

**SUMMARY OF THE 1997 POST CALVING AND RUT SURVEYS AND THE
1998 LATE WINTER SURVEY FOR THE ITCHA, ILGACHUZ AND RAINBOW
MOUNTAINS, CARIBOO REGION**

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SUMMARY OF THE 1997 POST CALVING AND RUT SURVEYS AND THE 1998 LATE WINTER SURVEY FOR THE ITCHA, ILGACHUZ AND RAINBOW MOUNTAINS, CARIBOO REGION

Abstract: As part of ongoing monitoring, the Itcha, Ilgachuz, and Rainbow Mountains caribou population was surveyed aerially three times in an effort to determine population trends, sex ratio, and calf recruitment. The post calving survey completed on June 20 and July 3 observed a total of 1800 caribou; 840 cows, 460 calves, 233 bulls, 84 yearling cows, 83 yearling bulls and 100 unsexed animals. The observed calf/100 cow ratio was 56/100 in the Itcha-Ilgachuz herd and 35/100 in the Rainbow herd. Cows with calves were found at higher elevations than cows without calves, with yearling and adult bulls being found at the lowest elevations. The October rut survey on October 20 and 21 observed 726 caribou; 448 cows, 87 calves, 75 mature bulls and 61 immature bulls. The observed calf/100 cow and bull/100 cow ratios in the Itcha-Ilgachuz herd were 23/100 and 31/100, respectively. In the Rainbow herd the observed calf/100 cow ratio was 4/100 and the bull/100 cow ratio was 27/100. The April late winter survey on March 27 and 28 observed 677 caribou; 674 in forest and 3 in alpine habitat. The Itcha-Ilgachuz herd calf percentage was estimated at 13.4% and the Rainbow calf percentage was assumed to be 7%. The Itcha-Ilgachuz herd appears to be stable, with an adequate calf recruitment but a low bull to cow ratio. The Rainbow Mountains herd showed low calf recruitment numbers but bull to cow ratios were higher than those found within the Itcha-Ilgachuz herd. Further studies coupled with population modelling will be necessary to confidently produce a long-term caribou strategy as required by the CCLUP (Cariboo-Chilcotin Land Use Plan).

INTRODUCTION

Caribou (*Rangifer tarandus caribou*) from the Itcha-Ilgachuz Mountains herd and the Rainbow Mountains herd in some years share a common winter range, thus for management purposes, they are considered two herds of the same population (Hatler, 1987). As such, aerial caribou population surveys were completed in June/July and October of 1997 and in March of 1998 over the Itcha, Ilgachuz, and Rainbow Mountains. These surveys contribute to developing a long-term caribou strategy as outlined in the Cariboo-Chilcotin Land Use Plan (CCLUP). Planned timber harvesting in the mature pine forests surrounding the Itcha-Ilgachuz Mountains will significantly decrease available terrestrial and arboreal lichens foraged upon by caribou in the winter months. Reduced winter habitat may impact the abundance and composition of the caribou population, therefore, population monitoring is required to provide a benchmark, as planned logging continues to expand throughout much of their range. The post calving June/July survey attempted to measure the relative abundance of the breeding female component and early calf production. The October rut survey estimated the sex composition and summer calf survival. The March late winter survey compared the proportions of forest and alpine-dwelling cows with calves as well as the overall calf recruitment. Observations of radio-collared caribou provided a sightability index in June/July and an additional measurement of calf production through the survey period.

Future surveys of the same area and the previous results will provide quantifiable population trends to aid wildlife managers.

We wish to thank Pat Dielman, Lara Webster, and Stefan Himmer for serving as observers during the surveys. Michaela Waterhouse provided statistical advice and performed the Duncan's Multiple Range Test and the Kruskal-Wallis Test. Debbie Cichowski provided her unpublished population survey data from the mid-1980's. Funding for this project was provided by Forest Renewal British Columbia (FRBC).

SURVEY AREA

The Itcha, Ilgachuz and Rainbow Mountain Ranges are situated in a plateau region of mature lodgepole pine (*Pinus contorta*) forest interspersed with wetlands and meadows and are within Management Units 5-10, 5-11 and 5-12 of the Cariboo Region (Figure 1). Once active volcanoes, the mountains now contain gently rolling alpine areas chosen by caribou for calving and rutting. All alpine areas are protected; Tweedsmuir Provincial Park surrounds the Rainbow Mountain Range and the Itcha and Ilgachuz Mountain Ranges now lie within the newly protected Itcha-Ilgachuz Provincial Park. The survey area is within the Western Chilcotin Uplands Ecosection and is characterized by two biogeoclimatic zones at the higher elevations; the Alpine Tundra zone and the Engelmann Spruce Subalpine Fir, very dry, very cold sub-zone.

METHODS

Aerial surveys were completed in a Bell 206 Jet Ranger utilising the total count technique (Simpson et al 1993). The surveys were restricted to high strata habitats, where under the proper conditions, animal sightability is high. This included the Itcha Flats wetland complex, alpine and adjacent parkland habitat and the larger wetlands between the Itcha and Ilgachuz Mountains. Mountain complexes were flown in a counter clockwise manner so that observers on the left side of the aircraft could scan the open habitat for caribou. The observer in the back right-hand seat provided additional coverage when necessary, particularly in the flatter terrain. Several of the larger plateaus required more than one pass (see flight maps for details). Radio-collared caribou not observed during the systematic survey were subsequently searched out and recorded separately. In this way, caribou numbers visually observed each year could be compared directly, and data collected from non-visually observed radio-collared caribou could still be gathered and used for separate purposes.

The post calving survey flights on June 20 (Itcha and Ilgachuz Mountains) and July 3 (Rainbow Mountains) included pilot Tom Arduini, Jim Young (navigator), Pat Dielman, and Lara Webster/ Kerra Shaw. The second survey day was delayed due to poor weather conditions after June 20. Flight time totalled 11.7 hours in high overcast and mild conditions. Caribou were classified into the following categories; cow, calf, yearling cow, yearling bull, or bull. UTM co-ordinates were recorded for each group of animals to digitally produce flight maps and elevational groupings.

Figure 1. Survey Area



Produced by the Data Management Section
 Ministry of Environment, Lands and Parks
 Williams Lake, British Columbia

Scale 1:450 000 - Échelle 1/450 000

Project #p9805112

Projection is Universal Transvers Mercator, Zone 10
 Projection DATUM is NAD83



The rut survey flights on October 20 and 21 included pilot Tom Arduini, Jim Young (navigator), Pat Dielman, and Kerra Shaw. Flight time totalled 11 hours in good visibility conditions. Caribou were classified into the following categories; mature bull, immature bull, cow and calf. Due to the difficulty of classifying large groups of caribou, both male and female yearlings were included in the cow classification.

The late winter survey flights on March 27 and 28 of 1998 included pilot Tom Arduini, Kerra Shaw (navigator), Lara Webster and Stefan Himmer. Flight time totalled 11.4 hours and the conditions were sunny with patchy clouds. Alpine and forest areas were searched using radio-telemetry to locate groups containing radio-collared females. Animals were classified as either adults or calves.

Population estimates were derived using the Peterson Method (White and Garrott, 1990). The total number of animals in the population (N) was estimated using the equation:

$$N = [(n+1)(M+1)/(m+1)] - 1$$

M is the total number of collared caribou, n is the total number of caribou counted during the survey, and m is the number of collared caribou counted during the survey. The estimate of unbiased variance was:

$$var(N) = (M+1)(n+1)(M-m)(n-m)/(m+1)^2(m+2)$$

and the 95 % confidence intervals for the population estimate N was calculated as:

$$N \pm 1.96 [var(N)^{0.5}]$$

The following attributes, adapted from Simpson et al (1993), were used to classify individual animals:

Class III Bulls: (Mature Bull)	large, heavy beamed antlers antlers often have many points and palmated brow tine body size testicles or penis sheath lack of vulva patch
Class II Bulls: (Medium Bull)	antlers larger than females and smaller than Class III body size testicles or penis sheath lack of vulva patch
Cows:	small antlers black vulva patch presence of calf or yearling short face for yearlings

called the Kruskal-Wallis Test and in both tests, all of the groups significantly differed from each other ($P=.0001$ for both; Appendix 2).

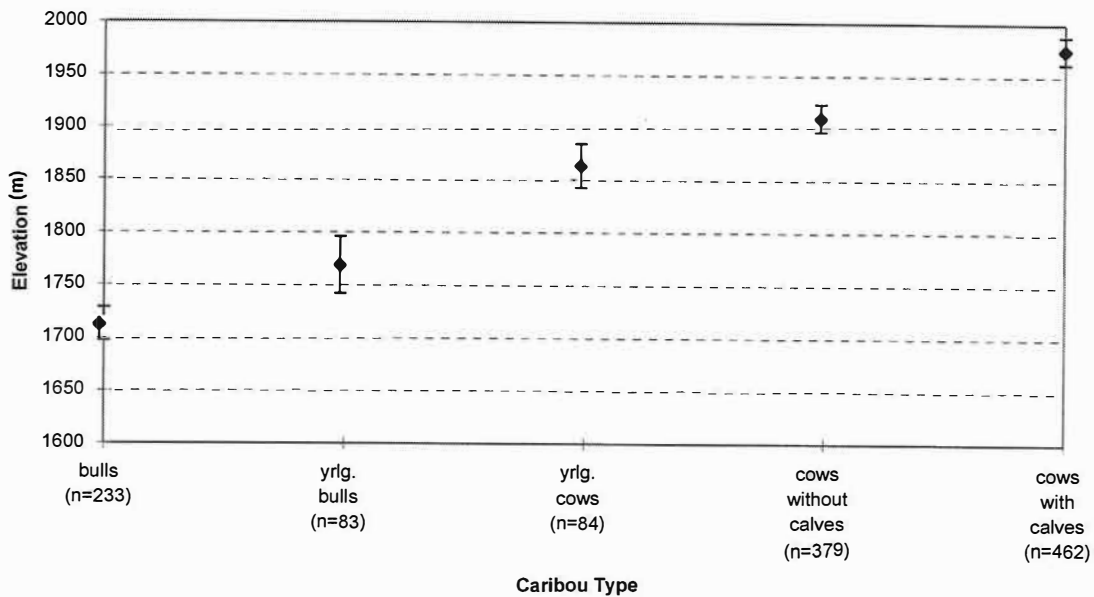


Figure 2. Average elevation of caribou populations segments with 95% confidence intervals, in June/July 1997

October Rut Survey

A total of 726 caribou were observed on the October 20 and 21 rut survey flights; 448 cows, 87 calves, 75 mature bulls, and 61 immature bulls (Table 2 and Appendix 3). Yearling caribou were included within the cow classification. The observed calf/100 cow ratio in the Itcha-Ilgachuz herd was 22.9/100 and in the Rainbow herd the ratio was 3.7/100. There were 175 mature bulls/100 immature bulls and 27.7 bulls/100 cows in the Rainbow herd compared to 115 mature bulls/100 immature bulls and 31.1 bulls/100 cows in the Itcha-Ilgachuz herd.

Table 2. Caribou Observed October 20 and 21, 1997, within the Itcha, Ilgachuz and Rainbow Mountains

Mountain Range	Total Seen	Cows	Calves	Mature Bulls	Immature Bulls
Itcha	468	272	65	42	34
Ilgachuz	152	95	19	19	19
Rainbow	106	81	3	14	8
Itcha-Ilgachuz	620	367	84	61	53
Itcha-Ilgachuz-Rainbow	726	448	87	75	61

March Late Winter Survey

A total of 677 caribou were observed during the late winter surveys on March 27 and 28, 1998 (Table 3 and Appendix 4). From previous population surveys and radio-telemetry information, the caribou in the alpine on the north side of the Ilgachuz Mountains and in the Anahim Lake area were assumed to have calved in the Rainbow Mountains. The caribou in the alpine on the north side and in the forests to the north, south and east of the Itcha Mountains were assumed to have calved in either the Itcha or Ilgachuz Mountains. The Itcha-Ilgachuz herd calf percentage was observed at 13.4% and the Rainbow herd calf percentage was observed at 6.8%. The overall calf percentage was 12.8%. Although searched, no caribou were observed in the alpine on the north side of the Rainbow or Ilgachuz Mountains.

Table 3. Caribou Observed March 27 and 28, 1998, within the Itcha, Ilgachuz and Rainbow Mountains

Caribou Herd	Mountain Range	Habitat Type	Total Classified	Adults	Calves
Itcha-Ilgachuz	Itcha	Alpine	3	2	1
	Itcha-Ilgachuz	Forest	615	533	82
		Total	618	535	83
Rainbow	Rainbow	Alpine	0	0	0
	Ilgachuz	Alpine	0	0	0
	Rainbow-Ilgachuz	Forest	59	55	4
		Total	59	55	4
Itcha-Ilgachuz-Rainbow	Combined	Alpine	3	2	1
	Combined	Forest	674	588	86
		Total	677	590	87

Annual Calf Survival Trend

The calf percentage in the Itcha-Ilgachuz herd dropped from 26.3% in June to roughly half of that (13.5%) in October. However, in March, the calf percentage remained almost exactly the same as October, at 13.4%. The observed calf percentage in the Itcha-Ilgachuz herd was higher than the Rainbow herd in all 3 of the surveys. The calf percentage started for the Rainbow herd in July at 16.8%, dropping to an observed 2.8% in October, and then 6.8% in March. A similar trend is evident in the calf/100 ratio of the relocated radio-collared animals. In the July survey, 3 of the 7 radio-collared cows in the Rainbow herd had calves. However, 0 of 7 had calves in the October and March surveys. In the Itcha-Ilgachuz herd, 15 of 19 had calves in the June survey, 8 of 19 had calves in October, and 5 of 19 had calves in March.

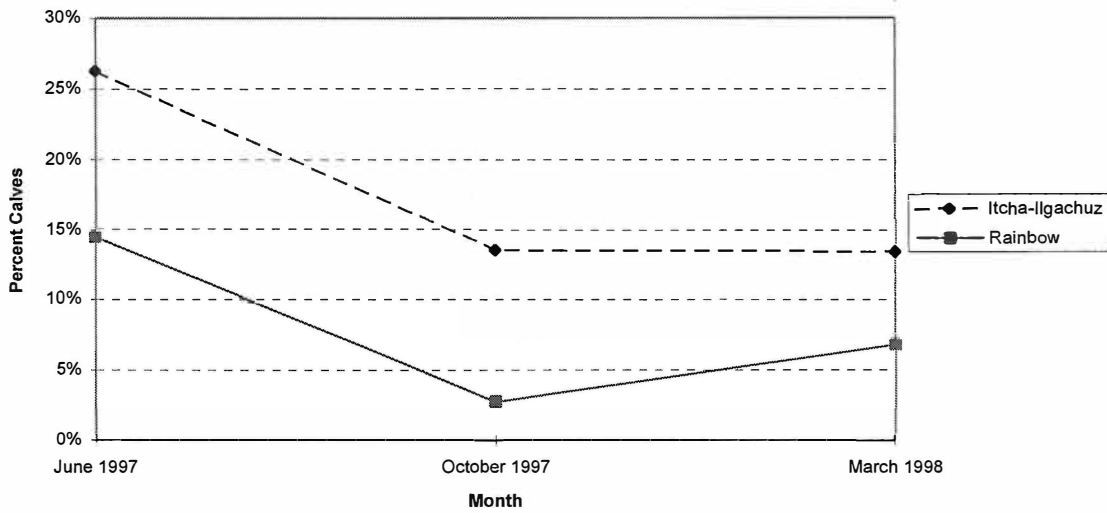


Figure 3. Calf Percentage Observed in the Post Calving, Rut and Late Winter Population Surveys of the Itcha-Ilgachuz and Rainbow Mountains Herds

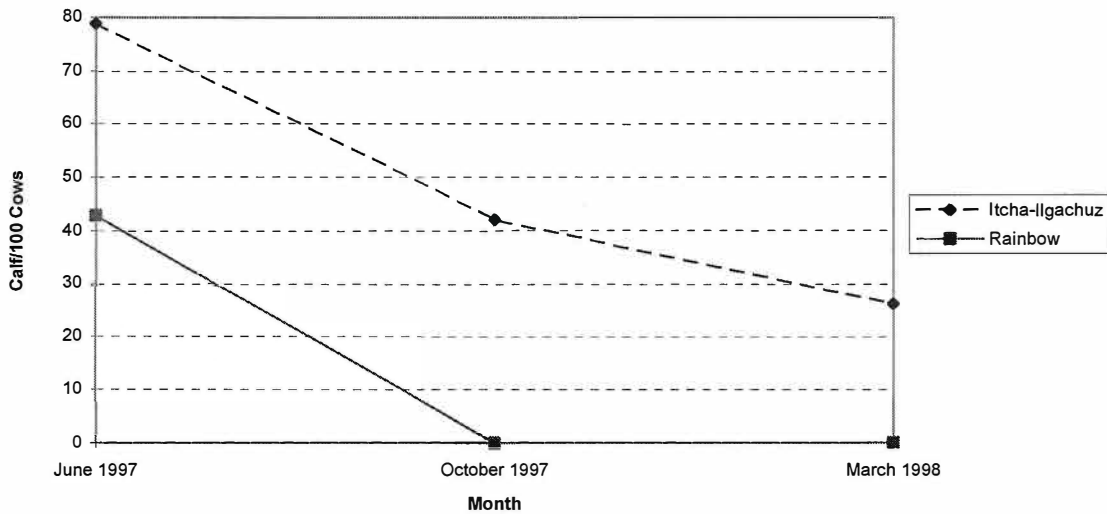


Figure 4. Calves/100 Cows Observed in the Post Calving, Rut and Late Winter Population Surveys of Radio-Collared Caribou in the Itcha-Ilgachuz and Rainbow Mountains Herds

Survey Costs

Helicopter rental costs totalled \$22,828.21 for all surveys. Wildlife staff committed 25 person days for pre-planning, surveys and report completion.

DISCUSSION

More caribou were observed in this year's June post calving survey (1800) than have been seen in past years (1400 in 1996 and 1466 in 1995; Loveridge and Young, 1997 and Young et al., 1998). The Itcha-Ilgachuz 1997 calf/100 cow ratio (56/100 cows) was very similar to the 1996 Itcha-Ilgachuz calf/100 cow ratio (55/100 cows), however the Rainbow herd (35/100 cows) was more similar to the 1995 June information (31/100 cows). Post calving surveys indicate that the Itcha-Ilgachuz herd has been relatively stable since the late 1980's and early 1990's (Figure 5). There appears to be a gradual increase in caribou numbers in the past four years, but it is unknown if this is due to actual increases or better sightability.

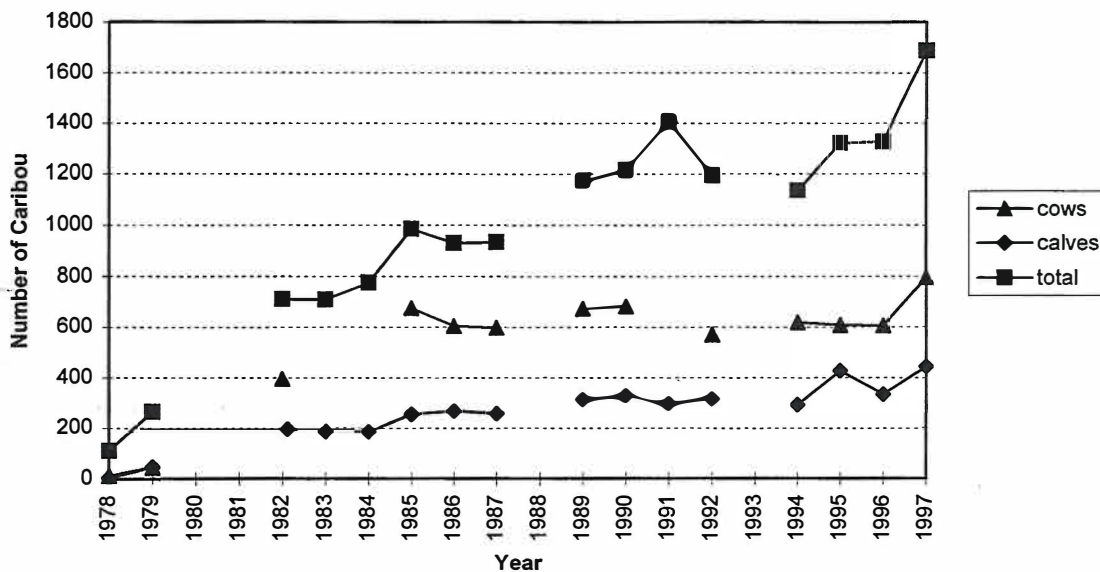


Figure 5. Summary of caribou post calving surveys for the Itcha-Ilgachuz Mountains herd

Bergerud (1978) counted 310 caribou in the Itcha and Ilgachuz Mountains in 1973, and suggested there was a maximum of 400 animals in the herd during the mid 1970's. During the late 1970's and early 1980's, surveys undertaken by regional wildlife staff observed a dramatic increase in caribou numbers (Smith and Hebert, 1986). Post calving surveys indicate the caribou herd has remained stable during the late 1980's and early 1990's (Figure 5). The herd is currently estimated at 1500 animals (post season) with healthy calf production and a stable breeding female component.

Ritcey (1956) estimated 100-150 caribou in the Rainbow Mountains in 1956 after seeing 68 while walking during the summer. Bergerud (1978) estimated the Rainbow herd likely peaked in the late 1960's at 200-300 animals after he observed only 41 caribou during a survey in 1977. There have been few complete surveys in the Rainbow Mountains, but the Rainbow herd has been recently estimated at 150 animals and has appeared to remain relatively stable since the mid 1980's with a high mature bull to

immature bull ratio. Although more caribou in total were counted in the 1997 post calving survey than in 1996, there were less calves observed during the June survey within the Rainbow herd this year (Figure 6). Table 4 compares the changes in calves and yearlings per 100 adults from June to March.

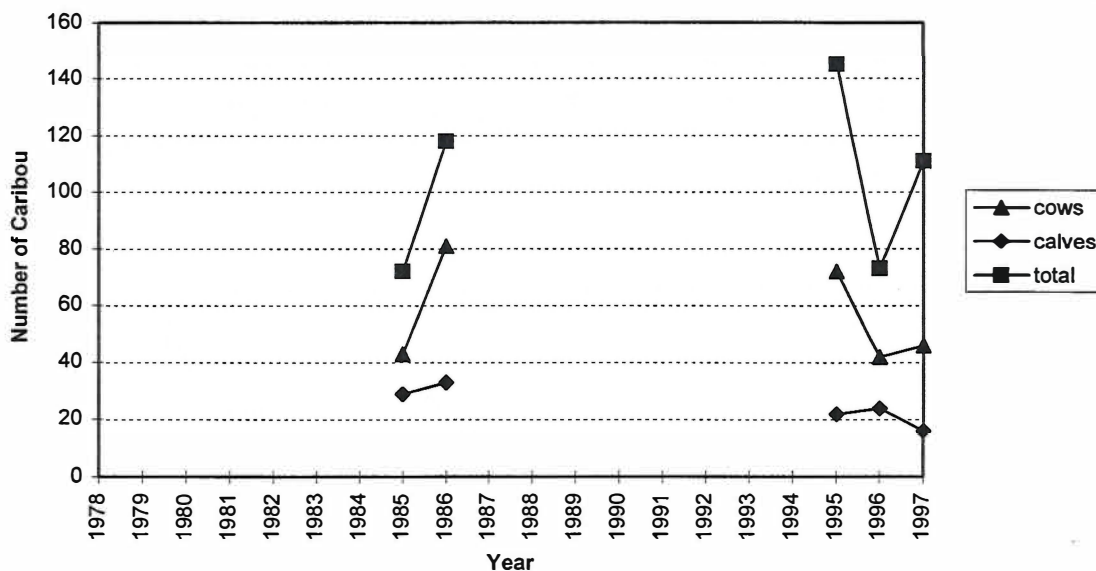


Figure 6. Summary of caribou post calving surveys for the Rainbow Mountains herd

During the June survey, two year and older females were included in the cow component during classification. As most two year old caribou do not bear young and many three year olds are not parous (Bergerud, 1983), the results overestimate the number of reproducing females.

When the yearling/100 adults ratio from the June 1996 and 1997 surveys were compared to the March 1996 and 1997 calf/100 adults ratios, there was good correlation. Table 4 compares the changes in calves and yearlings per 100 adults from March to June. These findings suggest that the results from the June survey may be adequate to estimate the previous year's recruitment if seasoned observers are utilised that are able to differentiate yearlings from adults.

Table 4: Caribou Calf and Yearling Percentages per 100 Adults for March and June within the Itcha-Ilgachuz and Rainbow Mountains herds

Year	Itcha-Ilgachuz Herd		Rainbow Herd	
	March calves/100 adults	June yrlg./100 adults	March calves/100 adults	June yrlg./100 adults
1996	27.1	22.9	12.5	11.4
1997	19.8	20.4	2.9	3.3

Sightability corrections were made to the survey information from 1985-87 and 1996-97 to estimate total cow numbers in June within the Itcha-Ilgachuz herd (Figure 7). The data from the 1980's included yearlings with the cow count, thus these numbers overestimated the female breeding population. The 1996-97 estimates included only adult cows and excluded bulls, yearlings, and calves. Although these differences make it difficult to directly compare the data between the late 1980's and the 1990's, it indicates the same stable population as Figure 5.

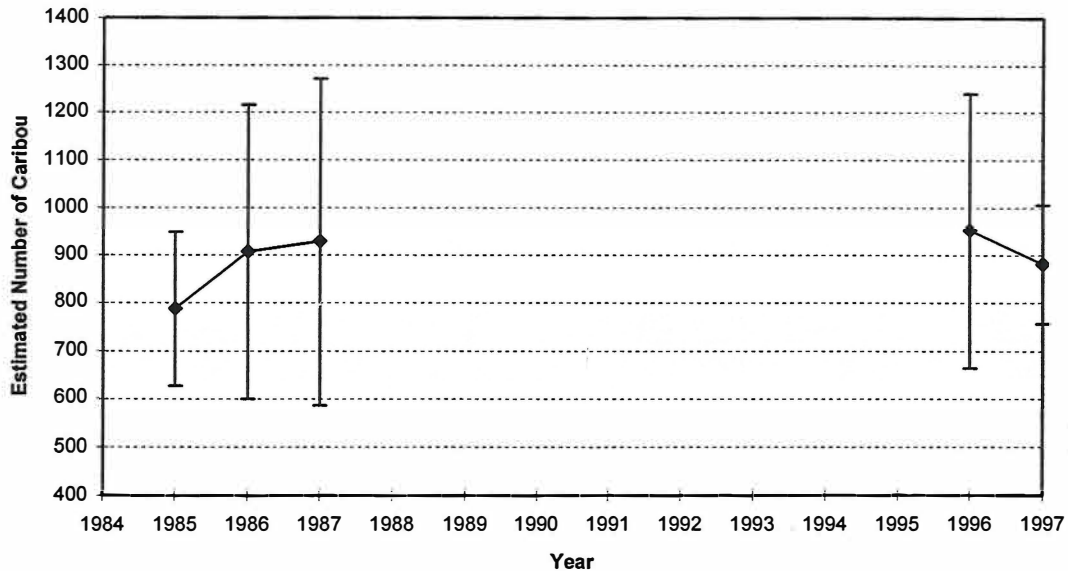


Figure 7: Estimated number of cow caribou in June and 95% confidence limits using collared animals to correct for sightability. Estimates in the 1980's included cows and yearlings, while in 1996-97 only cows were included (1985-87 estimates; Cichowski unpubl. data).

The annual migration to the alpine spring calving grounds is an anti-predator strategy by caribou to distance themselves from predators. By distancing themselves from other prey, the predator search time is increased making it less energetically favourable to subsist on a diet of caribou. Cows and calves are the most vulnerable segment of the population during calving, and will therefore seek out the highest elevations. Bulls are the last to migrate, choosing instead to feed on higher quality forage found at lower elevations.

In 1996, bull numbers in the Itcha-Ilgachuz herd appeared to be decreasing (16 bulls/100 cows in the October rut survey), based on post season rut surveys. However, this year we saw an increase in bull numbers to 31.1 bulls/100 cows similar to the ratio observed in June of 1996. We have limited information on the effects of sustenance hunting on this population, and there was some speculation that compulsory reporting, required in 1995-1996, was not as effective as compulsory inspection in obtaining accurate harvest values. Therefore, compulsory inspections were again required in 1997,

and more accurate accounts of hunting activity are expected. Between 1985, the year the mature bull season was implemented, and 1994, when compulsory inspection was required, the average annual harvest was 29 bulls (Appendix 5), comparatively higher than the reported harvest values for 1995 (10) and 1996 (25). The 1997 harvest was 24 bulls, close to the average when compulsory inspections were required in the late 1980's and early 1990's.

There is presently no method of determining the amount of mixing between the Itcha-Ilgachuz herd and the Rainbow herd, and therefore a small bias must be considered. In past years, the Itcha-Ilgachuz herd ratio of mature bulls to immature bulls has been much lower than the Rainbow herd, with 89 mature bulls/100 immature bulls in 1995 and 55 mature bulls/100 immature bulls in 1996. This year there is a marked improvement to 115 mature bulls/100 immature bulls. Although bull numbers are up, both herds are still below the provincial target of 35 bulls/ 100 cows. A comparison of bull numbers and mature bull to immature bull ratios for 1995, 1996, and 1997 is shown in Table 5.

Table 5: Rut Survey Mature Bull/100 Immature Bull Ratios in 1995, 1996, and 1997

Year	Itcha-Ilgachuz Herd				Rainbow Herd			
	N	Mature	Immature	Ratio	N	Mature	Immature	Ratio
1995	36	17	19	89/100	43	32	11	291/100
1996	76	27	49	55/100	23	11	12	91/100
1997	114	61	53	115/100	22	14	8	175/100

Only 2.8% of the Rainbow herd caribou observed in the October rut survey were calves, indicating a recurrence of the hypothesized predatory influence experienced in the previous years (9% calves in 1995 and 7% in 1996). This is below the minimum calf percentage suggested by Bergerud (1992) of 15-16% to balance the natural mortality of adults and maintain population stability. The calf percentages from the Itcha-Ilgachuz herd were lower this year than in the recent past, with 13.5% observed in the October survey and 13.4% observed in the late winter survey. In 1995 and 1996, the calf percentages were above the 15-16% mark in the Itcha-Ilgachuz herd for both the rut and late winter surveys. The decrease in mortality rate following the summer is expected, as calves become less vulnerable to predation with increased size.

The loss of winter habitat from clearcut harvesting will reduce the amount of winter forage available to caribou. The indirect effects of timber harvesting, such as increased poaching and human disturbance from access development, and increased predation from changes to habitat, may negatively effect caribou populations. Concerns have also been raised about the ecological impacts of fire suppression. Surveys will have to continue to monitor the effects of logging and to contribute to a long-term caribou strategy as required by the CCLUP by June of 2000. Population modelling will be required to determine the options necessary to maintain the population size and achieve a higher bull/cow ratio.

CONCLUSIONS

- During the 1997 post calving survey a total of 1800 caribou were observed which included 840 cows, 460 calves, 233 bulls, 84 yearling cows, 83 yearling bulls, 53 unsexed adults, and 47 unsexed yearlings. The observed calf/100 cow ratio was 55.9/100 in the Itcha-Ilgachuz herd and 34.8/100 in the Rainbow herd. Cows with calves were found at higher elevations than cows without calves, with yearling and adult bulls being found at the lowest elevations.
- During the 1997 October rut survey a total of 726 caribou were observed which included 448 cows, 87 calves, 75 mature bulls, 61 immature bulls, and 55 unclassified animals. The observed calf/100 cow ratio was 22.9/100 in the Itcha-Ilgachuz herd and 3.7/100 in the Rainbow herd. The observed bull/100 cow ratio was 31.1/100 in the Itcha-Ilgachuz herd and 27.2/100 in the Rainbow herd.
- During the 1998 March late winter survey a total of 677 caribou were observed which included 674 in forest and 3 in alpine habitat. The Itcha-Ilgachuz herd calf percentage was estimated at 13.4% and the Rainbow herd calf percentage was estimated at 7%.
- The Itcha-Ilgachuz and Rainbow Mountains caribou population appears to have remained relatively stable in recent years at its present level.
- The calf recruitment in the Itcha-Ilgachuz herd has appeared to be sufficient in balancing the adult natural mortality in the past few years, but has declined below population sustaining levels this year. The Rainbow herd continues to have low calf recruitment.
- The Itcha-Ilgachuz and Rainbow herds' bull/100 cow ratios are below the provincial target of 35 bulls/100 cows.

RECOMMENDATIONS

- Future survey efforts should continue with both spring and autumn surveys conducted within the same year and a late winter survey the following year.
- Surveys should be undertaken every year to take advantage of radio-collared animals. This will allow for development of a sightability correction factor and monitoring of calf survival amongst collared females within the population.
- Population modelling should be undertaken to predict the consequences of maintaining the present harvest strategy on bull/cow ratios.

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APPENDIX 1: POST CALVING SURVEY RESULTS										
ITCHA MOUNTAINS CARIBOU SURVEY - JUNE 20, 1997										
Sighting #	Easting	Northing	Total	# Cows	# Calves	# Bulls	# Yrlg. Cows	# Yrlg. Bulls	Unsex. Adults	Unsex. Yrlg.
			in group							
1	368453	5841121	10	4	3		3			
2	370331	5840149	9	4	4		1			
3	370949	5841364	10	4		1	5			
4	370418	3841712	10	1		6	2	1		
5	372634	5839880	95	59	35		1			
6	373914	5839257	2	1	1					
7	372745	5838518	1	1						
8	374756	5838229	1				1			
9	374220	5840189	2	1	1					
10	374864	5839792	4	2	2					
11	373927	5836721	2	1	1					
12	372683	5834410	3				1	2		
13	373486	5833162	5	3	2					
14	378236	5835397	16	8	8					
15	378145	5836733	16	5		4	3	4		
16	375998	5836558	3			3				
17	376389	5837292	3				2	1		
18	376554	5838454	29	15	14					
19	380050	5838061	2	1	1					
20	376384	5839321	2	1	1					
21	376571	5840900	8	4	3			1		
22	378702	5840537	2					2		
23	376431	5842950	2	1	1					
24	376093	5842475	8	4	4					
25	376287	5843922	7	1			1	5		
26	376043	5844925	8	2	1		5			
27	377619	5844926	14	8	1	1	1	3		
28	377017	5847828	2	1	1					
29	382178	5848662	37			35		2		
30	382838	5847564	40			33		7		
31	388034	5852377	5			4		1		
32	388576	5851509	12			8		4		
33	377374	5850397	6			6				
34	375540	5843316	2				1	1		
35	374952	5842791	4	1			3			
36	375326	5841991	2	1	1					
37	373558	5840718	4	2	2					
38	373783	5842013	1	1						
39	374673	5846809	8	4	4					
40	374044	5846416	81	8	4	6	3	4	26	30
41	373592	5845511	27			17		10		
42	372697	5843153	3	3						
43	373485	5843545	12	6	6					
44	373379	5844252	8	2		2	2	2		
45	372404	5841836	86	47	38		1			

Sighting #	Easting	Northing	Total	# Cows	# Calves	# Bulls	# Yrlg. Cows	# Yrlg. Bulls	Unsex.	Unsex.
			in group						Adults	Yrlg.
32	343212	5852391	6	3	3					
33	343698	5854909	4			4				
34	343076	5855851	9	3		5		1		
35	342557	5855083	27	7		18		2		
36	342565	5851164	4	2	2					
37	341398	5853321	54	40	12					2
38	340164	5853071	5	3			2			
39	339984	5852380	2	1	1					
40	342686	5849693	18	10	8					
41	343457	5849881	4	2	2					
42	344034	5849277	6	4	2					
43	343937	5849071	10	5	5					
44	341472	5848700	4	2	2					
45	339538	5850136	2	1	1					
46	339170	5849886	43	28	14		1			
47	340397	5848542	39	22	17					
48	340931	5847653	9	6	3					
49	341326	5844924	2	2						
50	342616	5844063	2	1	1					
51	345690	5841891	11	7	4					
52	347566	5842428	11	6	5					
53	348183	5840538	8			4	1	3		
54	348712	5840856	6			4	1	1		
55	349221	5840936	9	4			3	2		
56	348429	5842267	2	1	1					
57	349203	5843254	6	3	3					
58	349928	5842300	62	36	25		1			
59	349670	5843407	1	1						
60	352968	5843308								
61	352405	5842605	13						8	5
62	352565	5840441	2			1		1		
63	352805	5833816	5			5				
Total Caribou			986	554	297	65	27	28	8	7
RAINBOW MOUNTAINS CARIBOU SURVEY - JULY 3, 1997										
Sighting #	Easting	Northing	Total	# Cows	# Calves	# Bulls	# Yrlg. Cows	# Yrlg. Bulls	Unsex.	Unsex.
			in group						Adults	Yrlg.
1	306570	5836528	2	1	1					
2	300330	5834970	1	1						
3	299239	5832886	2			2				
4	9u70206	5837709	1			1				
5	9u70056	5830027	10	3		5	2			
6	9u69358	5835299	2			2				
7	9u69576	5828932	23	1		6			16	
8	9u70311	5828153	5			5				
9	300584	5829735	6	2		4				
10	305609	5832620	2	2						

Sighting #	Easting	Northing	Total	# Cows	# Calves	# Bulls	# Yrlg. Cows	# Yrlg. Bulls	Unsex. Adults	Unsex. Yrlg.
			in group							
11	306241	5827128	4	2		2				
12	316828	5829101	3	3						
13	315974	5818615	1			1				
14	313974	5843088	2			2				
15	313552	5844884	34	21	13					
16	306592	5844162	5	3	2					
17	305023	5848053	8	7			1			
Total Caribou			111	46	16	30	3	0	16	0
Total Caribou for Itcha Mountains										
			703	240	147	138	54	55	29	40
Total Caribou for the Ilgachuz Mountains										
			986	554	297	65	27	28	8	7
Total Caribou for the Rainbow Mountains										
			111	46	16	30	3	0	16	0
Total Caribou for the Itcha and Ilgachuz Mountains										
			1689	794	444	203	81	83	37	47
Total Caribou for the Itcha, Ilgachuz, and Rainbow Mountains										
			1800	840	460	233	84	83	53	47

APPENDIX 2: RESULTS OF STATISTICAL TESTS

DUNCAN'S MULTIPLE RANGE TEST (Multiple t-tests)

GROUP	Cows with calves	Cows w/o calves	Yrlg. Cows	Yrlg. Bulls	Bulls
MEAN ELEVATION	1975.38	1908.92	1864.24	1768.61	1713.32
SIGNIFICANT DIFFERENCE	A	B	C	D	E

Degrees of Freedom : 4

P-value : .0001

Type III SS : 12001680

F-Value : 170.94

KRUSKAL-WALLIS TEST (Chi-Squared Approximation)

GROUP	Cows with calves	Cows w/o calves	Yrlg. Cows	Yrlg. Bulls	Bulls
MEAN SCORE	839.36	660.76	547.31	340.17	246.51
MEAN ELEVATION	1975.38	1908.92	1864.24	1768.61	1713.32

Degrees of Freedom : 4

P-value : .0001

CHISQ : 486.28

APPENDIX 3: OCTOBER RUT SURVEY RESULTS								
ITCHA MOUNTAINS CARIBOU SURVEY - OCT. 20, 1997								
Sighting #	Easting	Northing	Total in Group	# Cows	# Calves	# Mature Bulls	# Imm. Bulls	Unclass.
1	3 91 545	58 36 428	35	25	4	5	1	
2	3 85 718	58 39 404	3	2	1			
3	3 84 579	58 49 802	31	4		5		22
4	3 86 064	58 48 896	34	6	1	1		26
5	3 87 457	58 52 204	23	15	4	1	3	
6	3 89 094	58 52 039	10	5	3	1	1	
7	3 91 425	58 51 211	9	5	3		1	
8	3 90 658	58 53 081	15	5	1	1	1	7
9	3 98 714	58 52 538	11	5	4	2		
10	3 96 217	58 46 103	1	1				
11	3 89 112	58 48 864	7	3	2		2	
12	3 89 754	58 48 913	4	3	1			
13	3 88 109	58 48 772	2	1	1			
14	3 86 288	58 49 298	8	5	3			
15	3 83 264	58 41 859	2	1			1	
16	3 80 776	58 41 939	4	1	2	1		
17	3 78 634	58 45 030	35	21	8	3	3	
18	3 77 914	58 45 496	37	24	4	6	3	
19	3 76 783	58 43 938	56	39	8	4	5	
20	3 76 184	58 45 193	3	1		1	1	
21	3 75 291	58 46 773	1	1				
22	3 75 301	58 46 743	3	2	1			
23	3 71 122	58 41 920	28	21	6		1	
24	3 68 060	58 44 074	7	7				
25	3 65 373	58 43 835	18	12	5	1		
26	3 77 064	58 33 224	24	16		4	4	
27	3 79 217	58 34 026	25	16	2	4	3	
28	3 78 175	58 36 562	31	24	1	2	4	
29	3 91 460	58 46 240	1	1				
TOTAL			468	272	65	42	34	55
ILGATCHUZ MOUNTAINS CARIBOU SURVEY - OCT. 20, 1997								
Sighting #	Easting	Northing	Total in Group	# Cows	# Calves	# Mature Bulls	# Imm. Bulls	Unclass.
30	3 59 207	58 40 153	1			1		
31	3 51 216	58 42 033	54	32	6	7	9	
32	3 52 736	58 42 723	56	36	5	7	8	
33	3 55 484	58 43 067	2	1	1			
34	3 57 864	58 44 718	4	4				
35	3 57 674	58 43 989	12	10	2			
36	3 49 557	58 44 856	2	2				
37	3 41 061	58 52 993	3	2	1			
38	3 38 534	58 56 116	2	1		1		
39	3 39 428	58 49 856	2	1			1	
40	3 39 099	58 47 760	9	4	3	2		
41	3 40 950	58 47 206	5	2	1	1	1	
TOTAL			152	95	19	19	19	0

RAINBOW MOUNTAINS CARIBOU SURVEY - OCT. 21, 1997								
Sighting #	Easting	Northing	Total in Group	# Cows	# Calves	# Mature Bulls	# Imm. Bulls	Unclass.
42	3 04 096	58 46 284	1			1		
43	3 01 803	58 45 612	16	15		1		
44	3 01 130	58 44 316	6	5		1		
45	2 99 966	58 44 254	32	26	2	4		
56	3 00 101	58 44 783	51	35	1	7	8	
TOTAL			106	81	3	14	8	0
Total Caribou for the Itcha and Ilgachuz Mountains								
			620	367	84	61	53	55
Total Caribou for the Itcha, Ilgachuz, and Rainbow Mountains								
			726	448	87	75	61	55

APPENDIX 4: LATE WINTER SURVEY RESULTS							
FOREST AND ITCHA-ILGACHUZ MOUNTAINS CARIBOU SURVEY - MARCH 27 AND 28, 1998							
Sighting #	Easting	Northing	Total in Group	# Adults	# Calves	Collared Female	Caribou Home Range
1	361005	5799101	8	5	3	531	Itcha-Ilgachuz
2	334981	5815713	19	17	2	350, 581	Rainbow
3	330569	5833467	19	17	2	701, 441	Rainbow
4	330791	5833947	2	2			Rainbow
5	329477	5832608	19	19		522, 602, 500	Rainbow
6	375176	5845842	3	2	1	590	Itcha-Ilgachuz
7	410089	5864064	25	21	4	766	Itcha-Ilgachuz
8	406033	5844564	28	22	6	641	Itcha-Ilgachuz
9	406295	5829348	18	14	4	754	Itcha-Ilgachuz
10	407918	5829683	51	44	7		Itcha-Ilgachuz
11	408253	5829595	21	20	1	621	Itcha-Ilgachuz
12	395932	5815782	49	44	5	807, 549	Itcha-Ilgachuz
13	394675	5814490	7	6	1	826	Itcha-Ilgachuz
14	363026	5805016	42	37	5		Itcha-Ilgachuz
15	396466	5785888	17	13	4	old blue collar	Itcha-Ilgachuz
16	397194	5785529	25	21	4	470	Itcha-Ilgachuz
17	397480	5785077	2	2			Itcha-Ilgachuz
18	395237	5784010	12	12		321	Itcha-Ilgachuz
19	386848	5792866	3	2	1	691	Itcha-Ilgachuz
20	405981	5807127	14	13	1		Itcha-Ilgachuz
21	406434	5807500	12	12			Itcha-Ilgachuz
22	406693	5807116	17	13	4		Itcha-Ilgachuz
23	407160	5806798	9	8	1		Itcha-Ilgachuz
24	406483	5809214	74	67	7	816	Itcha-Ilgachuz
25	407600	5808084	21	21		571	Itcha-Ilgachuz
26	409075	5807323	36	36		650	Itcha-Ilgachuz
27	409197	5807411	35	31	4		Itcha-Ilgachuz
28	406350	5803200	6	4	2	612	Itcha-Ilgachuz
29	393446	5811486	27	20	7		Itcha-Ilgachuz
30	392641	5812009	7	5	2		Itcha-Ilgachuz
31	393045	5812358	3	3		463	Itcha-Ilgachuz
32	390104	5816863	26	21	5	119	Itcha-Ilgachuz
33	396318	5815619	20	16	4	560	Itcha-Ilgachuz
			677	590	87		
			Total in Group	# Adults	# Calves		
Total Caribou for the Rainbow Mountains							
		Forest	59	55	4		
		Alpine	0	0	0		
		Total	59	55	4		
Total Caribou for the Itcha and Ilgachuz Mountains							
		Forest	615	533	82		
		Alpine	3	2	1		
		Total	618	535	83		

Total Caribou for the Itcha, Ilgachuz, and Rainbow Mountains					
		Forest	674	588	86
		Alpine	3	2	1
		Total	677	590	87

APPENDIX 5: ANNUAL BULL HARVEST

Year	Number of Bulls Harvested
1984*	47
1985	17
1986	9
1987	30
1988	29
1989	32
1990	24
1991	52
1992	37
1993	31
1994	24
1995	10
Average	29
Standard Deviation	13

* last year before mature bull season