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## **CHISANA CARIBOU CENSUS – 13-14 OCTOBER 2007**

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### **RESULTS SUMMARY**

**Caribou Observed:** 442 cows, 58 calves, 219 bulls = 719 caribou

**Population estimate:** 766 caribou (90% CI = 719 - 823)

**Sex/age ratios:**

-13.3 calves/100 cows

-78 male calves/100 female calves or 56% female calves

-49.5 bulls/100 cows

-30% small, 36% medium, 34% large

**Estimated herd composition:** 471 cows; 62 calves; 233 bulls = 766 caribou

**Recalculated October 2005 population estimate:** 706 caribou (90% CI = 646 – 792)

### **METHODS**

We conducted a census of the Chisana Caribou Herd on 13 and 14 October 2007 with Rick Swisher (Robinson R44 helicopter pilot) and Harley McMahan (Piper PA18 Supercub pilot). Lorne Larocque assisted as an observer in the helicopter on 14 October as we surveyed caribou on the Canadian portion of the herd's range. Our goal was to estimate herd size accounting for variability in sightability related to group size utilizing the same approach we employed for the October 2003 and October 2005 censuses. Prior to the census, we determined the distribution of 138 radiocollared females  $\geq 2$  years old. We delineated a survey area that encompassed the region inhabited by nearly all the radioed caribou with a reasonable buffer and bounded by obvious geographic features and treeline. During the census, we used the helicopter, with 2 observers in addition to the pilot, to search all the upland, non-forested habitats within the survey area without the aid of radiotelemetry. Caribou groups we encountered were classified (cows, calves by sex, bulls by 3 size classes) and classifications were recorded into a handheld tape recorder. We determined the occurrence of marked individuals within each group via radiotelemetry. Simultaneously, the Supercub located radiocollared caribou to determine their locations and group sizes. Periodically through the survey, we compared notes among the 2 aircraft to determine marked caribou groups that were missed by the helicopter, and those groups were then located by the helicopter and classified. As the survey progressed, the Supercub did a cursory search outside the boundary of the survey area to ensure that we did not miss any concentrations of caribou that were not well represented by the radiocollared cows.

With information on marked groups observed and missed by the helicopter crew, we determined the relationship between sightability and group size via logistic regression. We could then correct for unmarked groups missed during the survey to arrive at an estimate of total caribou in the survey area. To make that correction, we divided the group size of each unmarked group by the associated sighting probability (e.g., a group of 1 had a sighting probability of 0.45, so each unmarked group of 1 accounted for  $1/0.45$  or 2.2 caribou [1 observed + 1.1 missed] in the total estimate). The estimate of caribou in the survey area equaled the sum of all marked groups (both missed and observed groups) plus the sum of the unmarked groups each divided by

the sighting probability for that group size.

As in 2005, a few radiocollared females were widely scattered outside the survey area, particularly in heavily forested portions of the White River drainage. We could not expand the survey area to include these individuals because the resulting survey area would be too large to adequately survey with the time and money available, and sightability was certainly much lower in the forested areas than in the uplands we surveyed. To account for caribou outside the survey area in 2007, we assumed that the proportion of radiocollared females in the survey area was similar to that of the population and we divided the survey area estimate by the proportion of radiocollared females that were within the survey area. For the 2005 population estimate that we previously reported we merely added the number of caribou known to be outside the survey area to the estimated number of caribou in the survey area. Therefore, we recalculated the 2005 estimate using the same methods we applied in 2007. The 2003 estimate did not need to be adjusted because all marked caribou were within the survey area that year.

We used a jackknife procedure (Manley, B.F.J. 1991. Randomization and Monte Carlo methods in biology. Chapman and Hall, New York) to estimate the variance associated with the herd size estimate and calculated confidence limits. The jackknife procedure entailed sequentially dropping each of the marked groups and recalculating the sightability relationship and the proportion of radioed females in the survey area with the remaining  $n-1$  locations, where  $n$  = number of marked groups. We then recalculated the population estimate using the sightability relationship and proportion in the survey area. The resulting  $n$  estimates were used to estimate the variance following methods described by Manley (1991). In calculating confidence intervals, we truncated the lower confidence limit at the number of caribou actually observed.

## **RESULTS**

### **Survey area/conditions**

On 13 October, we began the survey in the Beaver Lakes area and worked our way east surveying Beaver Creek and the drainages coming in from the south including Willow Creek, Flat Creek, Ophir Creek, and western Sonya Creek (Fig 1). We also surveyed the Braye Plateau area. We had initially planned to search the areas between Sonya Creek and Braye Plateau, as well as the Solo Flats and North Fork regions, but marked caribou had vacated those areas by the date of survey. On 14 October, we surveyed the plateau north of Harris Creek; the uplands bounded by Wolverine Creek, Harris Creek, and St. Clare Creek; and the Klutlan Plateau.

The area surveyed included 910 km<sup>2</sup> and we spent 8.4 hours engaged in survey activities (not including ferry time to and from the survey areas) for a survey rate averaging 0.5 minutes/km<sup>2</sup>. The caribou were much more concentrated than during the previous 2 censuses. Other than being delayed by low clouds and scattered fog on the morning on 13 October, weather conditions during the survey were generally excellent. Snowcover was patchy in the lower elevation areas surveyed on 13 October, but areas search on 14 October had complete snowcover.

### **2007 population estimate**

During the survey, we counted 700 caribou in 46 groups in the survey area including those observed during the helicopter survey and marked groups missed by the helicopter but subsequently classified (Table 1). In addition, 4 marked groups, totaling 19 caribou, were outside the survey area. Of 138 radioed females > 1 year old, 132 were in the survey area. All but 1 (a calf with a radioed cow outside the survey area) of the 719 caribou observed were

classified. The 719 caribou observed included 442 cows, 58 calves (25 males, 32 females, 1 unknown), and 219 bulls (66 small, 75 medium, 75 large).

The 46 groups in the survey area included 30 marked groups and 16 unmarked groups. Marked groups ranged from 1 to 65 caribou (average = 21.5), whereas unmarked groups included 1 to 16 caribou (average = 3.4). We observed 25 of the marked groups and missed 5 groups ranging from 1 to 15 caribou (average = 6.0). Sightability was significantly correlated with group size (Fig. 2;  $\text{logit}(p) = -0.390 + 0.178 \cdot \text{Group Size}$ ;  $G_1^2 = 7.64$ ,  $P = 0.006$ ). For example, a single caribou had a 45% chance of being observed by the helicopter crew, whereas a group of 20 had a 96% chance. Sightability relative to group size in 2007 was nearly identical to the 2005 census (Fig. 2), and sightability-group size relationships did not differ significantly among the censuses conducted in 2003, 2005 and 2007 ( $G_4^2 = 3.08$ ,  $P = 0.545$ ; combined relationship:  $\text{logit}(p) = -0.531 + 0.166 \cdot \text{Group Size}$ ;  $G_1^2 = 22.65$ ,  $P < 0.001$ ).

Using the sightability-group size relationship, we estimated that there were 733 caribou (90% CI = 700 – 772) in the survey area. Based on the distribution of radiocollared caribou (132 of 138 in the survey area), we inflated that estimate by 4.5% ( $138/132 = 1.045$ ) and arrived at an estimate of 766 caribou (90% CI = 719 – 823).

### **Recalculated 2005 population estimate**

For the October 2005 population estimate, we calculated an estimate of caribou in the survey area, and associated confidence limits, and inflated those numbers by the caribou in marked groups that we knew were outside the survey area. Therefore, we did not adequately account for unmarked groups of caribou outside the survey area, and the resulting estimates are not directly comparable to the 2007 estimates. Therefore, we recalculated the 2005 population estimate including the procedure to account for caribou outside the survey area based on the distribution of radiocollared caribou as described above.

In October 2005, we observed 599 caribou during the survey, resulting in an estimate of 647 caribou (90% CI = 609 – 686) in the survey area, and 89 of 97 radiocollared cows were in the survey area. Given the distribution of radiocollared cows, the survey area estimate was inflated by 9.0% ( $97/89 = 1.090$ ), resulting in a 2005 population estimate of 706 caribou (90% CI = 646 – 792).

### **ASSOCIATED DATA FILE**

Chisana Census Data – October 2007.xls

Table 1. Results of Chisana census during 13-14 October 2007

gno	date	Cows				Calves				Bulls				Total	Location	n radios	marked?	seen ?
		M	F	U	S	M	L	M	L	M	L							
1	13	9	0	0	0	2	0	0	11	California Lake	1	1	1					
2	13	13	0	2	0	0	4	5	24	NE Beaver Lake	4	1	1					
3	13	7	0	1	0	1	1	1	11	SE Beaver Lake	3	1	1					
4	13	3	2	0	0	2	2	0	9	Funshoot Mtn	0	0	1					
5	13	12	1	0	0	3	0	1	17	E Flat Cr Hills	5	1	1					
6	13	33	2	0	0	4	3	4	46	S Black Lake	5	1	1					
7	13	2	0	0	0	0	0	0	2	N Black Lake	0	0	1					
8	13	47	1	2	0	5	4	6	65	L Carl Creek	11	1	1					
9	13	7	0	0	0	1	1	0	9	Mth Carl Creek	1	1	1					
10	13	0	0	0	0	0	0	1	1	S Carl Cr Mth	0	0	1					
11	13	0	0	0	0	0	0	1	1	Ophir Mth	0	0	1					
12	13	4	0	1	0	1	0	10	16	Ophir Mth	0	0	1					
13	13	12	2	3	0	1	1	1	20	Flat/Ophir	4	1	1					
14	13	1	0	0	0	0	0	0	1	Flat/Ophir	1	1	0					
15	13	43	0	0	0	4	2	3	52	W Ophir Creek	11	1	1					
16	13	14	0	0	0	2	0	1	17	U Ophir Creek	5	1	1					
17	13	4	0	0	0	0	0	0	4	UE Ophir Creek	0	0	1					
18	13	0	0	0	0	0	1	1	2	E Ophir Creek	0	0	1					
19	13	2	0	0	0	0	0	0	2	E Ophir Creek	1	1	1					
20	13	1	0	0	0	1	0	2	4	Ophir/Sonya	0	0	1					
21	13	1	0	1	0	0	1	4	7	Ophir/Sonya	1	1	1					
22	13	23	0	1	0	9	7	1	41	Sonya Creek	7	1	1					
23	13	0	0	0	0	0	1	0	1	Sonya Creek	0	0	1					
24	13	3	0	0	0	1	0	0	4	Ophir/Sonya	1	1	0					
25	13	7	1	0	0	0	1	0	9	Ophir/Sonya	2	1	0					
26	13	4	0	0	0	0	1	1	6	Braye Plateau	1	1	1					
27	13	4	0	0	0	2	0	1	7	Braye Plateau	1	1	1					
28	13	1	0	0	0	0	0	0	1	Ophir/Sonya	1	1	0					
29	14	3	1	1	0	2	0	0	7	N Harris Plateau	2	1	1					
30	14	0	0	0	0	0	2	0	2	N Harris Plateau	0	0	1					
31	14	1	1	0	0	0	0	0	2	N Harris Plateau	0	0	1					
32	14	29	0	3	0	5	7	7	51	N Harris Plateau	13	1	1					
33	14	18	3	2	0	6	10	4	43	Mid Harris Plat	6	1	1					
34	14	0	0	0	0	0	2	0	2	S Harris Plateau	0	0	1					
35	14	7	0	0	0	1	0	1	9	Bull Creek	3	1	1					
36	14	25	3	6	0	3	7	4	48	N Bull Creek	6	1	1					
37	14	0	0	0	0	0	1	1	2	W Brooke Creek	0	0	1					
38	14	5	0	0	0	0	0	0	5	Big Boundary Cr	2	1	1					
39	14	2	0	0	0	0	0	0	2	W Klutlan Plat	0	0	1					
40	14	23	1	1	0	0	1	2	28	Big Boundary Cr	10	1	1					
41	14	13	2	2	0	2	5	4	28	S Pens	3	1	1					
42	14	21	1	1	0	2	3	1	29	SE Pens	7	1	1					
43	14	0	0	0	0	0	2	1	3	SE Pens	0	0	1					
44	14	2	0	0	0	0	0	0	2	NW Klutlan Plat	0	0	1					

45	14	15	1	2	0	4	7	3	32	NE Klutlan Plat	8	1	1									
46	14	9	2	1	0	1	1	1	15	W Kletsan	6	1	0									
47	14	4	1	0	0	0	0	0	5	Cub Creek	1	1	out									
48	14	6	0	2	0	1	0	2	11	E U Sheep Cr	3	1	out									
49	14	1	0	0	1	0	0	0	2	Harris Creek	1	1	out									
50	14	1	0	0	0	0	0	0	1	Harris Creek	1	1	out									
											442	25	32	1	66	78	75	719			138	34

Fig. 1. Survey area and groups of caribou observed during the 13-14 October 2007 census of the Chisana Caribou Herd. “Marked” groups included  $\geq 1$  radiocollared female and “observed” groups were seen during the initial helicopter survey without the aid of radiotelemetry.

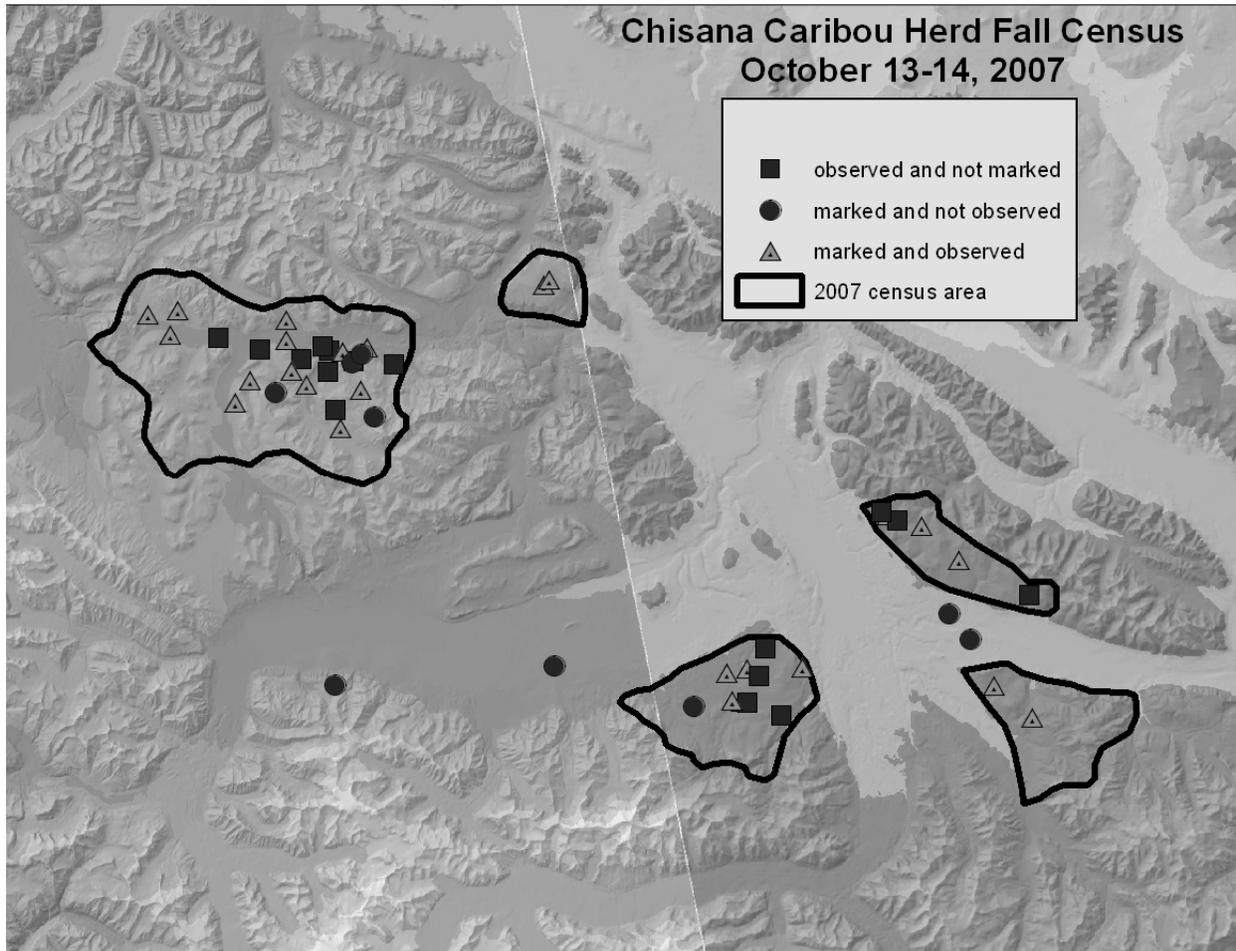
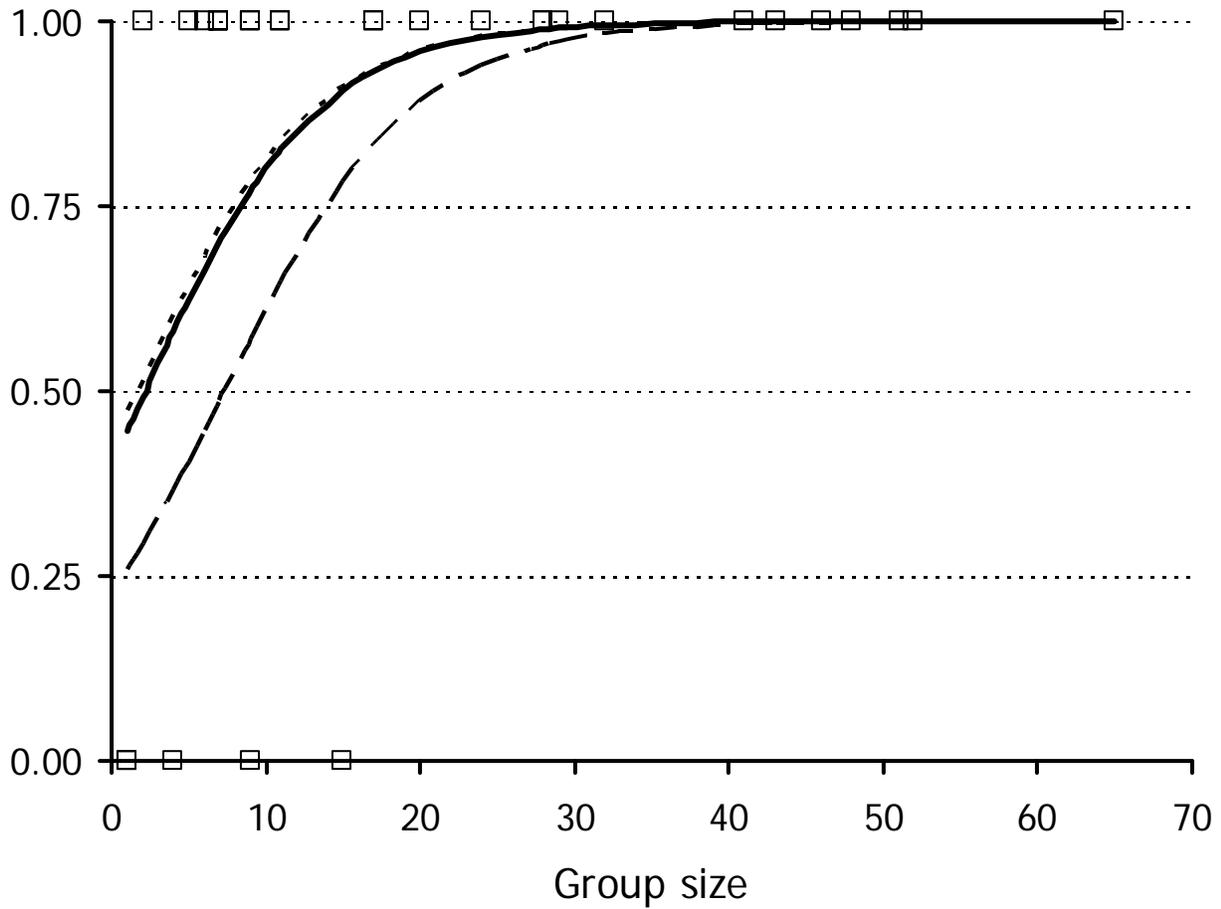


Fig. 2. Sighting probability relative to group size for the 2007 Chisana Caribou Herd census (solid line), based on 30 groups that included radiocollared females > 1 year old. Squares at 0 (5 groups not seen during survey) and 1 (25 groups seen during survey) are the raw data for the logistic regression ( $\text{logit}(p) = -0.390 + 0.178 \cdot \text{Group Size}$ ;  $G_1^2 = 7.64$ ,  $P = 0.006$ ). Sightability relationships for the 2003 (dashed line) and 2005 (dotted line) censuses are provided for comparison.



Appendix 1. Census results for the Chisana Caribou Herd during 2003-2007.

Dates	Population Estimate	90% Confidence Interval*
19-20 October 2003	720	606 – 833
15-16 October 2007	706	646 – 792
13-14 October 2007	766	719 – 823

\* Lower confidence limit truncated at number of caribou observed.

Appendix 2. Fall composition survey results for the Chisana Caribou Herd, 1977 – 2007.

Year	Caribou observed	Calves: 100 cows	Bulls: 100 cows	Calf Sex Ratio (m:f)	Bull Size Classes		
					S (%)	M (%)	L (%)
1977	273	44	42				
1978	100	18	34				
1980	582		36				
1982	409	22	43				
1986	507	33	39				
1987	760	28	39		53	26	21
1988	979	31	36		28	46	26
1989 <sup>a</sup>	625	8	37				
1990	851	11	36		37	44	19
1991	855	1.3	40		45	42	13
1992	1,142	0	31		34	43	23
1993	732	2.1	24		30	45	24
1994	543	11	27		20	44	35
1995	542	4.4	21		30	23	47
1996	377	4.8	16		58	18	42
1997	520	14	24		3	68	28
1998	231	4.3	19		49	14	37
1999	318	7.0	17		57	16	27
2000	412	6.1	20		52	25	23
2001	356	3.9	23		42	23	24
2002	258	13	25		28	23	49
2003 <sup>b</sup>	603	25	37	59:100	20	32	48
2004 <sup>b</sup>	538	21	38	94:100	40	27	33
2005 <sup>b</sup>	646	23	46	75:100	34	34	32
2006 <sup>b</sup>	628	21	48	92:100	34	33	33
2007	719	13	50	78:100	30	36	34

<sup>a</sup> Fixed-wing survey.

<sup>b</sup> Captive rearing efforts. Calf:cow ratios observed during survey are adjusted by extrapolating the calf:cow ratio for the wild population to a total estimate of wild cows and then adding the cows and calves from the captive rearing program.