POPULATION CENSUSES OF CARIBOU THE NORTH COLUMBIA MOUNTAINS

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Executive Summary

Mountain caribou in the Columbia Forest District were studied using radio-telemetry from 1992 to 2006. Censuses conducted between 1994 and 1997 indicated a relatively stable population of between 290 and 375 animals in the area of the upper Columbia River. These censuses had jurisdictional, not ecological boundaries and changes in numbers in the mid-1990s likely reflected caribou movements in and out of the census areas between years more than actual changes in numbers. In 2002 the entire range of mountain caribou in British Columbia was censused so biological subpopulations could be enumerated. Even with the expanded census areas, the sum of the 4 subpopulations (Columbia North, Columbia South, Frisby/Queest, and Kinbasket South) that included the earlier census area was only 212 animals or 57% of the 1997 estimate for an annual decline of 10%. This downward trend occurred in all mountain caribou populations in southern B.C. The 2004 census indicated that the decline likely continued, although not as rapid. The 2006 census indicated that the population had stabilized. Several hypotheses have been suggested for the cause of mountain caribou declines including high predation rates due to “apparent competition”, a lack of arboreal lichen for food due to logging old forests, and implications of rapidly expanding outdoor winter recreation (heli-skiing, snowmobiling, and ski-touring). Because the number of caribou in Mt. Revelstoke and Glacier National Parks declined at least as rapidly as other subpopulations, the lack of food and outdoor recreation hypotheses are not supported. The apparent competition hypothesis is supported and is consistent with the hypothesis that a decline in deer numbers in 1996, 1997, and 1999 due to the deepest and longest lasting snow pack at low elevations in over 20 years. The hypothetical decline in deer would have caused predators (primarily cougar) to increase their consumption of caribou before the predator numbers also declined due to a shortage of primary prey. This specific hypothesis remains untested.

Introduction

Woodland caribou (*Rangifer tarandus caribou)* in southeastern British Columbia are commonly referred to as mountain caribou. They are a unique ecotype of caribou distinguished from others by their use of the deep wet-belt snowpack (>2m) as a platform to access arboreal lichens in the canopy of subalpine forests during winter. Because of their low numbers, decreasing population trend, and shrinking and fragmented distribution, these caribou are considered threatened by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and were added to the red-list (species at risk of extinction or extirpation) by the British Columbia Conservation Data Centre in 2002.

Mountain caribou habitat is contiguous in British Columbia from north of Prince George to the Columbia Forest District (CFD). Several small, isolated populations are found south of the CFD with one extending below the international border. Population characteristics of caribou on the Revelstoke Reservoir portion (former Revelstoke Forest District) of the CFD were examined from 1981 to 1985 by Simpson and Woods (1987) and from 1992 to 2004 by McLellan et al. 1994, Flaa and McLellan 2000, and Hooge et al. 2004. This report updates the population inventory to March 2006.

Census Areas

Before 2002, caribou census areas were bounded by jurisdictional borders such as Ministry of Forests Districts because of funding constraints and because the actual delineation of subpopulations based on animal movements was not well known. The census boundaries used before 2002 make comparisons among years difficult because we now know that many animals move across the pre-2002 census area boundaries and the largest groups of caribou in the entire area were often located along previous census-area boundaries. Recent analyses by Wittmer et al. (2005) determined that five separate subpopulations (Columbia North; CN, Columbia South; CS, Kinbasket South; KS, and Frisby/Queest; FQ, Monashee South; MS Fig. 1) cover at least portions of the CFD and only one of these (CS) is completely contained within the old Revelstoke Forest District and Mt. Revelstoke and Glacier National Parks. Censuses before 2002 that covered only the CFD or, most commonly, a portion of the CFD, undoubtedly missed counting animals in the CN and FQ subpopulations, so these old censuses

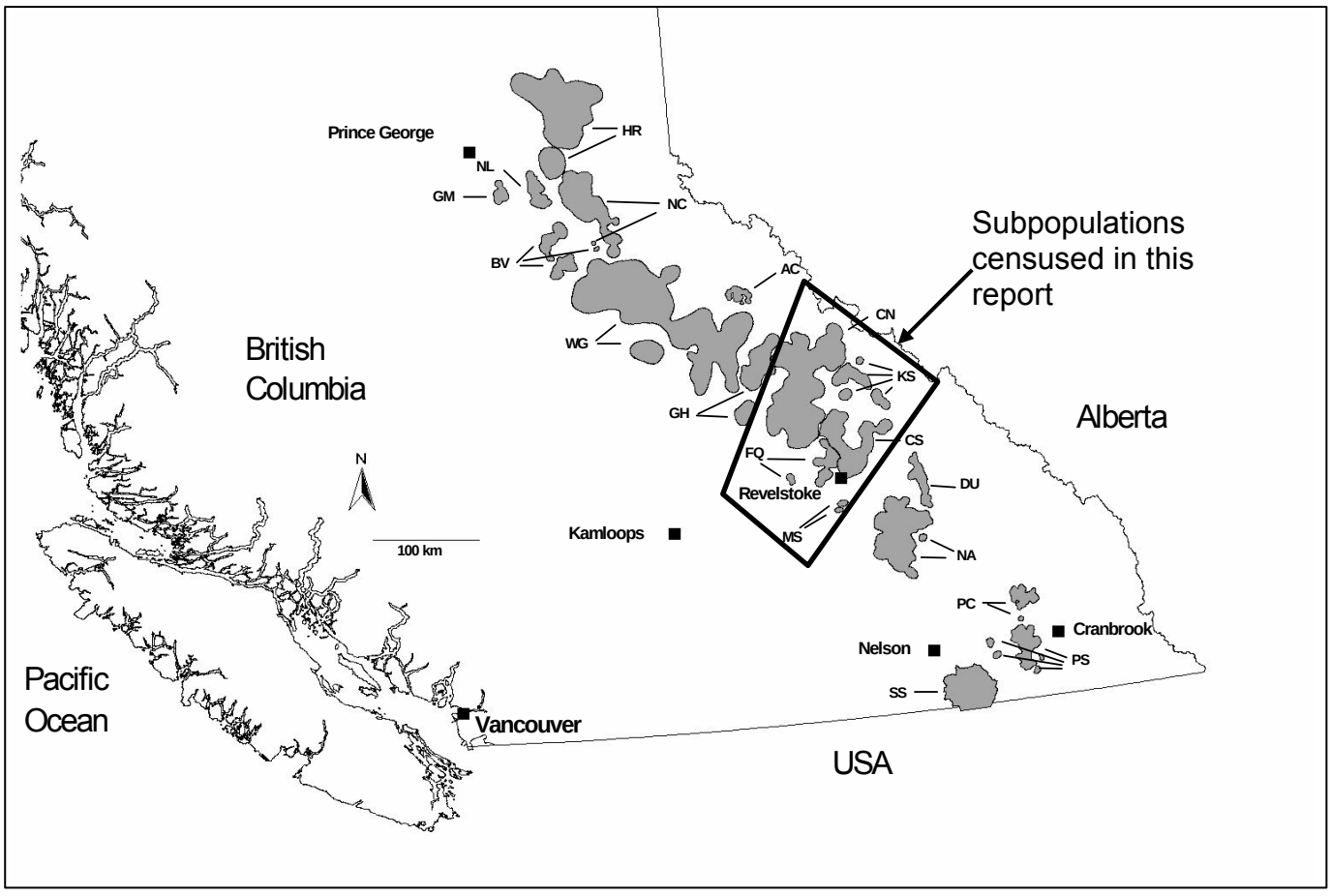
underestimated these subpopulations. For this report, we primarily use new sub-population boundaries as described by Wittmer et al. (2005).

Methods

Between 1992 and 2006, 107 caribou were captured by net-gunning from a helicopter in subalpine habitat in the CFD and the Okanagan/Shuswap Forest District. All caribou were fitted with mortality/motion sensitive GPS or VHF radiocollars. Caribou were censused during late winter when they were in open subalpine parkland (Simpson and Woods 1987, McLellan et al. 1995, Seip 1992). Censuses between 1993 and 2006 were conducted shortly after new snowfalls most often using a Bell 206 helicopter with 3 experienced observers plus the pilot. In 2004 and 2006, a Bell Long Ranger and an A Star were used. In 2004 and 2006 we also used fixed wing aircraft (Cessna 337 or Piper Super-Cub) to search for tracks over extensive, very low density areas such as the Kinbasket and Monashee South areas. A contour near treeline (1800–2130 m) was flown including all suitable habitat within the study area, and tracks were followed until animals were sighted unless the tracks descended into mature timber and were lost from view. An estimate of the number of caribou in these unsighted groups was based on separate tracks and/or beds. The location of each group was marked and numbered on a 1:250,000 map and recorded with a GPS, which allowed us to map the distribution of herd sizes through time. Although all male groups were easily identifiable, discrimination of young males from adult females in large groups was difficult and would have required additional harassment. We therefore limited our classes to calves and adults in these larger mixed groups.

During the census, collars were used as marks for mark-resight calculations only and not to locate animals for the mark-resight portion of the census. Animals missed were later tracked and the reason they were missed and their group size was recorded. Population estimates were calculated using the program NOREMARK, using the maximum likelihood joint hypergeometric estimator for closed populations and 90% confidence intervals (White 1996).

Figure 1. Mountain caribou subpopulations in British Columbia as described by Wittmer et al. (2005). Subpopulations in the CFD include CN – Columbia North, KS – Kinbasket South, FQ = Frisby/Queest, CS = Columbia South, MS = Monashee South.



Results

A total of 174 caribou was seen in 39 groups in the 5 subpopulations (MS, CN, CS, FQ, and KS) that were surveyed in their entirety during March 2006. Group size varied from 1 to 20 with a mean of 5 and median of 4. In addition, the tracks of an additional 9 caribou were followed but the animals were not found. Two of the 13 animals with radiocollars were not seen during the census. These 2 animals were located using their radiocollars, and one was thought to be alone in a low elevation cedar/hemlock forest where she was not seen even when telemetry was used. The second was in a group of 9 that had been in a steep strip of forest between 2 avalanche chutes for several days before the census, so did not make any tracks in more typical late-winter habitat.

Only 69 animals were seen in the old Revelstoke Forest District. Although this is fewer than in 2002 and 2004 and much fewer than in the 1990's, more animals were observed in the Okanagan-Shuswap district than before (Table 1, Fig. 2). The mark-recapture estimates suggest that the number of animals in the CN, CS, KS, and FQ combined has stabilized since 2004 (Table 2, Fig. 3). Although there are far fewer caribou in the census area in 2006 than in the 1990's, most subpopulations appear to have remained at a similar size to 2004 (Table 3). Although only 26 animals were seen in CS, it was here that a collared animal in a group of 9 was missed. Only 1 of the 35 animals seen (including the 9 that were seen using telemetry) was a calf. As in 2004, no animals were seen in the KS subpopulation but tracks of an estimated 2 animals were seen. The MS subpopulation remained at 7 animals including one calf.

Discussion

It is unfortunate that early censuses did not cover the entire subpopulations but followed jurisdictional boundaries. In 1994, 276 caribou were observed in the former Revelstoke Forest District and an additional 71 were seen in Mt. Revelstoke and Glacier National Parks and an additional 15 animals were estimated from tracks. Mark-recapture suggested that there were 375 animals in that area. In 1994 the Okanagan-Shuswap Forest District and the previous Golden Forest District (Kinbasket) were not censused so it is unknown how many additional animals were present. We do know, however, that during the 1994 census, 60 animals were within 1 km of the census area boundary (33 were likely in the Okanagan-Shuswap District) and another 25 were within

5 kms of the boundary in an area of contiguous habitat between the 2 districts in the Pettipice Pass and Kirbyville areas. It is likely that the majority of the animals in the large groups that are often found between the two districts were actually counted in 1994.

Table 1. The number of caribou observed plus those estimated from tracks in parenthesis within jurisdictional boundaries, 1994 – 2006.

Year	South Monashee	Kinbasket (Golden FD)	Revelstoke FD	Mt. Rev/ Glacier Park	Salmon Arm FD	Total
1994	10		276[a] (285)	71 (77)		357 (372)
1995		42 (51)				42 (51)
1996			226[b] (253)	42 (54)		268 (307)
1997		40 (44)	272[c] (273)	36 (36)		348 (353)
2002	4	18 (18)	118 (130)	13 (13)	50 (50)	203 (215)
2004	7	11 (12)[d]	116 (124)	9 (9)	47 (47)	190 (199)
2006	7	28 (30)	69 (78)	10 (10)	60 (60)	174 (185)

[a] Groups totaling 85 animals were along the border with the Salmon Arm FD.
[b] A group of 21 animals was along the border with Salmon Arm FD
[c] .Groups totaling 48 animals were along the border with the Salmon Arm FD.
[d] A small group (≈ 4 animals) were seen 2 weeks prior but missed during census

In 1995 the old Golden Forest District was censused and 42 animals were seen and, with tracks, a total of 51 animals were estimated. We now know that half of these were in the KS subpopulation and the others were part of the CN, and these may or may not have been counted in 1994.

As in 1994, the 1996 census was conducted only in the former Revelstoke Forest District. Only 77% of the 1994 number was seen and estimated in 1996. In 1996, only 23 animals were found in the Pettipice to Kirbyville area, 62 less than in 1994 so these animals were likely in the Salmon Arm District at the north end of the Anstey Mountains, Mt. Grace, or Bichoff Lakes in 1996. In 1997, both the previous Golden and Revelstoke Districts (i.e. entire CFD) were censused and caribou numbers remained similar to what they were in 1994.

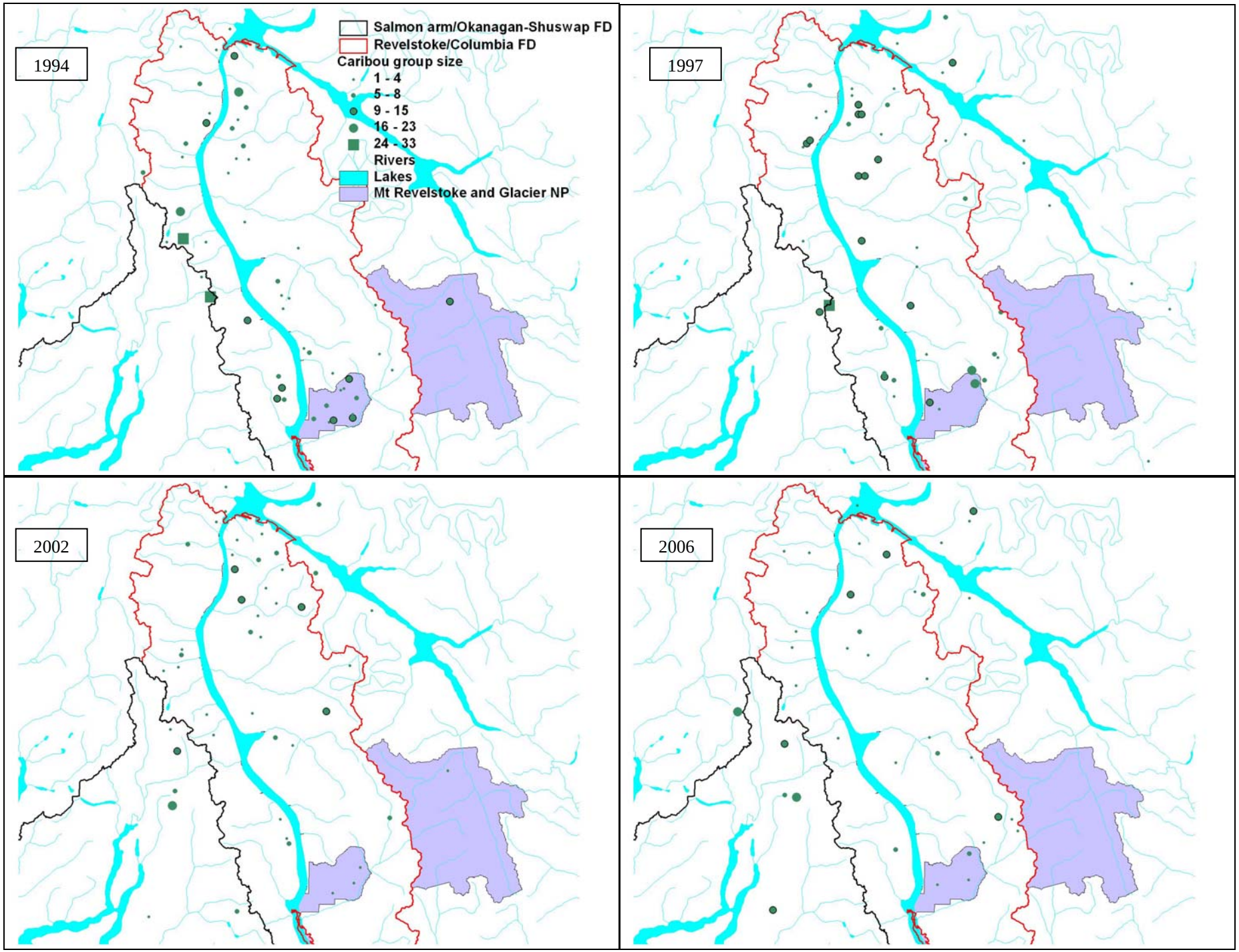


Figure 2. Map of caribou group sizes across 4 winter censuses. Prior to 2002, censuses did not cover the Salmon Arm Forest District more than 3 km W of the Revelstoke District boundary.

After 1997, caribou were not censused until 2002. At that time, numbers had dropped (Tables 1, 2, Fig. 2). Although 2002 was the first year that the entire areas of all 5 subpopulations were censused, the combined population of the KS, CN, CS, and FQ had declined to 57% of what it was in 1997 or at an average rate of 10% per year. All subpopulations declined significantly but the CS and KS appeared to decline most.

Table 2. Census results of Columbia North, Columbia South, Kinbasket, and Frisby/Queest pooled, 1994 to 2006. Note: Not all portions of all subpopulation ranges were covered each year.

Year	Number Observed	Observed plus Tracks	Number Collared	Collars Observed	Calculated Estimate	90% CL
1994	347	362	26	24	375	354-426
1996	268	307	25	23	291	274-331
1997	348	353	35	33	369	354-404
2002	199	211	16	15	212	201-249
2004	183	192	17	16	194	185-226
2006	167	178	12	10	200	175-268

Figure 3. Trend of the caribou population inhabiting the Revelstoke portion of the Columbia Forest District, 1994 to 2006.

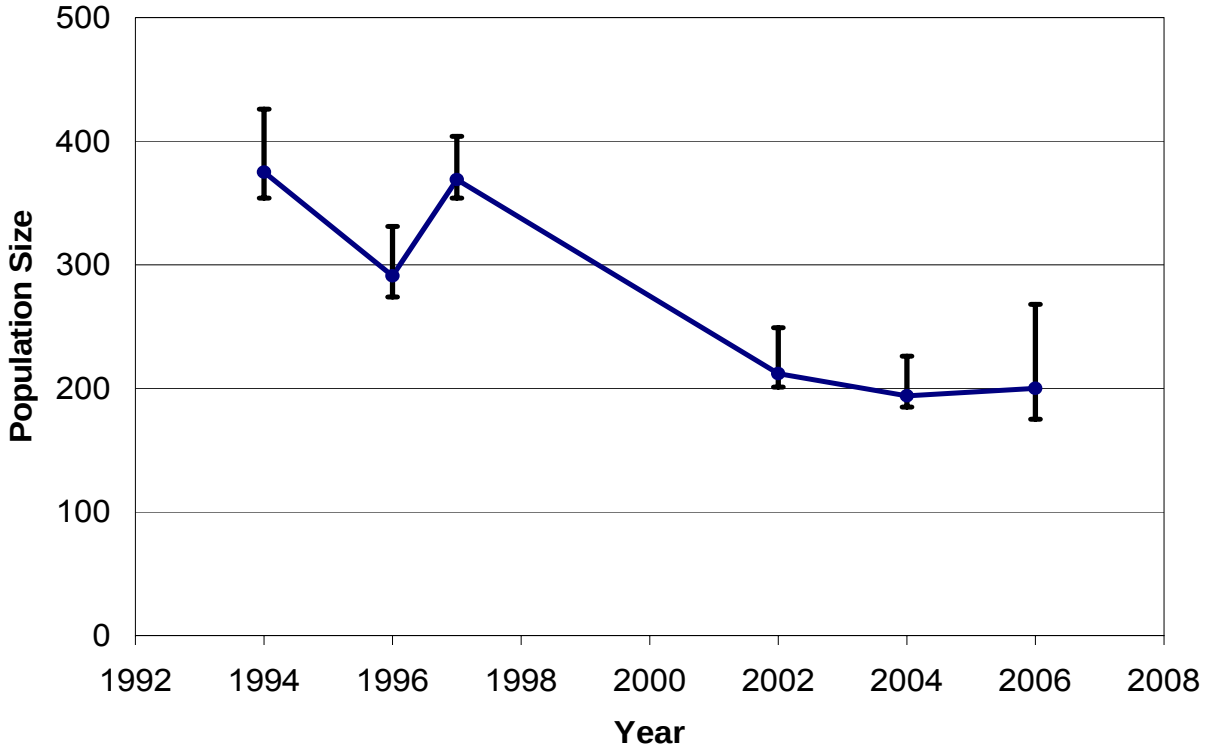


Table 3. Total number of caribou observed, estimates from tracks, and percent calves of the subpopulations of Wittmer et al. (2005). Includes NOREMARK estimates for populations with sufficient numbers of collared animals, 1994 to 2006.

Columbia North	Observed (+ Tracks)	Calves (%)	Number Collared	Collars Observed	Calculated Estimate	90% CL
1994	206 (209)	19.4	12	12	206	206-229
1996	167 (193)	19.2	11	11	167	167-188
1997	203 (204)	11.8	17	15	280	210-280
2002	145 (152)	11.7	7	7	145	145-175
2004	129 (136)	14.0	12	12	129	129-143
2006	125 (131)	14.3	10	9	138	127-181

Columbia South	Observed (+ Tracks)	Calves (%)	Number Collared	Collars Observed	Calculated Estimate	90% CL
1994	105 (117)	12.4	12	11	114	106-142
1996	81 (94)	12.35	10	9	103	94-112
1997	93 (93)	15.1	9	9	93	93-107
2002	29 (34)	17.2	3	2		
2004	38 (40)	15.8	3	3		
2006	26 (29)	2.9	1	0		

Frisby/ Queest	Observed (+ Tracks)	Calves (%)	Number Collared	Collars Observed	Calculated Estimate	90% CL
1994	36	8.3	2	1	NA	NA
1996	20	25.0	4	3	NA	NA
1997	35	11.4	4	4	NA	NA
2002	20	25.0	5	5	NA	NA
2004	16	25.0	2	1	NA	NA
2006	16	18.8	1	1	NA	NA

Kinbasket	Observed (+ Tracks)	Calves (%)	Number Collared	Collars Observed	Calculated Estimate	90% CL
1995	19 (25)	5.3	0		NA	NA
1997	17 (21)	5.9	5	5	NA	NA
2002	5 (5)	0	1	1	NA	NA
2004	0[a]	NA			NA	NA
2006	0(2)	NA			NA	NA

[a] A small group (≈ 4 animals) were seen 2 weeks prior but missed during census

Monashee	Observed (+ Tracks)	Calves (%)	Number Collared	Collars Observed	Calculated Estimate	90% CL
1994	10	30	0	0		
2002	4	0	1	1		
2004	7	14.3	2	2		
2006	7	14.3	1	1		

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The rate of decline appeared to be slowing in 2004 and stable between 2004 and 2006. Only the very small MS subpopulation remained relatively stable, for 10 in 1994 to 7 in 2006, over the period when other subpopulations were rapidly declining. The census in 1994, however, was not extremely thorough in the MS and animals may have been missed. The KS population is very small and will likely be soon gone.

The results of the censuses between 1994 and 2006 show a stable, then rapidly decreasing, and then once again stable number of caribou. Censuses before 1994 were limited to the former Revelstoke Forest District, and in general not believed to have been as thorough as those since. In the 1970's, estimates were under 200 animals but thought to be unreliable. In the early 1980's, Simpson and Woods (1987) used mark-recapture methods to estimate 200 animals in 1983, 255 in 1984, and 275 in 1985 (Table 4). With an average of 27 calves/100 adults (21% calves), Simpson and Woods suggested the population was increasing. It is probable that the number of caribou was increasing and reached a maximum in the mid-1990s.

What caused the number of caribou to change so dramatically over the past 2 decades? Three hypotheses have been suggested: 1) high predation rates due to "apparent competition" or when predator numbers are maintained by other prey species and there is sufficient incidental killing of caribou to be unsustainable (Bergurd and Elliot 1986, Seip 1992), 2) a lack of arboreal lichen for food due to logging old forests or highly variable winter snow conditions cause arboreal lichen to be too high in the canopy in low snow years that follow very high snow years, and 3) and implications of rapidly expanding outdoor winter recreation (heli-skiing, snowmobiling, and ski-touring). Because the number of caribou in Mt. Revelstoke and Glacier National Parks, where there is no logging or winter recreation, declined at least as rapidly as other subpopulations, the lack of food and outdoor recreation hypotheses are not supported.

Across the distribution of mountain caribou, available evidence supports the apparent competition hypothesis for the decline in numbers (Wittmer et al. 2005 a, b). Not only has predation been the primary cause of adult mountain caribou mortality across their distribution, but mortality rates are higher in populations with an abundance of old forest per individual than in populations with less old forests per individual (Wittmer et al. 2005b). Predation accounts for between 50 and 57% of the adult caribou

mortality in the subpopulations covered in our census, so apparent competition is also suggested. However, if an unsustainable predation rate due to apparent competition was the cause of the decline, why was the population relatively stable between 1994 and 1997 and again between 2002 and 2006? We suggest that the unusually deep, and long-lasting snow pack during the winters of 1996, and particularly 1997 and 1999, precipitated the change in predation rates on caribou.

The winters of 1996, 1997, and 1999 had deeper and longer lasting snow at low elevations across an area from at least Blue River to Nelson, than since 1974 most months of the year and even longer in some months. In Nelson, the 1 May snowpack in 1997 was the deepest since 1958 when records began and in Ferguson, the 1 April snowpack in 1999 was the deepest since 1938 when records began. Although the number of alternative prey and predators, in particular deer and cougar, have not been directly measured, both mule and whitetail deer appeared relatively abundant in the early 1990's. Following the winters with unusually deep snow at low elevations, deer appeared very rare, and, it is probable that their predators had to search further for prey, and in doing so encountered and killed more caribou. Although we did not detect a dramatic increase in predation of the radio-collared caribou, 3 or 4 collared caribou were killed by cougar between 1996 and 2000 while none had been killed by cougar between 1992 and 1996. The number of predators that are dependent of prey would have declined, after a time lag, following the decline of their prey. Once predators that depend primarily on deer declined, then the decline in caribou numbers should stop and even increase, provided other mortality factors, such as bears, wolverine, and accidents, are not sufficient to stop population growth. This untested hypothesis matches the trend data of caribou, snow, and general observations of deer numbers and should be more fully explored with available deer harvest statistics.

Results of the 2006 census that suggests a leveling off of the overall caribou population is encouraging, however, concerns remain. In particular, only 1 of 35 caribou observed in the CS was a calf, indicating very high calf mortality because pregnancy rate is generally high in these caribou (Wittmer 2005a). The very small numbers of animals in the MS, KS, FQ, and CS make their continued persistence tenuous.

Table 4. Caribou census results from the north Columbia Mountains, 1975 to 1985 (Simpson and Woods, 1987)

Counts		Population Estimates			Source
Animals	Tracks	Mean	Min	Max	
		140	110	170	Russell and Demarchi 1975
		150			Environmental Resource Consultants 1976
			95	135	Keller and Berry 1979
		118	67	184	Simpson and Hebert 1982
111	55	200[a]	111[b]		Simpson and Woods 1983
140	7	255[c]	195[d]		Simpson and Woods 1984
177	53	275	261[e]	300	Simpson and Woods 1985

[a] 5 of 9 radio-collared animals sighted among 111 seen. Therefore total population was 9/5 x 111 = 200 animals (Simpson and Woods 1987). This estimator gives a biased estimate. The Chapman estimator gives a mean estimate of 186 animals with 95% confidence limits between 111 and 271.

[b] 111 observed plus (55 tracks x 1.5 correction) = 192. The correction factor was generated by the estimated number of caribou in a group from tracks and the actual number in the group once they were observed.

[c] 6 of 9 marked animals sighted among 140 seen and thus 9/6 x140 = 210 plus and estimated 45 from an unsurveyed portion = 255. The Chapman estimator for the surveyed area is 200 with 95% confidence limits between 140 and 275.

[d] North 1/3 of study area not censused in 1984. Estimated minimum of 45 additional animals in this area from 1983 census. Counts = 140 + 45 + (7 x 1.5) = 195

[e] Entire area censused March 8-18. South of Bigmouth: 157 animals + 8 tracks; North: 20 animals + 45 tracks. 5 animals seen outside 1982-84 survey area not included.

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