisions. As is the case for much in wildlife science, opinion often creeps into scientific thought and becomes established as paradigm. Ideas and hypotheses that have the power to sway management decisions must be identified and tested appropriately before being accepted. We strongly suggest that all "documented" declines of any furtive species be scrutinized thoroughly before assuming the worst.

Regardless of the true historical woodland caribou trend in Alberta, we acknowledge the concern for this sub-species and believe that a better understanding of their population dynamics is warranted. Maintaining healthy populations in spite of proposed timber allocations is a challenge for provincial authorities in the future.

Finally, we offer our opinion on the role of provincial authorities in maintaining reliable census data. Admittedly, many of the older survey projects operated on inadequate budgets, although the designs of many of these projects were faulty. In most cases, modification of the survey designs, such as density stratification or sightability estimates, would have answered many more questions. Due to the nature of woodland caribou research, the use of expensive aircraft is currently the only effective means of collecting data. Therefore, it is essential that surveys are designed to maximize quality data returns. We suggest that the focus of woodland caribou management should be switched from enumeration to understanding the dynamics of local populations.

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