

**SUMMARY OF THE 1998 POST CALVING AND RUT SURVEYS
AND THE 1999 LATE WINTER SURVEY FOR THE ITCHA,
ILGACHUZ AND RAINBOW MOUNTAINS, CARIBOO REGION**

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Abstract

As part of ongoing monitoring, the Itcha, Ilgachuz, and Rainbow Mountains caribou population was surveyed aurally three times in an effort to determine population trends, sex ratios, and calf recruitment. The post calving survey completed on June 20 and June 21, 1998 observed a total of 2219 caribou; 1060 cows, 578 calves, 349 bulls, 4 yearling cows, 35 yearling bulls and 193 unsexed animals. The observed percent calves was 26.3 in the Itcha-Ilgachuz Herd and 21.4 in the Rainbow Herd. No significant differences in elevation use were found from one age/sex group to the next. The 1998 October rut survey on October 19 and 20 observed 749 caribou; 495 cows, 123 calves, 68 mature bulls and 63 immature bulls. The observed calves/100 cows and bulls/100 cows in the Itcha-Ilgachuz Herd were both 26/100. In the Rainbow Herd the observed calf/100 cow ratio was 18/100 and the bull/100 cow ratio was 27/100. The late winter survey on March 16 and 17 observed 309 caribou, all of which were in forest habitats. The Itcha-Ilgachuz Herd calf percentage was estimated at 14.6% and the Rainbow calf percentage was assumed to be 9%. The Itcha-Ilgachuz Herd appears to be increasing, with adequate calf recruitment and an increasing bull to cow ratio. The Rainbow Mountains Herd showed lower calf recruitment numbers but a more adequate bull to cow ratio. 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).

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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 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 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 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, Kerra Shaw, 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. Project funding 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 Ecoregion 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

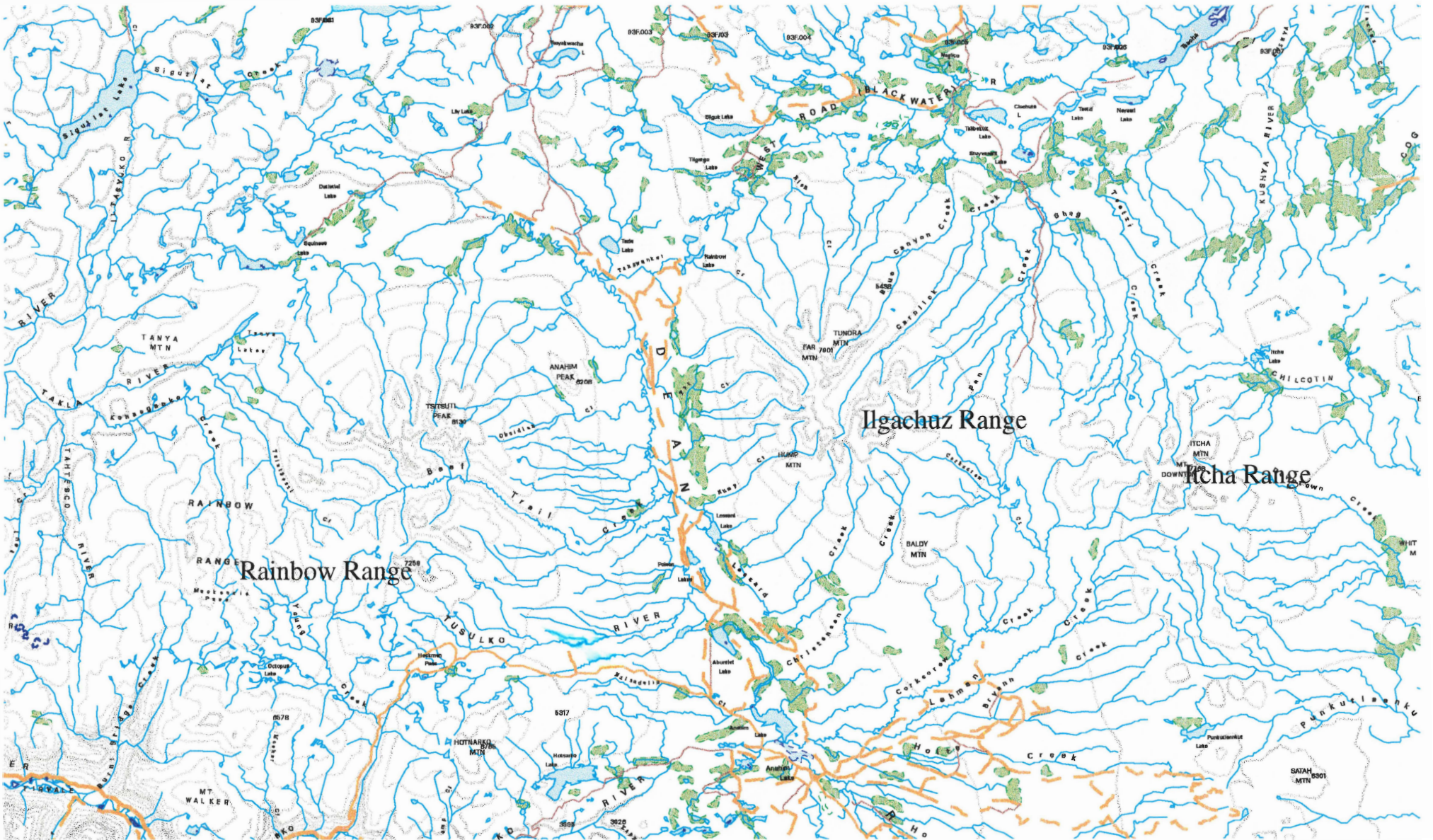
Aerial surveys were completed in a Bell 206 Jet Ranger utilising the total count technique (Resource Inventory Committee 1997). The surveys were restricted to high strata habitats, where under the proper conditions, animal sightability is high. This included the Itcha Flats wetland complex, alpine and adjacent parkland habitat and the larger wetlands between the Itcha and Ilgachuz Mountains. Mountain complexes were flown in a counter clockwise manner so 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 June 21, 1998 (Rainbow Mountains) included pilot Tom Arduini, Jim Young (navigator), Pat Dielman(observer/navigator), and Lara Webster/ Kerra Shaw. An earlier flight on June 19 was cancelled after 1.4 hours due to poor weather. Flight time totalled 14.6 hours in mostly clear conditions with some high overcast. 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 elevation groupings.

The rut survey flights on October 19 and 20, 1998 included pilot Tom Arduini, Pat Dielman (navigator), Lara Roorda, and Kerra Shaw. Flight time totalled 11.0 hours in good visibility conditions. Caribou were classified as mature bulls, immature bulls, cows and calves. 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 16 and 17 of 1999 included pilot Tom Arduini, Kerra Shaw (navigator), Lara Webster and Stefan Himmer. Flight time totalled 9.4 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.

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

Population estimates were derived using the Joint Hypergeometric Estimator (JHE) and the NOREMARK computer statistical package by Gary White. The JHE is an extension of the Peterson Method (White & Garrot 1990) used in previous population reports and is now the Resource Inventory Committee (RIC) standard method for mark recapture estimates in closed populations with only one sighting occasion. A sighting occasion is an attempt to view animals in a population, keeping track of the number of marked and unmarked animals observed. This model assumes that individual marked animals have the same probability of sighting as every other individual within the population on a given occasion.

The maximum likelihood estimator is the value of N that maximises the expression:

$$\prod_{i=2}^{k+1} \frac{(n_i/m_i) \times [(N-n_1) / (n_i-m_i)]}{(N/n_i)}$$

Where n_i and m_i are the total number of animals observed and the number of marked animals observed, respectively, on occasion i , $i=2, \dots, k+1$. Computerised optimization is required to find the value N. The 95% confidence interval is constructed directly from the likelihood. As such, estimates of the lower and upper confidence bounds are the values of N that produce values of the log likelihood which are 2 units less than the value of the log likelihood at the maximum (White & Garrot 1990). With this type of confidence interval the lower confidence bound is never estimated at a value less than the minimum number of animals known to exist.

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 |
| Calf: | body size
dark bodies
lack of antler development
proximity to adults |

RESULTS

Post Calving Survey

A total of 2219 caribou were observed on the June 20 and June 21 flights; 1060 cows, 578 calves, 4 yearling cows, 35 yearling bulls, 143 unsexed yearlings, 50 unclassified adults, and 349 bulls (Table 1 and Appendix 1). The observed calf to 100 cow ratio in the Itcha-Ilgachuz Herd was 55/100 and the bull to 100 cow ratio was 32.8/100. The observed bull/100 cow ratio was higher in the Rainbow Herd at 56.3/100, while the calf/100 cow ratio was lower at 43.8/100. The overall calf/100 cow and bull/100 cow ratios were 54.5/100 and 32.9/100, respectively. In the Itcha-Ilgachuz area, there were 13.0 yearlings/100 adult caribou, and this ratio was lower at only 2.7 in the Rainbow Mountains area.

Table 1. Caribou Observed June 20 and 22, 1998, within the Itcha, Ilgachuz and Rainbow Mountains.

Mountain Range	Total Caribou	Cows (>1yrs)	Calves	Bulls (>1yrs)	Yrlg.-Cows	Yrlg.-Bulls	Unsexed Yrlgs.	Unsexed Adults
Itcha	995	411	188	233	1	32	80	50
Ilgachuz	1126	601	369	89	3	2	0	62
Rainbow	98	48	21	27	0	1	1	1
Itcha-Ilgachuz	2121	1012	557	322	4	34	50	142
Itcha-Ilgachuz-Rainbow	2219	1060	460	233	84	83	47	53

Average elevations of each age/sex group during the post calving surveys were within 25 meters of each-other (Figure 2). These groups were compared with Sheffe's test as opposed to last year's Duncan's Multiple Range Test. Both tests are non-parametric analysis of variance (one way ANOVA's) but Sheffe's has a bit more conservative approach. Since the majority of the yearlings were unclassified, resulting in small sample sizes of yearling bulls (35) and yearling cows (4), all yearlings were lumped into one category (Figure 2). Sheffe's test found no significant elevation use differences between any of the groups. However, when the analysis was done with yearling bulls as a separate group, they were found to be using significantly higher elevations than all other sex/age categories (Appendix 2).

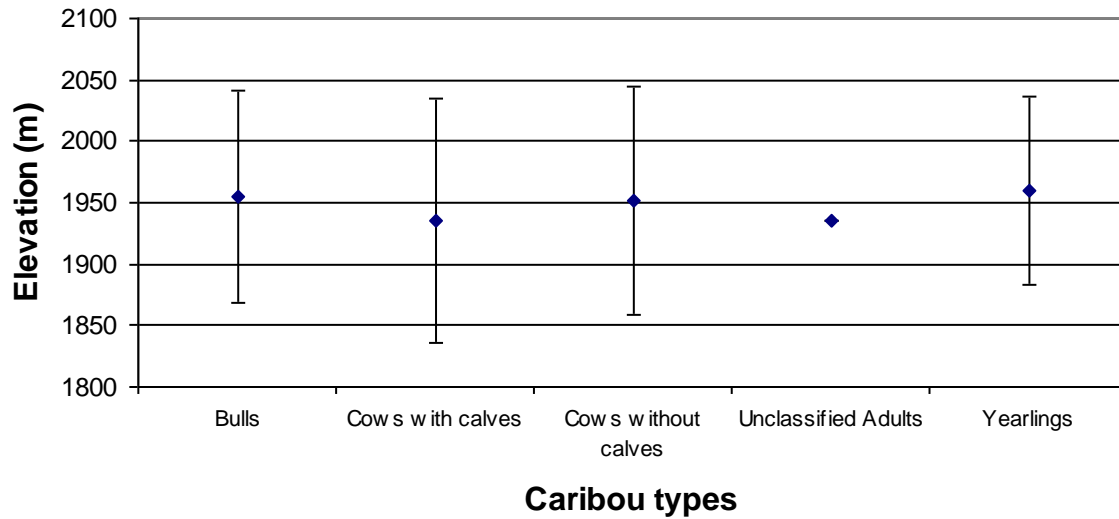


Figure 2. Average elevation of caribou populations segments with 95% confidence intervals, in June 1998.

October Rut Survey

A total of 749 caribou were observed on the October 19 and 20, 1998 rut survey flights; 495 cows, 123 calves, 68 mature bulls, and 63 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 22.2/100 and in the Rainbow Herd the ratio was 17.6/100. There were 300 mature bulls/100 immature bulls and 27.0 bulls/100 cows in the Rainbow Herd compared to 91 mature bulls/100 immature bulls and 26.4 bulls/100 cows in the Itcha-Ilgachuz Herd.

Table 2. Caribou observed on October 19th and 20th 1998, within the Itcha, Ilgachuz and Rainbow Mountains.

Mountain Range	Total Seen	Cows	Calves	Mature Bulls	Immature Bulls
Itcha	524	355	87	43	39
Ilgachuz	118	66	23	10	19
Rainbow	107	74	13	15	5
Itcha-Ilgachuz	642	421	110	53	58
Itcha-Ilgachuz-Rainbow	749	495	123	68	63

March Late Winter Survey

A total of 309 caribou were observed during the late winter surveys on March 16 and 17, 1999 (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 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 17.2% and the Rainbow Herd calf percentage was observed at 10.4%. The overall calf percentage was 16.2%. Although searched, no caribou were observed in the alpine in the Itcha Mountains or on the north side of the Rainbow or Ilgachuz Mountains.

Table 3. Caribou observed March 16th and 17th 1999 in the Itcha, Ilgachuz and Rainbow Mountains and surrounding areas.

Caribou Herd	Mountain Range	Habitat Type	Total Classified	Adults	Calves
Itcha-Ilgachuz	Itcha	Alpine	0	0	0
	Itcha-Ilgachuz	Forest	261	216	45
		Total	261	216	45
Rainbow	Rainbow	Alpine	0	0	0
	Ilgachuz	Alpine	0	0	0
	Rainbow-Ilgachuz	Forest	48	43	5
		Total	48	43	5
Itcha-Ilgachuz-Rainbow	Combined	Alpine	0	0	0
	Combined	Forest	309	259	50
		Total	309	259	50

Annual Calf Survival Trend

The calf percentage in the Itcha-Ilgachuz Herd dropped from 26.3% in June to 17.1% in October. However, in March, the calf percentage remained almost exactly the same as October, at 17.2%. The calf percentage for the Rainbow Herd in June started at 21.4%, dropping to an observed 12.1% in October, and then 10.4% in March (Figure 3). A similar trend is evident in the calf/100 cow ratio of the relocated radio-collared animals. In the June survey, 4 of the 6 radio-collared cows in the Rainbow Herd had calves. However, only 1 of 6 had calves in the October and none were observed with calves during the March surveys. In the Itcha-Ilgachuz Herd, 11 of 18 had calves in the June survey, 9 of 17 had calves in October, and 7 of 17 had calves in March (Figure 4).

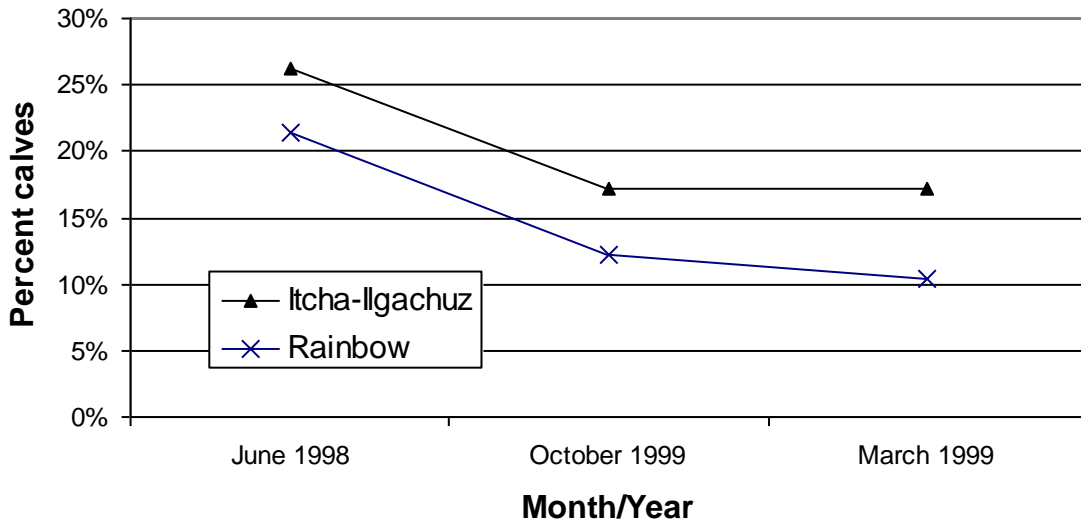


Figure 3. Calf percentage observed in the post calving, rut and late winter population surveys of the Itcha-Ilgachuz and Rainbow Mountains Herds.

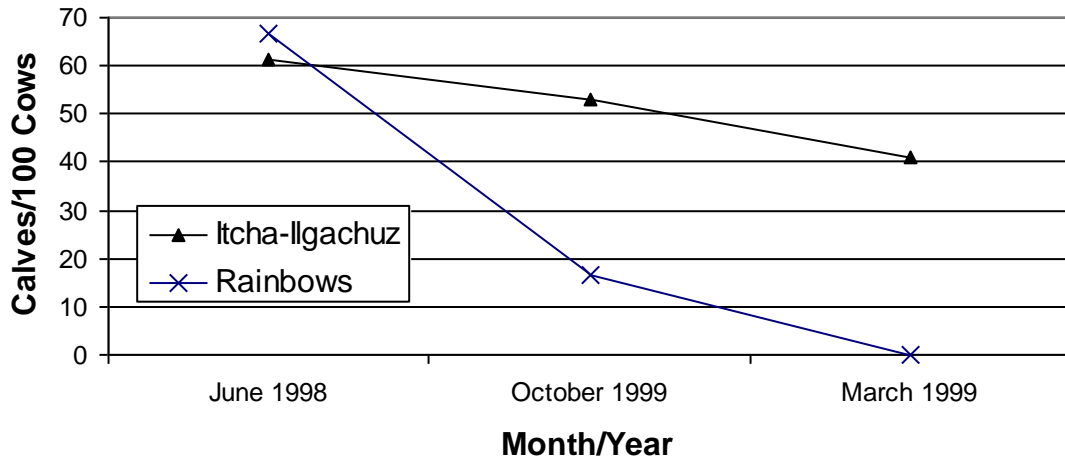


Figure 4. Calves/100 cows observed in the post calving, rut and late winter population surveys of radio-collared caribou in the Itcha-Ilgachuz and Rainbow Mountains Herds.

Survey Costs

Helicopter rental costs totalled \$26,589.87 (or 35 helicopter hours) 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 (2219) than have been seen in past years (1466 in 1995 and 1799 in 1997; Loveridge and Young, 1997 and Young et al., 1998). The Itcha-Ilgachuz 1998 June calf/100 cow ratio (55/100 cows) was very similar to the 1997 Itcha-Ilgachuz calf/100 cow ratio (56/100 cows). The post calving Rainbow Herd ratio of 44calves/100 cows was higher than last year's ratio of 35calves/100 cows. Post calving surveys indicate that the Itcha-Ilgachuz Herd remained relatively stable during the late 1980's and early 1990's (Figure 5). There appears to have been an increase in caribou numbers over the past five years, likely due to actual increases and better overall sightability.

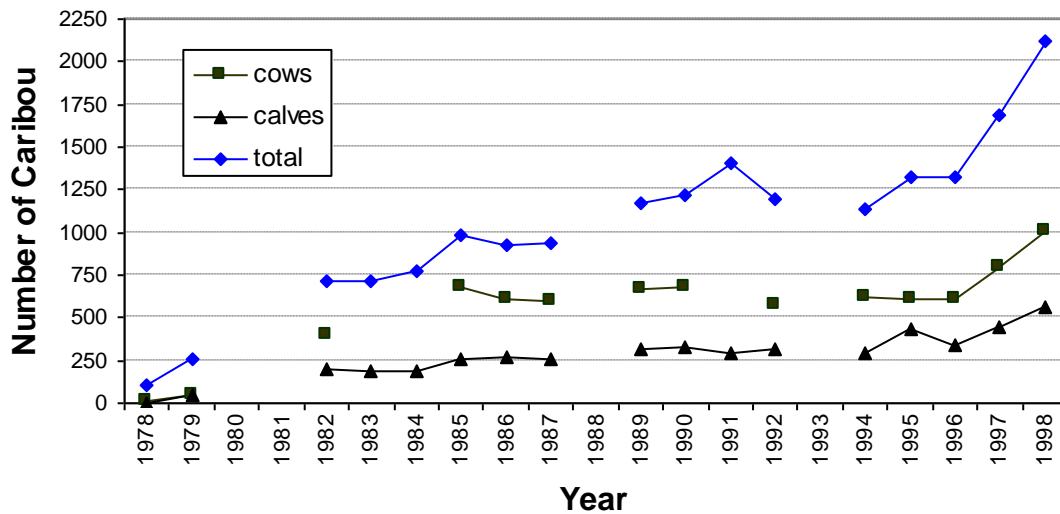


Figure 5. Summary of caribou post calving surveys for the Itcha-Ilgachuz Mountains Herd.

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). The herd is currently estimated at about 1900-2000 animals (post hunting season) with healthy calf production, a stable breeding female component and a relatively stable bull/100 cow ratio. Over the past four years June surveys have observed bull/cow ratios of approximately 35 bulls/100 cows, which is the provincial target for post season estimates (Figure 6). There may be an unaccounted for sightability bias during October surveys, resulting in lower bull/cow ratios being observed at that time (Figure 7).

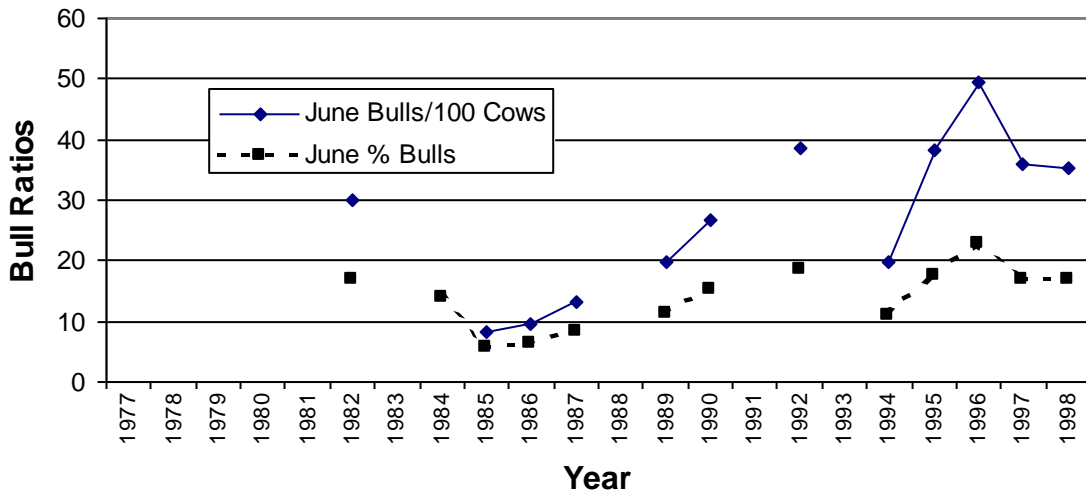


Figure 6. Summary of post calving bull ratios for the Itchas-Ilgachuz Mountains Herd for all years (1991 omitted due to small sample size).

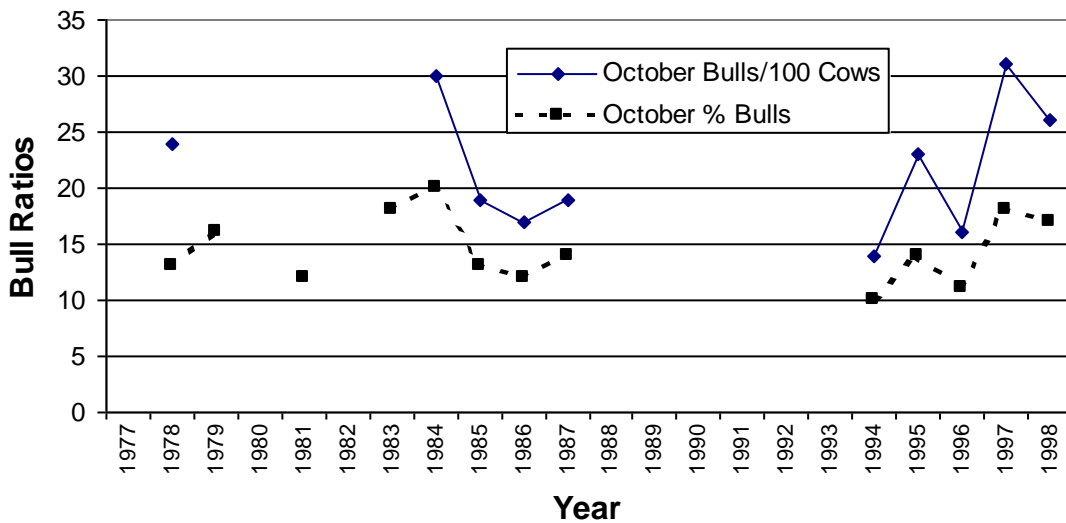


Figure 7. Summary of caribou rut surveys for the Itcha-Ilgachuz Mountains Herd detailing observed bull ratios for all years.

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 is now estimated at about 150 animals and has appeared to remain stable since the mid 1980's with a relatively high mature bull to immature bull ratio (Figure 8).

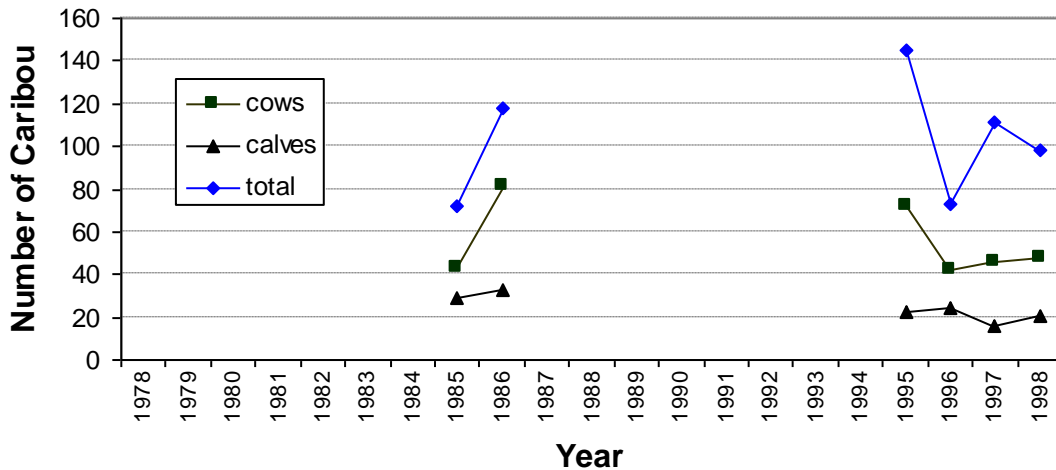


Figure 8. Summary of caribou post calving surveys for the Rainbow Mountains Herd.

During the June survey, mature females (2 years and older) 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 the results overestimate the number of reproducing females (Bergerud 1983).

When the yearling/100 adult ratios from June 1996-1998 surveys were compared to the March 1996-1998 calf/100 adults ratios, there was generally good correlation (Table 4). The exception being a substantial drop in the estimates from March 98 to June 98 in the Rainbow Herd. These findings suggest that the results from the June surveys 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 calves and yearlings/100 adults for March and June in 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
1998	14.7	13.0	7.3	2.7

Sightability corrections were made to the survey information from 1985-87 and 1996-98 to estimate total cow numbers in June within the Itcha-Ilgachuz Herd (Figure 9). Data from the 1980's included yearlings with the cow count and therefore overestimated the female breeding population. The 1996-98 estimates included only two year and older 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 generally stable to increasing population trend as found in Figure 5.

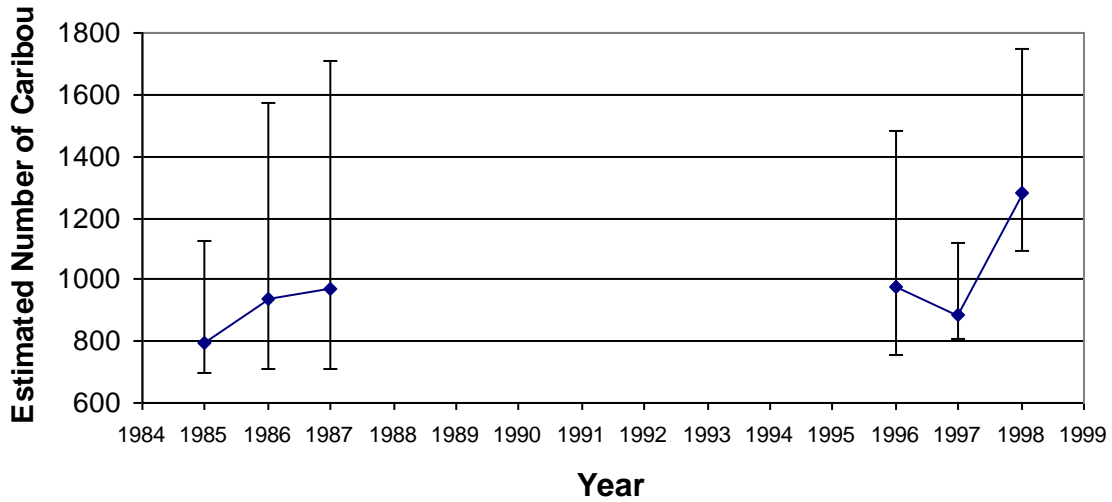


Figure 9: Estimated number of cow caribou in the Itcha-Ilgachuz Herd in June and 95% confidence limits using collared animals to correct for sightability. Estimates in the 1980's included cows and yearlings, while 1996-98 data included only cows (1985-87 estimates; Cichowski unpubl. data).

The annual migration to the alpine spring calving grounds is thought to be an anti-predator strategy by caribou to distance themselves from predators. By distancing themselves from other prey types, 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 therefore tend to seek out the highest elevations. Bulls are often the last to migrate, choosing instead to feed on higher quality forage found at lower elevations. The similar use of elevations for all sex/age groups this year (Figure 2) may have been due in part to unseasonably warm weather which contributed to early green-up in alpine areas. The average elevation of caribou locations in the June 1998 survey was 1947m, quite a bit higher than last year's average of 1917m. Data from the Environment Canada weather stations at Lunch Lake (approximately 100km SE of Anahim Lake) and Kleena Kleene (100km NE of Anahim Lake) showed temperatures 3.6°C and 3.9°C above normal for the month of May 1998 (Table 5).

Table 5. Average monthly temperatures at Lunch Lake and Kleena Kleene weather stations for April and May 1996-1998 (normal temperatures calculated from 1980-1992).

Year	Location	Av. Temp. April	Normal Temp. April	Ave. Temp. May	Normal Temp. May
1996	Lunch Lake	4.4	3.4	5.7	7.7
1996	Kleena Kleene	4.5	3.6	5.9	7.8
1997	Lunch Lake	3.5	3.4	8.3	7.7
1997	Kleena Kleene	3.9	3.6	8.8	7.8
1998	Lunch Lake	3.3	3.4	11.3	7.7
1998	Kleena Kleene	3.9	3.6	11.7	7.8

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 (Figure 7). However, in 1997 and 1998 we observed an increase in bull numbers to 31.1 and 26.4 bulls/100 cows respectively (Table 6).

Table 6. Rut survey bulls/100 cows ratios and mature bulls/100 immature bulls in 1995, 1996, 1997 and 1998.

Year	Itcha-Ilgachuz Herd			Rainbow Herd		
	Bulls/100Cows	Mat. Bulls/100 Imm. Bulls	% Calves	Bulls/100Cows	Mat. Bulls/100 Imm. Bulls	% Calves
1995	23/100	89/100	24.6%	36/100	291/100	9.0%
1996	16/100	55/100	18.2%	24/100	91/100	7.1%
1997	31/100	115/100	13.5%	27/100	175/100	2.8%
1998	26/100	91/100	17.1%	27/100	300/100	12.1%

There is no hunting season for caribou of the Rainbow Herd and the male component of the Itcha-Ilgachuz Herd is harvested under a mature bull regulation. We have limited information on the effects of sustenance hunting on this population, and there is some speculation that compulsory reporting, required in 1995-1996, was not as effective as compulsory inspection in obtaining accurate harvest values. Thus, compulsory inspections became required once again in 1997 and more accurate accounts of hunting activity have since been recorded. 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). Estimates from reported harvest values for 1995 and 1996 were 10 and 25 respectively. The 1997 and 1998 harvests were 26 and 40 bulls. As such, the annual bull harvest only represents approximately 2% of the entire population.

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 when interpreting sex ratios. In the past four years, the Itcha-Ilgachuz Herd ratio of mature bulls to immature bulls has been much lower than the Rainbow Herd (Table 6).

In the 1980's greater numbers of bulls were observed during rut surveys than post-calving surveys (Figures 6 and 7). Although bull numbers have been fairly consistent over the last 4 years, October results still show both herds below the provincial target of 35

bulls/100 cows post season. The fact that recent pre-season bull/cow ratios were substantially higher and the harvest has been relatively low may indicate some sightability bias during the rut surveys. June surveys observe more of the population and may better represent sex ratios.

Only 12.1% of the Rainbow Herd caribou observed in the October rut survey were calves, indicating a recurrence of the hypothesised predatory influence experienced in previous years (9% calves in 1995, 7% in 1996 and 2.8% in 1997; Figure 10). 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. In 1995, 1996 and 1998, calf percentages were above the 15-16% mark in the Itcha-Ilgachuz Herd for both the rut and late winter surveys (Figure 11). Similar trends were observed with radio-collared cows (Figures 12 and 13). The decrease in mortality rate following the summer is expected, as calves become less vulnerable to predation with increased size.

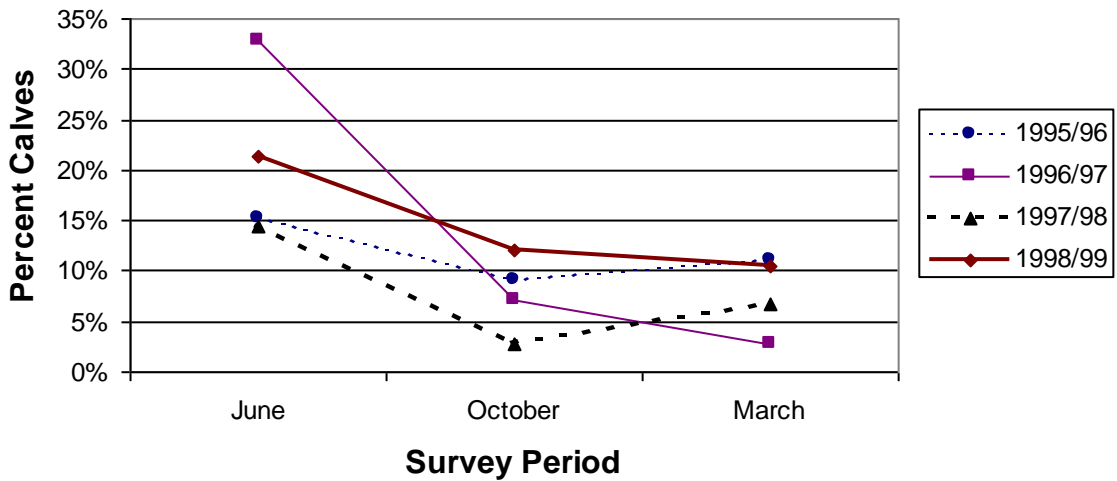


Figure 10. Summary of observed caribou calf survival for the Rainbow Mountains during the last four caribou years.

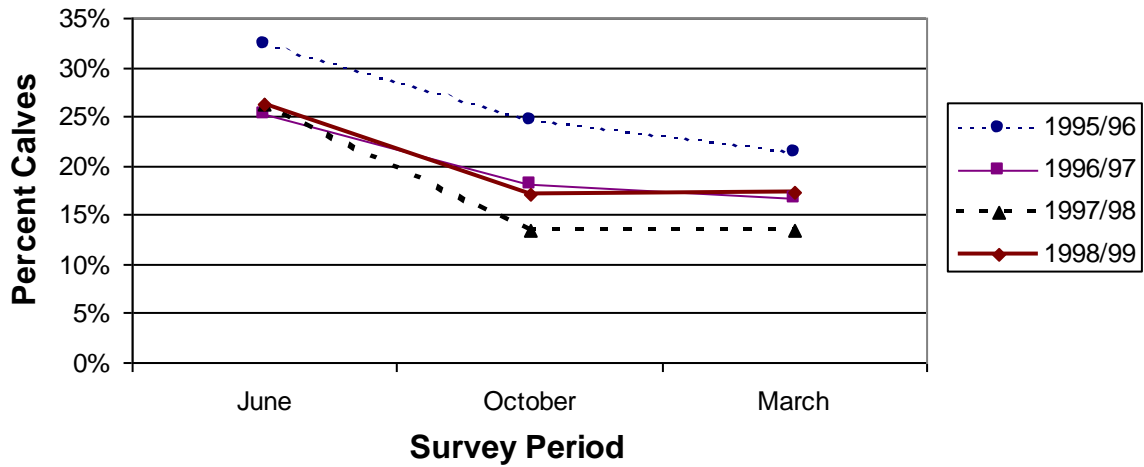


Figure 11. Summary of observed caribou calf survival for the Itcha-Ilgachuz Mountains during the last 4 caribou years.

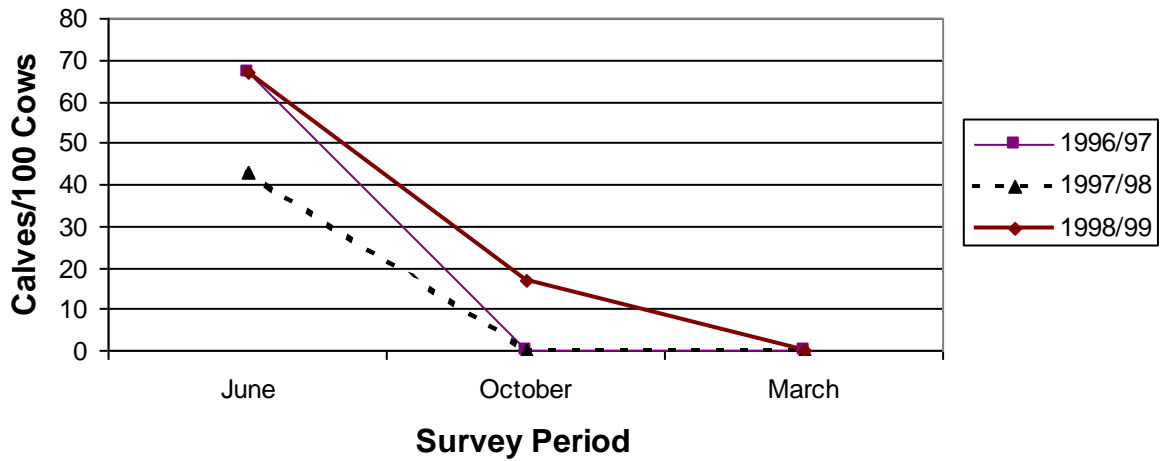


Figure 12. Calf survival ratios of radio-collared cows in the Rainbow Mountain Herd from June, October and March surveys (1996-1999).

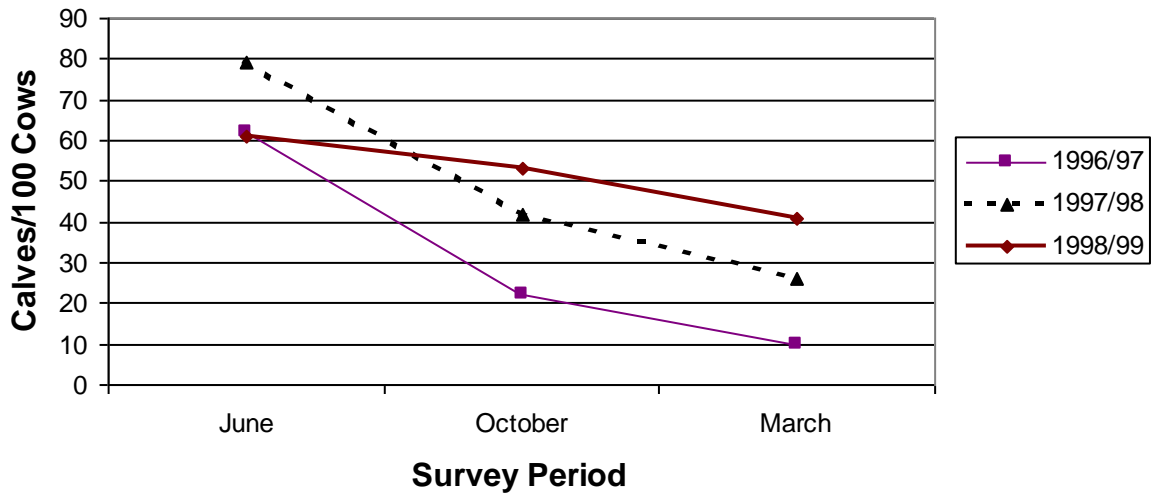


Figure 13. Calf survival ratios of radio-collared cows in the Itchas-Ilgachuz Mountains Herd from June, October and March surveys (1996-1999).

The loss of winter habitat from clear-cut 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. 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 undertaken to determine options for maintaining the population size and achieving a higher bull/cow ratio.

CONCLUSIONS

During the 1998 post calving survey a total of 2219 caribou were observed which included 1060 cows, 578 calves, 349 bulls, 4 yearling cows, 35 yearling bulls, 50 unsexed adults, and 143 unsexed yearlings. The observed calf/100 cow ratio was 55.0/100 in the Itcha-Ilgachuz Herd and 43.8/100 in the Rainbow Herd.

During the 1998 October rut survey a total of 749 caribou were observed which included 495 cows, 123 calves, 68 mature bulls and 63 immature bulls. The observed calf/100 cow ratio was 26.1/100 in the Itcha-Ilgachuz Herd and 17.6/100 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 1999 March late winter survey 309 caribou were observed, all of which were in forested habitats. The Itcha-Ilgachuz Herd calf percentage was estimated at 19.2% and the Rainbow Herd calf percentage was estimated at 10.4%.

The Itcha-Ilgachuz and Rainbow Mountains caribou populations appear to have remained relatively stable in recent years.

The calf recruitment in the Itcha-Ilgachuz Herd has appeared to be sufficient to balance adult natural mortality in the past four years. The Rainbow Herd continues to have low calf recruitment.

The Itcha-Ilgachuz and Rainbow Herds' post season bull/100 cow ratios appear to be 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, 1998

Sighting	Easting	Northing	Total	Cows	Calves	Bulls	Yrlg. Cows	Yrlg. Bulls	Unclass. Adults	Unclass. Year.
1	3 65 966	58 39 479	2	1	1					
2	3 67 716	58 41 302	74	42	24					8
3	3 72 369	58 39 837	89	67	15	6				1
4	3 73 916	58 39 134	27	14	9					4
5	3 74 440	58 39 064	3			2		1		
8	3 77 742	58 29 921	2	1	1					
9	3 75 973	58 35 398	6	3	3					
10	3 78 300	58 36 287	1	1						
11	3 76 676	58 36 745	5					5		
12	3 76 026	58 36 285	83	5		55	1			22
13	3 76 218	58 37 080	29	1		25				3
14	3 75 797	58 37 699	51	2		26				23
15	3 79 820	58 38 238	4	2	2					
16	3 75 786	58 41 419	220	149	59	3				9
17	3 77 588	58 43 543	132			110		22		
18	3 75 604	58 43 357	4			4				
19	3 76 225	58 45 529	2	1	1					
20	3 89 321	58 49 956	1			1				
21	3 74 370	58 42 433	61	5	1				50	5
22	3 74 096	58 41 241	127	76	49					2
23	3 72 740	58 41 623	5			1		4		3
24	3 71 170	58 41 042	48	30	15					
25	3 70 593	58 40 907	2	1	1					
26	3 65 337	58 45 351	4	2	2					
27	3 66 333	58 43 474	13	8	5					
Total Caribou			995	411	188	233	1	32	50	80

ILGATCHUZ MOUNTAINS CARIBOU SURVEY - JUNE 20, 1998

Sighting	Easting	Northing	Total	Cows	Calves	Bulls	Yrlg. Cows	Yrlg. Bulls	Unclass. Adults	Unclass. Year.
1	3 53 761	58 40 196	1			1				
2	3 47 502	58 43 854	8	5	2					1
3	3 47 381	58 46 177	18	9	8					1
4	3 49 474	58 49 276	151	88	63					
5	3 49 415	58 48 564	19	11	8					
6	3 46 609	58 44 040	19	11	6					2
7	3 45 378	58 43 685	15	11	2					2
8	3 43 589	58 45 051	4				2	2		
10	3 47 813	58 52 495	6	2	1	3				
11	3 46 832	58 51 789	3	3						
12	3 46 240	58 51 423	7	3		4				
13	3 45 088	58 51 706	2	1	1					
14	3 45 879	58 52 970	3	2	1					
15	3 47 150	58 55 574	6			6				
16	3 45 161	58 53 195	2	1	1					
17	3 45 941	58 55 302	211	123	86					2
18	3 44 076	58 53 559	86	5	1	57	1			22
19	3 43 818	58 51 918	51	26	24					1
20	3 43 068	58 51 548	2	1	1					
21	3 43 274	58 52 555	4	2	2					
22	3 41 980	58 53 704	428	254	133	16				25
23	3 41 498	58 52 857	31	17	13					1

ILGATCHUZ MOUNTAINS CARIBOU SURVEY - JUNE 20, 1998

Sighting	Easting	Northing	Total	Cows	Calves	Bulls	Yrlg. Cows	Yrlg. Bulls	Unclass. Adults	Unclass. Year.
26	3 43 628	58 51 044	2	1	1					
27	3 42 215	58 48 071	2	1	1					
29	3 40 905	58 47 991	10	5	2					3
30	3 44 294	58 43 963	15	8	7					
31	3 43 382	58 41 936	1	1						
32	3 43 221	58 41 064	2	1	1					
33	3 45 291	58 43 636	2	1						1
34	3 46 861	58 42 921	2	1	1					
35	3 47 403	58 45 026	2	2						
36	3 48 082	58 42 856	4	3	1					
37	3 47 956	58 43 151	7	2	2	2				1
Total Caribou			1126	601	369	89	3	2	0	62

RAINBOW MOUNTAINS CARIBOU SURVEY - JUNE 21, 1998

Sighting	Easting	Northing	Total	Cows	Calves	Bulls	Yrlg. Cows	Yrlg. Bulls	Unclass. Adults	Unclass. Year.
2	3 10 779	58 36 796	10	6	4					
8	2 97 658	58 34 176	3	2		1				
9	2 97 108	58 35 151	1			1				
11	6 85 310	58 25 097	6	3	3					
13	6 83 403	58 30 401	8	4		3				1
14	6 94 711	58 29 230	10			10				
15	7 00 778	58 29 178	7	1		6				
16	7 03 161	58 27 957	9	2		6		1		
17	3 04 476	58 35 024	5	3	2					
18	3 07 996	58 34 307	2	2						
19	3 09 078	58 33 111	1	1						
20	3 11 272	58 31 840	1	1						
21	3 14 785	58 37 167	17	11	6					
22	3 15 644	58 43 594	2	2						
23	3 10 329	58 46 954	14	9	5					
27	3 04 056	58 47 740	2	1	1					
Total Caribou			98	48	21	27	0	1	0	1

Total Caribou for the Itcha Mountains

	995	411	188	233	1	32	50	80
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Total Caribou for the Ilgachuz Mountains

	1126	601	369	89	3	2	0	62
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Total Caribou for the Rainbow Mountains

	98	48	21	27	0	1	0	1
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Total Caribou for the Itcha and Ilgachuz Mountains

	2121	1012	557	322	4	34	50	142
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Total Caribou for the Itcha, Ilgachuz and Rainbow Mountains

	2219	1060	578	349	4	35	50	143
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APPENDIX 2: RESULTS OF STATISTICAL TESTS

SCHEFFE'S TEST

Yearling bulls and cows lumped with unclassified yearlings

GROUP	Cows with calves	Cows w/o calves	Bulls	Adult Unclass.	Yearlings
MEAN ELEVATION	1935	1951	1955	1935	1960
N	584	477	349	50	182
SIGNIFICANT DIFFERENCE	A	A	A	A	A

Degrees of Freedom: 1637 (difference due to omission of the classified cows)

Alpha: 0.05

Minimum Significant Difference: 31.994

F-Value: 2.3774

SCHEFFE'S TEST

Yearling bulls separated from unclassified yearlings (cows omitted)

GROUP	Cows with calves	Cows w/o calves	Bulls	Adult Unclass.	Yrl. Bulls	Yrl. Unclass.
MEAN ELEVATION	1935	1951	1955	1935	2010	1947
N	584	477	349	50	35	143
SIGNIFICANT DIFFERENCE	B	B	B	B	A	B

Degrees of Freedom: 1632

Alpha: 0.05

Minimum Significant Difference: 43.683

F-Value: 2.2196

**APPENDIX 3: OCTOBER RUT SURVEY RESULTS
ITCHA FLATS AND MOUNTAINS CARIBOU SURVEY-OCT. 19, 1998**

Sighting#	Easting	Northing	Total	Cows	Calves	mat.bulls	imm.bulls	unclass
1			1	0	0	1	0	
2			26	17	7	0	2	
3			1	1	0	0	0	
4			23	16	4	2	1	
			22	15	2	1	4	
5			37	28	7	1	1	
6			27	20	5	1	1	
7			12	8	2	1	1	
8			10	7	2	1	0	
9			14	12	2	0	0	
10			12	9	1	1	1	
			12	7	4	0	1	
11			7	3	1	1	2	
12			8	7	0	1	0	
13			10	10	0	0	0	
			114	76	15	7	16	
14			5	3	2	0	0	
15			3	3	0	0	0	
16			3	1	1	0	1	
17			7	4	2	1	0	
			3	2	1	0	0	
18			4	3	1	0	0	
19			3	2	0	1	0	
20			15	8	3	4	0	
22			24	13	6	5	0	
23			32	24	4	3	1	
24			3	1	1	0	1	
			1		0	1	0	
25			52	33	6	8	5	
26			19	12	6	1	0	
27			10	6	2	1	1	
28			4	4	0	0	0	
TOTAL			524	355	87	43	39	0

ILGACHUZ MOUNTAINS CARIBOU SURVEY - OCT.19, 1998

Sighting#	Easting	Northing	Total	Cows	Calves	mat.bulls	imm.bulls	unclass
30			6	2	1	1	2	
31			1	1	0	0	0	
32			18	9	3	2	4	
			3	3	0	0	0	
33			32	20	6	2	4	
34			14	9	4	0	1	
35			41	21	8	5	7	
36			3	1	1	0	1	
TOTAL			118	66	23	10	19	0

RAINBOW MOUNTAINS CARIBOU SURVEY - OCT.20, 1998

Sighting#	Easting	Northing	Total	Cows	Calves	mat.bulls	imm.bulls	unclass
1			17	11	3	2	1	
5			39	29	5	3	2	
6			11	10	1			
7			40	24	4	10	2	
TOTAL			107	74	13	15	5	0

Total caribou for the Itcha Flats and the Itcha and Ilgachuz Mountains

	642	421	110	53	58	0
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Total caribou for Itcha Flats, and the Itcha, Ilgachuz and Rainbow Mountains

	749	495	123	68	63	0
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APPENDIX 4: LATE WINTER SURVEY RESULTS

FOREST AND ITCHA-ILGACHUZ MOUNTAINS CARIBOU SURVEY - MARCH 16 AND 17, 1999

Sighting#	Easting	Northing	Total	Adults	Calves	Collared female	Caribou Home Range
1A			9	9	0	150.701	Rainbow
2A			2	2	0		Rainbow
3A			12	10	2	150.581/150.522	Rainbow
4A			7	6	1		Rainbow
5A			9	9	0	150.602	Rainbow
6A			8	6	2	150.500	Rainbow
10A	344988	5820829	1	1	0	150.441	Rainbow
1	373635	5855600	8	6	2	150.590	Itcha-Ilgachuz
2	383860	5845716	6	4	2	150.050	Itcha-Ilgachuz
3	407177	5854057	11	8	3	150.641	Itcha-Ilgachuz
4	408035	5850558	9	8	1		Itcha-Ilgachuz
5	418979	5850591	4	3	1	150.040	Itcha-Ilgachuz
6	418175	5850169	5	4	1	150.020	Itcha-Ilgachuz
7	410480	5832585	1	1	0	150.621	Itcha-Ilgachuz
8	400989	5831514	10	8	2	150.612	Itcha-Ilgachuz
9	399677	5831742	3	2	1	150.826	Itcha-Ilgachuz
10	396396	5829147	10	9	1	150.321	Itcha-Ilgachuz
11	390079	5824489	11	9	2	150.119	Itcha-Ilgachuz
12	386100	5822140	3	2	1	150.531	Itcha-Ilgachuz
13	390324	5812271	5	4	1	150.561	Itcha-Ilgachuz
14	401328	5818504	14	13	1	150.030	Itcha-Ilgachuz
15	403610	5816398	13	9	4		Itcha-Ilgachuz
16	404644	5814547	15	14	1	150.549/150.816	Itcha-Ilgachuz
17	406448	5816369	5	5	0	150.571	Itcha-Ilgachuz
18	403530	5834054	15	15	0	150.754	Itcha-Ilgachuz
19	402722	5830937	9	7	2		Itcha-Ilgachuz
20	402706	5831323	17	15	2		Itcha-Ilgachuz
21	403832	5817527	6	5	1	150.464	Itcha-Ilgachuz
22	408967	5811600	9	6	3		Itcha-Ilgachuz
23	408174	5809618	24	21	3	150.181/150.000	Itcha-Ilgachuz
24	406680	5805424	11	7	4	150.807	Itcha-Ilgachuz
25	400297	5787371	7	7	0	150.470	Itcha-Ilgachuz
26	406252	5789184	13	12	1	150.010	Itcha-Ilgachuz
27	388327	5788280	17	12	5	150.662	Itcha-Ilgachuz
TOTAL			309	259	50		

**Total for the Rainbow Mountains
Caribou**

Forest	48	43	5
Alpine	0	0	0
Total	48	43	6

Total for the Itcha and Ilgachuz Caribou

Forest	261	216	45
Alpine	0	0	0
Total	261	216	45

APPENDIX 5: ANNUAL BULL HARVEST

Year	Number of Bulls Harvested
1984 (last year before mature bull season)	47
1985	17
1986	9
1987	30
1988	29
1989	32
1990	24
1991	52
1992	37
1993	31
1994	24
1995*	10
1996*	25
1997	26
1998	40
Average	29
Standard Deviation	12

*Numbers estimated from reported harvest values