

# Mountain Caribou 2006 Survey Results, Subpopulation Trends and Extinction Risk

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## Introduction

Woodland caribou within the Southern Mountains National Ecological Area of Canada (SMNEA) were designated as “threatened” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2002, and are listed under Schedule 1 of the federal *Species at Risk Act* (SARA). A subgroup of these caribou, the mountain ecotype, referred to as Mountain Caribou, are found in the interior wet belt of British Columbia (MCTAC 2002), and are considered “endangered” (red-listed) by the provincial Conservation Data Centre (see also Hatter et al. 2004). The distribution of mountain caribou in British Columbia has declined and fragmented over the past century and are currently distributed as 18 subpopulations, some of which are contiguous while others appear isolated (Wittmer et al. 2005).

In response to their endangered status, a Mountain Caribou Recovery Strategy was prepared (MCTAC 2002). The Species at Risk Coordination Office (SaRCO) was established in 2004, with a mandate to accelerate recovery planning for Mountain Caribou in BC. SaRCO established the Mountain Caribou Science Team (MCST) in order to provide a science-based approach to caribou recovery. The MCST drafted the following recovery statement for mountain caribou:

*"To halt the current decline in Mountain Caribou numbers within one generation (7 years), promote a stable-increasing population trend over the next three generations (20 years), and create ecological conditions that allow Mountain Caribou herds to be self-sustaining within nine generations (60 years), where ecologically feasible."*

with the following monitoring statement (Hatter 2006):

*"To monitor the Mountain Caribou meta-population over the next 7 year period with a power of 90% to detect a change in the population of 20%."*

This report summarizes the 2006 survey results, and re-examines subpopulation trends and extinction risk, based on survey data from 1987 to 2006.

## Methods

### Study Area

The study area included all 18 subpopulation ranges (Fig. 1). The subpopulation ranges were determined by analyzing radio-telemetry data of > 308 collared caribou with 95% fixed kernel utilization distributions (Wittmer et al. 2005).

### Subpopulation Size

Specific survey details can be found from the 2006 sub-population survey reports (Freeman and Stalberg 2006, Furk 2006, Hamilton 2006, Kinley 2006, McLellan et al. 2006, Seip et al. 2006, Wakkinnen et al. 2006). The following description of survey methods is adapted from Wittmer et al (2005:409).

*Caribou subpopulations were censused in March or early April, 2006 when caribou were in open, high-elevation habitats, shortly after new snow fell, using Bell 206 helicopters. In mountainous terrain, a pilot and two or three observers flew contours along the forest–subalpine habitat boundary, whereas in plateau habitats the numerous forest openings were searched for caribou tracks. Fresh tracks were followed until the animals were sighted, unless the tracks descended into mature timber and were lost from view. When caribou were encountered they counted and were classified as adult males, adult females, or calves. In forested areas where close examination was not always possible, antlered females were sometimes difficult to distinguish from young males and classification was often limited to adults and calves only. When available, the location of the sighting was recorded using a GPS in the helicopter, and locations were also recorded on topographic maps.*

As in previous years, sightability was measured opportunistically whenever radio-collared animals were present in the survey area. Radio-collared animals were confirmed by scanning each observed group for known collar frequencies. An average sightability correction factor (*scf*) for each subpopulation from 1987 to 2006 was calculated as the sum of all radio-collar caribou observed on all surveys divided by the sum of radio-collared caribou present on all surveys. The estimated number of caribou was the survey count (observed caribou plus tracks) divided by the *scf*.

### Subpopulation Trend and Extinction Risk

The finite rate of population change ( $\lambda$ ) was estimated using the regression method recommended by Dennis et al. (1991) and Morris and Doak. (2002:68-69). This method regresses  $\log(N_{t+1})/N_t/(t_{i+1}-t_i)^{0.5}$  against  $(t_{i+1}-t_i)^{0.5}$ , with the regression intercept forced to be zero. The slope of the regression is an estimate of  $\mu$  (exponential rate of increase, where  $\lambda = e^\mu$ ), and the regression's error mean square is an estimate of the variance,  $\sigma^2$ . Estimates of  $\mu$  and  $\sigma^2$  were used to calculate time to quasi-extinction ( $N < 20$  animals) and the probability of quasi-extinction by methods outlined in Morris and Doak (2002: 79-87). Morris and Doak (2002:97) suggest that ten censuses should be viewed as a

minimum requirement to use these methods. Only 4 subpopulations (South Selkirks, Purcells South, Purcells Central and Barkerville) had ten or more survey estimates. The average number of surveys per subpopulation was 6. Thus, estimates of extinction risk are considered preliminary and should be viewed cautiously.

## **Results and Discussion**

### **Subpopulation Size**

Table 1 summarizes the results of the 2006 surveys, and compares these results to the mid 1990's and 2002 survey estimates when most subpopulations were also completely surveyed (Wittmer et al. 2002). A *scf* was not available for the South Selkirks or Kinbaset-South subpopulations. The estimate of 83% sightability developed by Seip (1990) was applied to North Cariboo Mountains, George Mountain, Narrow Lakes and Hart Ranges (Seip et al. 2006).

While several sub-population's showed evidence of >20% decline since 2002 (e.g. Purcell Central, Duncan, Kinbaset-South, George Mountain, Narrow Lakes) there were also some subpopulations that showed evidence of >20% increase (e.g. Monashee-South, Groundhog, and Hart Ranges). Overall, the metapopulation size was slightly higher in 2006 than in 2002 (1907 versus 1838). If the Hart Ranges is excluded from the analysis, the remaining sub-population declined from an estimate of 1948 in the mid 1990's to 1388 in 2002 to 1190 animals in 2006, for an average rate of decline of about 4.5% per year.

### **Subpopulation Trends and Extinction Risk**

Table 2 shows changes in annual growth rates of sub-populations, and well as preliminary estimates of quasi-extinction risks, using the methods of Morris and Doak (2002). Based on an analysis of all survey results since 1987 two subpopulations have become extirpated (Purcells-Central and George Mountain), thirteen have declined, two are stable (Barkerville and North Caribou Mtns) and one (Hart Ranges) has increased (Fig. 2 to 19). The large increase in the Hart Ranges, while likely reflecting some population growth, is also partially attributed to more complete survey coverage in the Parsnip drainage in 2006. For example, 191 caribou were counted in Parsnip in 2006, compared to 81 in 2005 (Seip et al. 2006). Appendix 1 and 2 provide the raw survey counts and estimated numbers for each subpopulation from 1987 to 2006.

The subpopulations at highest risk of quasi-extinction (> 75% probability of 20 or fewer caribou in 20 years) include: Purcell South, Nakusp, Duncan, Monashee-South, Columbia South, Frisby-Boulder, Kinbasket-South, Groundhog, Allan Creek, and Narrow Lakes. However, confidence limits indicate a low level of confidence with these predictions for Nakusp, Columbia South, Groundhog, Allan Creek, and Narrow Lakes (Table 2). The extinction risks were similar to those reported by Wittmer (2004) based on vital rates.

It is recommended that another survey of all subpopulations be undertaken in 2009. However, some subpopulation that are at or close to quasi-extinction thresholds should be monitored more frequently (preferably annually), if possible. A *scf* should be developed for the South Selkirk subpopulation. A Bayesian analysis of sightability should be investigated to enable calculation of credibility intervals on all population estimates.

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Table 1. Summary of subpopulation counts (observed number of caribou and tracks) and estimates based on application of a sightability correction factor (*scf*). Count years include the mid 1990's, 2002 and 2006 when all subpopulations were surveyed.<sup>1</sup>

Herd	Mid-to-late 1990's Survey			2002 Survey		2006 Survey		<i>scf</i>
	Year	Count	Estimate	Count	Estimate	Count	Estimate	
SS	1995	52	52	34	34	37	37	1.00
PS	1995	63	77	14	17	16	20	0.81
PC	1995	15	18	5	6	0	0	0.86
NA	1996	186	211	76	103	74	85	0.87
DU	1996	25	29	20	23	0	9	0.87
MS	1994	10	12	4	5	7	8	0.83
CS	1994	105	114	29	34	16	29	0.89
FB	1996	20	24	20	24	16	19	0.83
CN	1997	203	280	145	145	125	138	0.96
KS	1995	19	25	5	5	0	2	1.00
GH	1995	37	48	15	19	23	30	0.78
WG	1995	511	620	310	516	398	422	0.81
AC				22	38	11	33	0.58
BV	1994	39	55	41	58	44	51	0.71
NC	1993	232	279	236	284	209	267	0.83
GM	1992	20	24	3	4	0	0	0.83
NL	1999	67	81	61	73	33	40	0.83
HR <sup>2</sup>		n/a	n/a	374	450	578	717	0.83
<b>Total<sup>3</sup></b>				<b>1414</b>	<b>1838</b>	<b>1587</b>	<b>1907</b>	

SS, South Selkirks; PS, Purcells-South; PC, Purcells-Central; NA, Nakusp; DU, Duncan; MS, Monashee South; CS, Columbia-South; FB, Frisby-Boulder; CN, Columbia-North; KS, Kinbasket-South; GH, Groundhog; WG, Wells Gray; AC, Allan Creek; BV, Barkerville; NC, North Cariboo Mountain; GM, George Mountain; NL, Narrow Lake; and HR, Hart Ranges

<sup>1</sup> Allan Creek was not surveyed in 1995. Recent radio-telemetry surveys suggest that Allan Creek is actually part of the Wells Gray subpopulation (Furk 2006).

<sup>2</sup> There is no mid-1990's survey data for the Hart Ranges that includes the Parsnip portion. Excluding the Parsnip portion the estimates are: 1992: 376; 2002: 331, 2006: 487

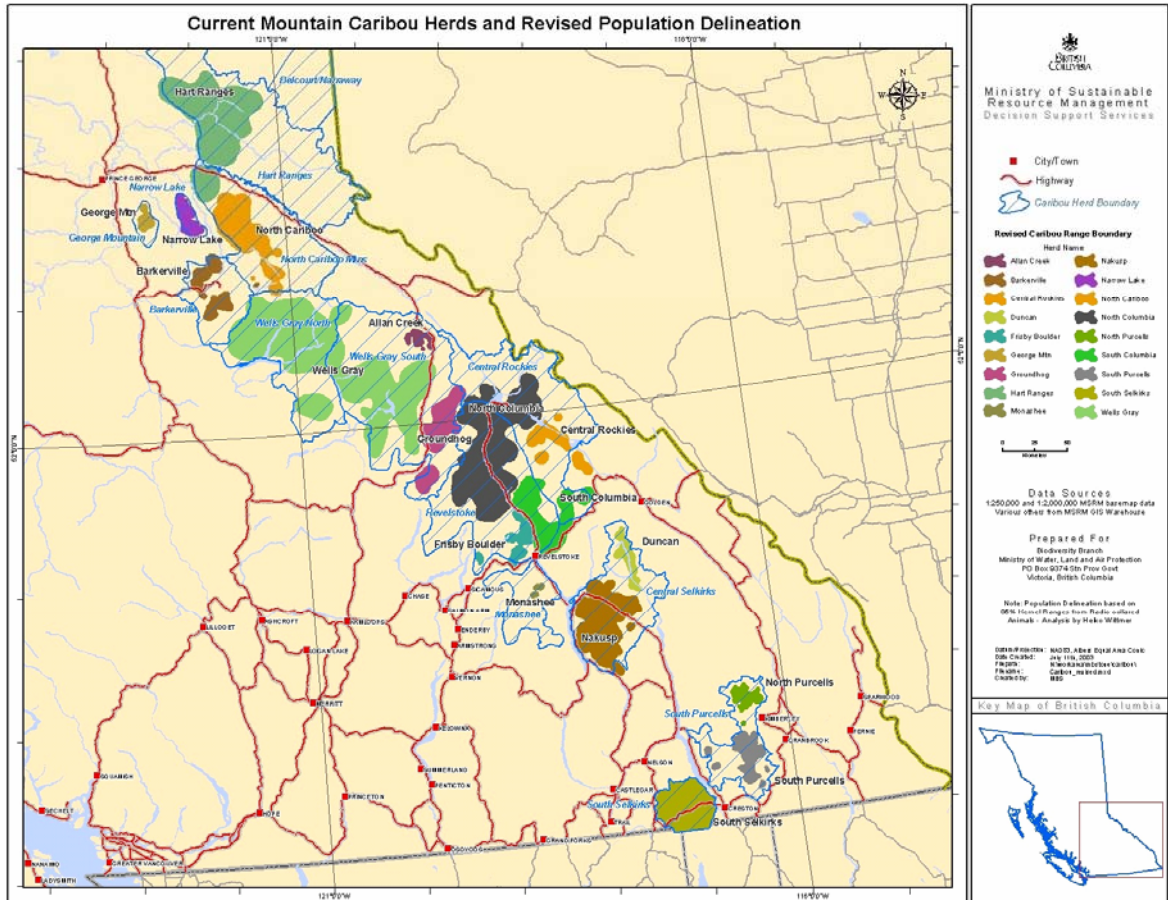
<sup>3</sup> Including the non-Parsnip portion of the Hart Ranges, the totals are 1992:1917, **2325**; 2002: 1315, **1719**; and 2006: 1396, **1677**

Table 2. Annual population growth rate, time to quasi-extinction (N < 20 animals), and probability of quasi-extinction in 20 years. LCL and UCL are the 95% lower and upper confidence limits respectively. Estimates of extinction risk are considered preliminary and should be viewed cautiously.

Survey Area	Annual Growth Rate ( $\lambda$ )			Time (yrs) to Quasi-Extinction			Probability of Quasi-Extinction in 20 yrs		
	mean	LCL	UCL	mean	LCL	UCL	mean	LCL	UCL
SS	0.98	0.90	1.08	39	0	233	54%	0%	97%
PS	0.91	0.77	1.08	0	0	0	100%	100%	100%
PC	extirpated			extirpated			extirpated		
NA	0.91	0.83	1.00	16	5	27	83%	0%	99%
DU	0.89	0.76	1.05	0	0	0	100%	100%	100%
MS	0.97	0.63	1.42	0	0	0	100%	100%	100%
CS	0.89	0.76	1.04	3	0	6	100%	5%	100%
FB	0.93	0.70	1.25	0	0	0	100%	100%	100%
CN	0.97	0.76	1.23	58	0	325	24%	0%	94%
KS	0.79	0.41	1.52	0	0	5	100%	100%	100%
GH	0.95	0.76	1.18	8	0	33	91%	10%	99%
WG	0.97	0.81	1.15	87	0	356	0%	0%	78%
AC	0.97	0.03	33.89	14	0	170	86%	0%	100%
BV	1.00	0.76	1.32	200	0	10720	69%	4%	98%
NC	1.00	0.95	1.05	799	0	4837	0%	0%	7%
GM	extirpated			extirpated			extirpated		
NL	0.90	0.54	1.50	7	0	26	92%	0%	100%
HR	1.02	0.87	1.19	173	0	708	0%	0%	60%

SS, South Selkirks; PS, Purcells-South; PC, Purcells-Central; NA, Nakusp; DU, Duncan; MS, Monashee South; CS, Columbia-South; FB, Frisby-Boulder; CN, Columbia-North; KS, Kinbasket-South; GH, Groundhog; WG, Wells Gray; AC, Allan Creek; BV, Barkerville; NC, North Cariboo Mountain; GM, George Mountain; NL, Narrow Lake; and HR, Hart Ranges (excludes counts in Parsnip drainage)

Figure 1. Map of mountain caribou distribution showing identified subpopulations. The previous 13 local populations identified by MCTAC (2002) are also shown.





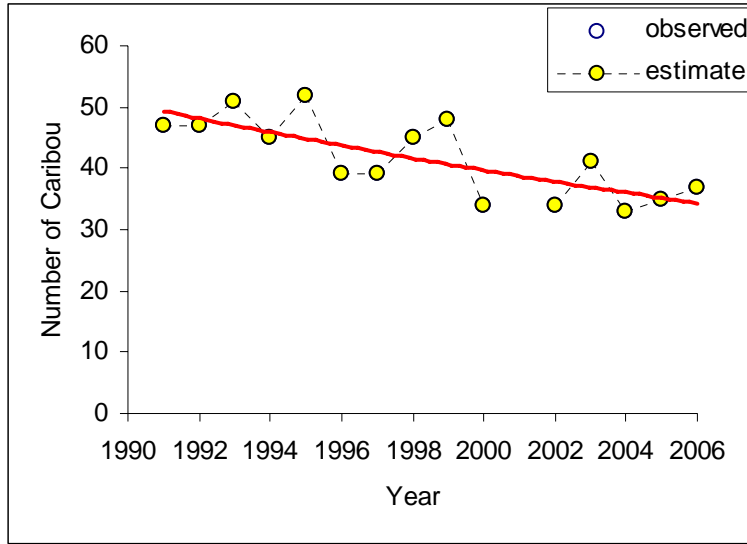


Figure 2. South Selkirk subpopulation trend from 1991 to 2006.

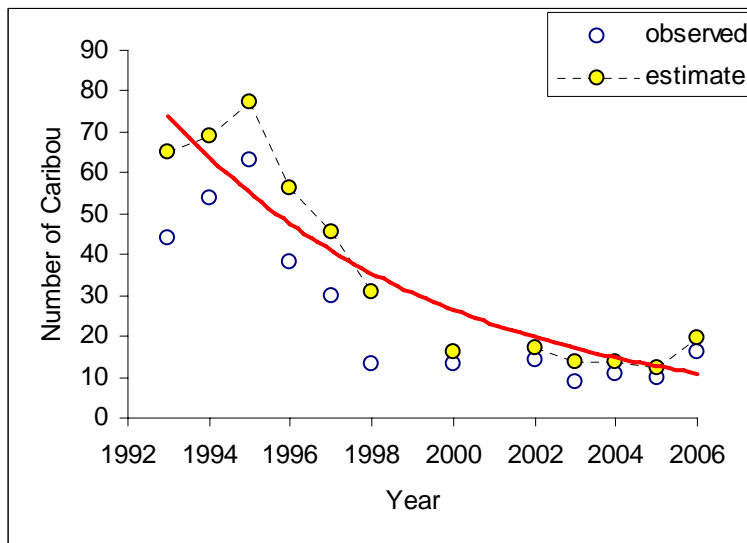


Figure 3. Purcell-South subpopulation trend from 1993 to 2006.

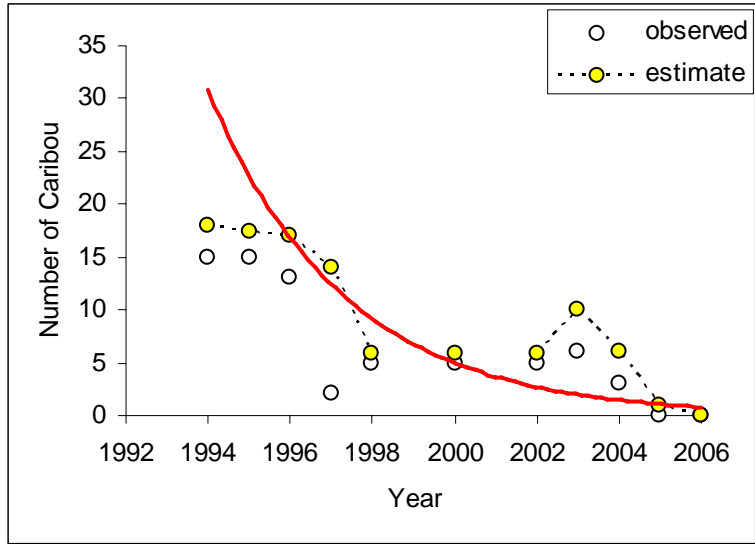


Figure 4. Purcell-Central subpopulation trend from 1994 to 2006.

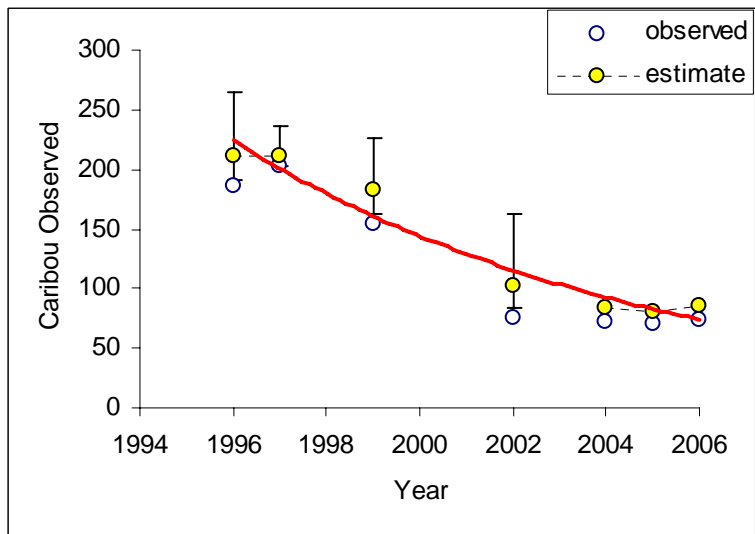


Figure 5. Nakusp subpopulation trend from 1996 to 2006.

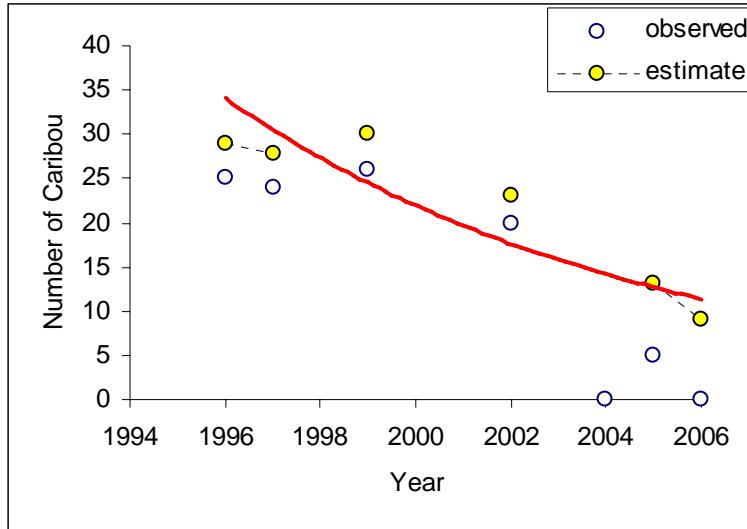


Figure 6. Duncan subpopulation trend from 1996 to 2006.

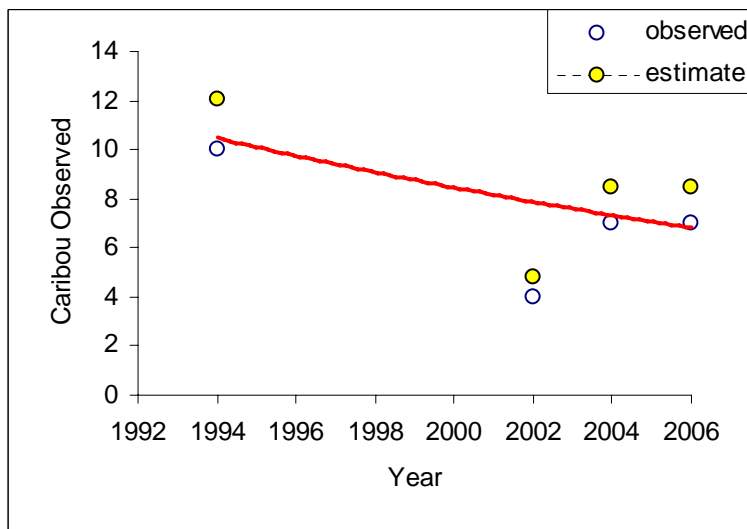


Figure 7. Monashee-South subpopulation trend from 1994 to 2006.

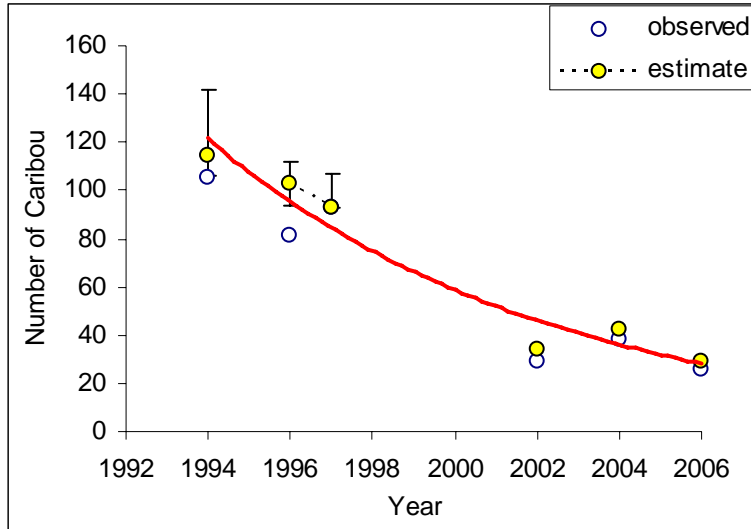


Figure 8. Columbia-South subpopulation trend from 1994 to 2006.

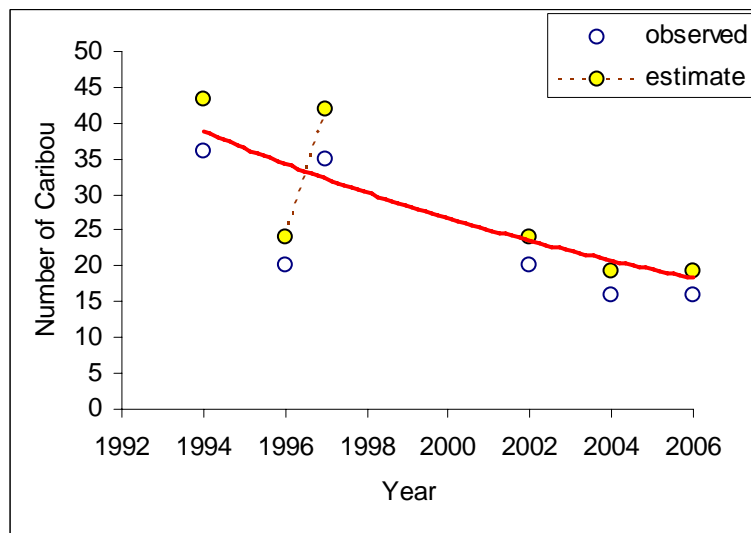


Figure 9. Frisby-Boulder subpopulation trend from 1994 to 2006.

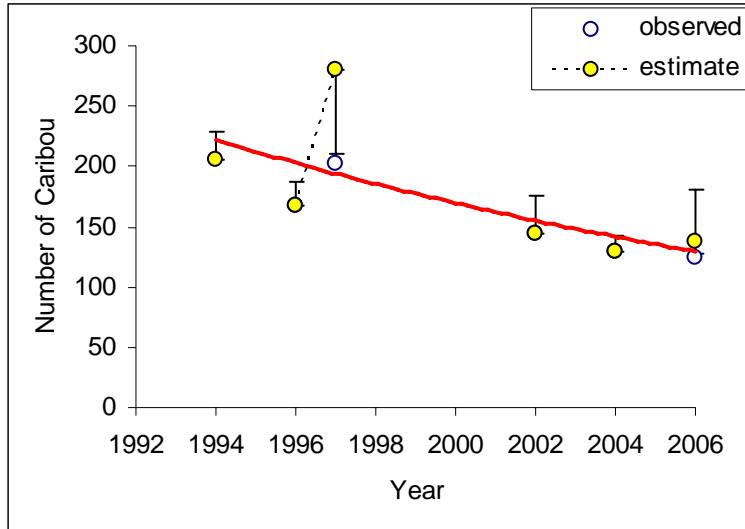


Figure 10. Columbia-North subpopulation trend from 1994 to 2006.

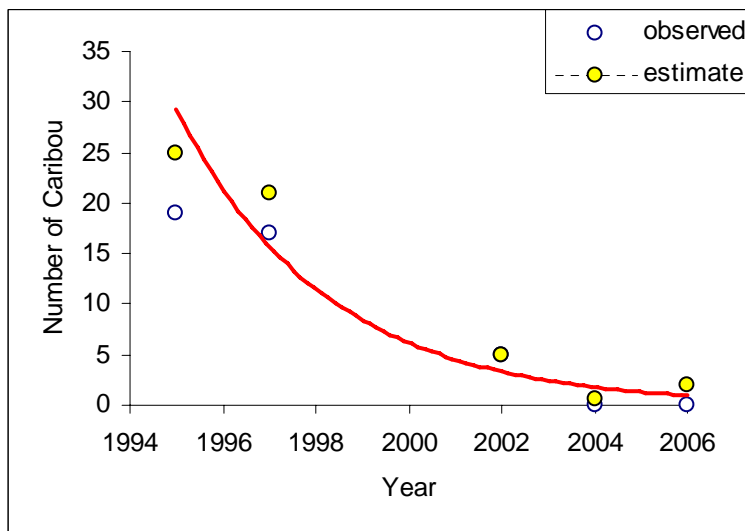


Figure 11. Kinbasket-South subpopulation trend from 1995 to 2006.

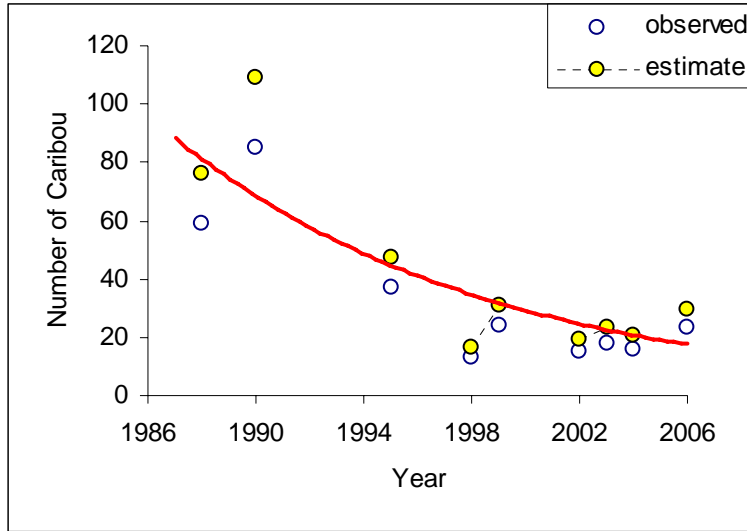


Figure 12. Groundhog subpopulation trend from 1988 to 2006.

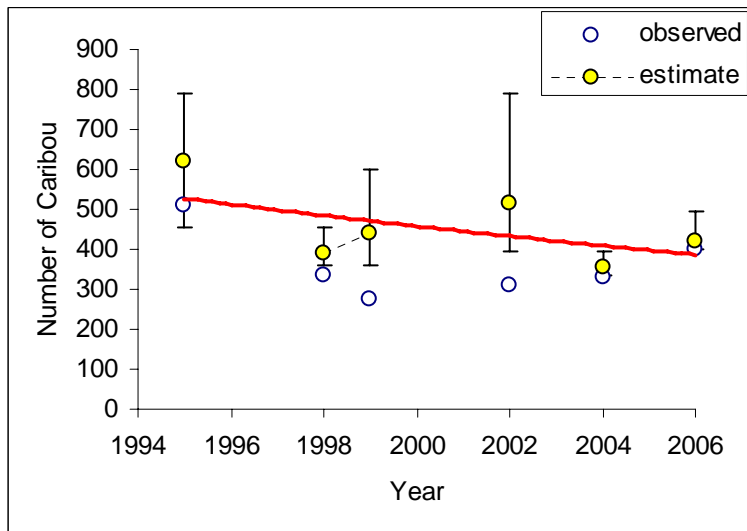


Figure 13. Wells Gray subpopulation trend from 1995 to 2006.

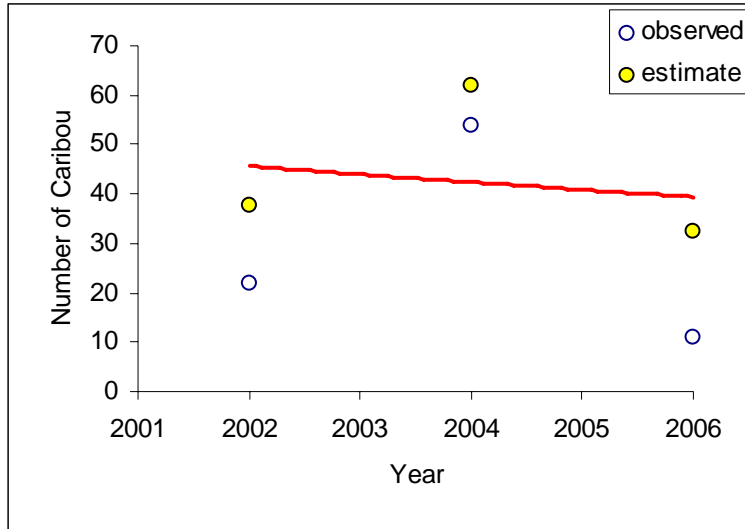


Figure 14. Allan Creek subpopulation trend from 2002 to 2006.

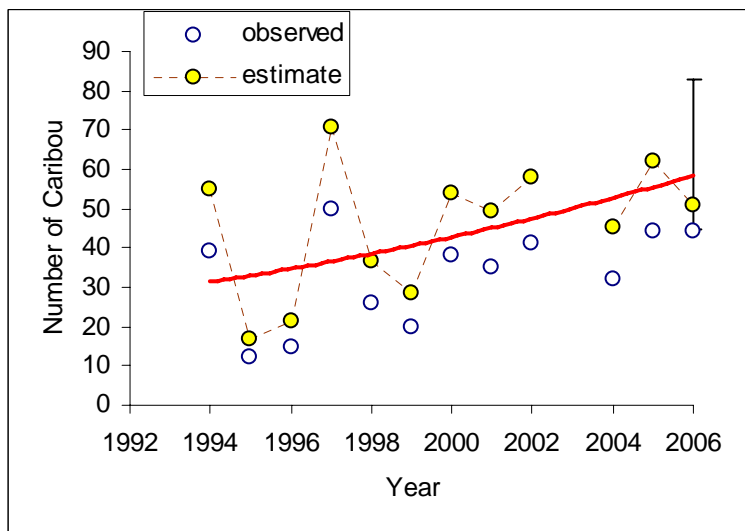


Figure 15. Barkerville subpopulation trend from 1987 to 2006.

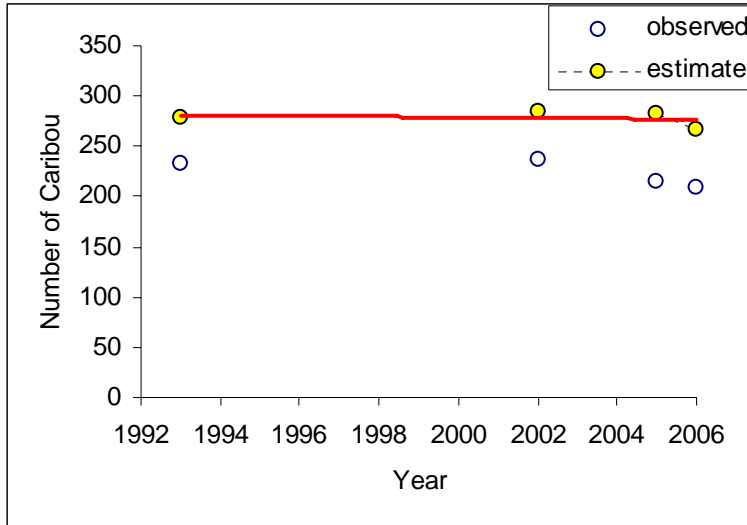


Figure 16. North Caribou Mountains subpopulation trend from 1993 to 2006.

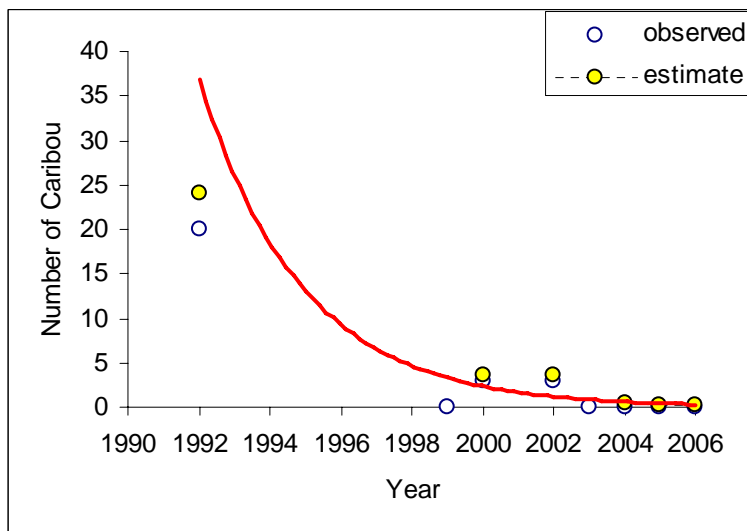


Figure 17. George Mountain subpopulation trend from 1992 to 2006.



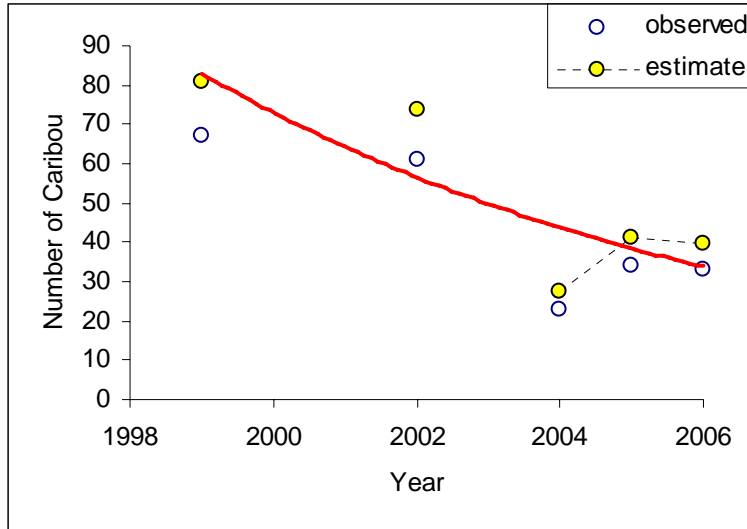


Figure 18. Narrow Lakes subpopulation trend from 1999 to 2006.

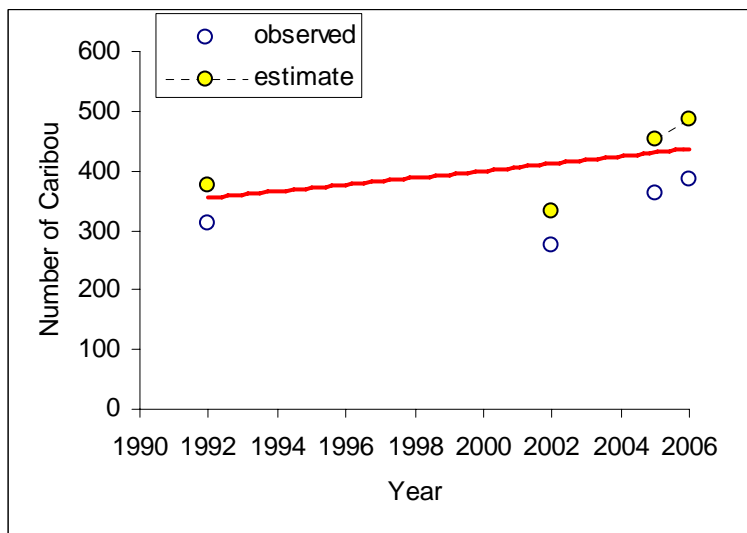


Figure 19. Hart Ranges subpopulation trend from 1992 to 2006 (excludes Parsnip portion or range).

Appendix 1. Number of caribou counted (plus tracks) in each subpopulation by year.

Year	SS	PS	PC	NA	DU	MS	CS	FB	CN	KS	GH	WG	AC	BV	NC	GM	NL	HR
1987														33				
1988											59			38				
1989														37				
1990											85							
1991	47													31				
1992	47													27		20		
1993	51	44												16	232			
1994	45	54	15			10	105	36	206					39				
1995	52	63	15							19	37	511		12				
1996	39	38	13	186	25		81	20	167					15				
1997	39	30	2	203	24		93	35	280	17				50				
1998	45	13	5								13	337		26				
1999	48			155	26						24	276		20		0	67	
2000	34	13	5											38		3		
2001														35				
2002	34	14	5	76	20	4	29	20	145	5	15	310	22	41	236	3	61	374
2003	41	9	6								18					0		
2004	33	11	3	72	0	7	38	16	129	0	16	331	54	32		0	23	
2005	35	10	0	70	5									44	215	0	34	458
2006	37	16	0	74	0	7	26	16	138	0	23	398	11	44	209	0	33	596

Appendix 2. Estimated number of caribou in each subpopulation by year.

Year	SS	PS	PC	NA	DU	MS	CS	FB	CN	KS	GH	WG	AC	BV	NC	GM	NL	HR
1987														47				
1988											76			54				
1989														52				
1990											109							
1991	47													44				
1992	47													38		24		
1993	51	65												23	279			
1994	45	69	18			12	114	43	206					55				
1995	52	77	18							25	48	620		17				
1996	39	56	17	211	29		103	24	167					21				
1997	39	45	14	211	28		93	42	280	21				71				
1998	45	31	6								17	390		37				
1999	48			182	30						31	441		28			81	
2000	34	16	6											54		4		
2001														49				
2002	34	17	6	103	23	5	34	24	145	5	19	516	38	58	284	4	73	451
2003	41	14	10								23							
2004	33	14	6	83		8	42	19	129	1	21	355	62	45		0	28	
2005	35	12	1	81	13									62	283	0	41	552
2006	37	20	0	85	9	8	29	19	138	2	30	422	33	51	267	0	40	718