

Population Status of the Itcha-Ilgachuz Northern Caribou Herd, 2014-2015



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Abstract

The Itcha-Ilgachuz northern caribou herd was surveyed in June 2014 to assess population trends, sex ratios, and early calf recruitment. A radio-collaring program implemented in 2011 provided a collared sample of both adult female (n=19) and male caribou (n=11) for mark-resight population estimation; at the time of the survey 17 collared cows and 6 collared bulls were within the defined survey area. The 2014 post-calving survey resulted in a survey count of 685 caribou: 399 cows, 226 calves, 46 bulls, 12 yearling, and 2 unsexed adults. This was the lowest caribou count during a post-calving survey since the early 1980s. An additional 266 caribou (106 cows, 53 calves, 99 bulls, and 8 yearlings) were observed post-survey, resulting in a minimum count of 951 caribou. Calves represented 33.0% of the total survey count with 56.6 calves: 100 cows; for the 19 collared cows, a ratio of 61.2 calves: 100 cows was observed. Bull ratio using minimum count data was 28.7 bulls: 100 cows. Survey estimate for adult cows was 753 (535-1319) and adult males was 137 (66-696). The 2014 population estimate for the Itcha-Ilgachuz herd is 1350 caribou. The long-term population trend is *stable* (1994-2014) with change in population size of -11.1%. Although the 20 year trend suggests stability, this does not accurately represent the variability observed in caribou numbers. The Itcha-Ilgachuz caribou herd experienced population growth in the late 1990s and early 2000s with the population increasing from approximately 1500 animals to 2800 between 1995 and 2003. Since then, numbers have steadily declined and the population appears to be similar in size to that of the early 1990s. Change in estimated population size over the past 10 years has averaged -6.4% per annum, consequently the short term population trend is *decreasing* (2003-2014) with an overall change in population size of 51.8%. The current trend of surveys done in 2012 and 2014 is *down* with a change in caribou numbers of -15.6%.

Contents

Abstract.....	2
Introduction.....	4
Methods.....	4
Survey Area.....	4
Survey Technique.....	4
Data Analysis	5
Results.....	7
Survey Conditions	7
GPS and Radio-Collars	8
Survey Results.....	9
Survey Cost	10
Discussion.....	10
Survey Area Expansion.....	10
Sightability	11
Recruitment.....	12
Sex Ratios.....	13
Population Trends	14
Conclusions.....	15

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Introduction

As part of ongoing monitoring, the Itcha-Ilgachuz northern caribou herd was surveyed in June 2014 to assess the population status. When the current Itcha-Ilgachuz caribou radio-collaring program was implemented in 2011 the intent was to investigate distribution and habitat use, but also provide a collared sample of both adult female and male caribou for robust population estimation. Objectives of the 2014 post-calving survey were to:

- expand the survey area to assess caribou re-distribution on the landscape,
- obtain a total count with classification,
- assess bull:cow ratios and calf recruitment,
- apply mark-resight methodology to generate survey estimates of adult female and adult male caribou, and
- assess population status and trend.

Methods

Survey Area

In 2014, the total survey area was increased in response to concern that caribou have changed their distribution on the landscape and that historic survey boundaries may not be representative of caribou distribution during post-calving. Current telemetry data has shown shifting distribution and expansion of known caribou range (Cichowski and McLean 2013, 2015), while recent population surveys conducted within historic survey boundaries have suggested a decline in caribou numbers (Dodd 2014a; Freeman, 2010; Roorda & Dielman, 2007). Since the 1990s the survey area has been limited to high strata habitat and lower elevation open meadow complexes where under suitable conditions animal sightability is high; this included alpine and parkland habitat in the Itcha and Ilgachuz mountain ranges, the Itcha Flats wetland complex, and the larger wetlands between the Itcha and Ilgachuz Mountains. During the 2009 survey in response to low bull numbers being observed, the survey area was expanded to include meadows and cut blocks south of the Itcha Mountains, specifically in the Punkutlaenkut Lake and Satah Mountain areas. In 2014 the survey area was further expanded to include the meadow system north and northeast of the Itcha Mountains, bounded to the west by Shag Creek and to the east by the headwaters of the Coglistiko River (hereafter referred to as the Coglistiko Meadows). The Coglistiko meadows survey area was comprised of meadow and wetlands interspersed amongst lodgepole pine forest. Additional time was also spent searching for caribou in the Satah Mountain area and south to Holtry Creek.

Survey Technique

In 2014 a portion of the adult females and adult males in the Itcha-Ilgachuz caribou herd had GPS or VHF collars, thereby enabling surveyors to utilize mark-resight methods to generate survey estimates. The post-calving caribou survey was conducted in two stages: a pre-survey telemetry fixed-wing flight followed by rotary survey using total count for absolute abundance methods (Resource Information Standards Committee, 2002). The purpose of the telemetry flight was to locate all collared caribou, determine the number of radio-collars within the defined survey area, and identify any collars on mortality signal. For the rotary survey mountain complexes were flown in a counter clockwise manner to allow observers on the left side of the

helicopter to scan the open habitat for caribou; several of the wider ridges and meadows required more than one pass for complete visual coverage. The observer in the back right-hand seat provided additional coverage when necessary, particularly in the flatter and forested terrain. Caribou group locations and flight lines were recorded in UTM coordinates using a handheld GPS unit to ensure complete survey area coverage and allow comparison over survey years.

Caribou were classified into the following categories: adult cow, adult bull, yearling cow, yearling bull, calf, unsexed adult, unsexed yearling and unclassified. Unclassified animals were caribou whose age and sex could not be determined; thus, the unclassified category may include adults, yearlings or calves. When a collared caribou was visually detected within a group of caribou surveyors classified as cow or bull, identified the individual animal by ear tag color combination, and then verified the collar radio-frequency. If the collared caribou was a cow, presence of a calf was recorded: a calf in close proximity and following a collared cow's movements closely was recorded as a cow-calf pair. All collared caribou not observed during the defined survey period, including those outside the defined survey area, were relocated post-survey using radio-telemetry to assess calf presence and confirm herd affiliation to specific mountain ranges.

Mountain goats were also inventoried using total count for absolute abundance methods; results of the goat inventory were not included in this report.

Data Analysis

For the Itcha-Ilgachuz caribou post-calving survey, population measures are defined in Table 1.

Table 1. Definitions of population measures calculated from the Itcha-Ilgachuz post-calving survey data

Survey count	The total number of caribou observed during the defined survey period and defined survey area for a given classification category.
Survey estimate	An adjustment of the survey count using mark-resight statistical methodology (e.g. Lincoln-Petersen Index; Joint Hypergeometric Estimator) or a sightability correction factor. Correction factors are derived through ratios of observed collared animals and total available collared animals. Confidence intervals accompany survey estimates when calculated using mark-resight statistical methodology.
Population estimate	An estimate based on subjective assessment of the survey count, post-survey observations, survey estimate, and recent survey trends. Error cannot be quantified for the population estimate.
Minimum count	The total number of caribou observed during the defined survey period and defined survey area, plus any caribou observed post-survey. Post-survey observations are caribou missed (i.e., not counted) during the defined survey period. Minimum count may be presented instead of survey or population estimates if the outcome of the survey is viewed with low confidence.

Survey estimates with 95% confidence intervals for adult females and adult males were derived using the Joint Hypergeometric Estimator (JHE) Mark-Resight Population Estimation for Closed

Population from the NoREMARK software (White & Garrot 1996). For a 2 sighting occasion, comprised of a single capture event followed by a single resight event, the JHE is reduced to the 2 sample Lincoln Petersen index for small sample sizes (Chapman 1951):

$$N = \frac{((M+1)(C+1))}{(R+1)} - 1$$

where N is the survey estimate, C is the total caribou observed during the survey, M is the number of marked caribou available, and R is the number of marked caribou seen. These measures are limited to the defined survey period and the defined survey area. A combined survey estimate of the adult female and males with 95% confidence intervals was presented as the sum of the two survey estimates with combined error (i.e., the sum of the NoREMARK JHE estimates, bounded by the sum of each of the lower and the upper confidence intervals). Survey estimates for calf, yearling, unsexed adult¹ and unclassified counts were derived by adjusting each survey count with a surrogate sightability metric: calf counts were adjusted using sightability of collared adult females while yearling, unsexed adult, and unclassified counts were adjusted using the pooled sightability of female and male collared adult caribou. As such, error could not be quantified for calves, yearlings, unsexed adults or unclassified estimates. Total survey estimate was the sum of survey estimates for all classification categories.

The 2014 population estimate was the sum of all sightability corrected caribou observations from the defined survey period and defined survey area, rounded up to the nearest multiple of twenty-five. Post-survey counts of adult females and adult males were excluded because these counts would have been "accounted" for using the mark-resight sightability adjustment. Post-survey counts of yearlings, calves and unclassified caribou were also excluded as these would have also been accounted for by adjustment using the sightability surrogate metrics. Confidence intervals (i.e., error) could not be quantified for the population estimate. Historically, the population estimate was an adjusted number based on subjective assessment of survey counts, survey estimates, and population trend.

Population trend analysis included assessment of long-term and short-term trends based on definitions adapted from Thomas and Gray (2002). Long-term trend was defined as *declining* or *increasing* by a greater than 20% change in population size over three generations of caribou (1 generation is ~6.7 years) or 20 years. A long term change less than 20% was defined as *stable*. A trend denoted as *indiscernible* indicates no data or a lack of data for the designated time frame, such that the available data was insufficient to draw confident conclusions upon. Short-term changes in caribou numbers can vary considerably due to influence of survey conditions, weather and predators; therefore, for periods shorter than 20 years, a decrease was not inferred on a pro-rated average of 1% change per year. Rather, short-term trend assessment included a temporal

¹ For data consistency between survey years, unsexed adult counts were not redistributed into adult female and adult male categories using bull: cow ratios, as was done in the analysis by Wilson 2012. Redistributing unsexed adults is not a preferred data analysis methodology for the caribou post-calving survey. Observed bull: cow ratio may not accurately represent the composition of unsexed adult groups because 1) groups with unsexed adults reflect the surveyor's inability to classify individual animals due to variability in sightability by habitat type and 2) the male and female component of the herd utilize different habitat types during the post-calving survey. Cow-calf groups are primarily located in high elevation sub-alpine and alpine habitat, while the bull and non-parous female groups are located in low elevation meadow and forested habitat. In the meadow and forested habitat, sightability is lower, groups are more likely to contain unsexed adults, and there is a greater male component present.

scaling, such that an average change in population size of more than 3% per year over 10 years was defined as a *decreasing* or *growing* population.² A current trend over the past 2 years of *up* or *down* was defined as a change in population size greater than 10%.

Other population metrics calculated using survey count data included observed percent calves, calf:cow ratio, yearling:adult ratio and bull:cow ratio. Percent calves was the calf survey count divided by total survey count. The post-calving bull:cow ratio was calculated by dividing adult bulls by adult cows; yearling cows and yearling bulls were excluded due to lower confidence in yearling classification. Over the years surveyor effort towards classification of yearlings has varied due to survey conditions, caribou group sizes, and surveyor experience. The yearling classification counts are biased low, due in part to yearlings being of similar size or slightly smaller than adults at the time of the post-calving survey, and in part to habitat segregation of the female and male herd components. Yearlings may be misclassified as adults and/or are often assumed to be yearling cows if within a large group of cow-calves, or yearling bulls if observed with adult bulls. Survey count data metrics (i.e., percent calves and bull:cow ratio) were evaluated against minimum count data metrics to assess whether survey and post-survey observations of caribou groups were demographically skewed by age or sex. Estimated percent calves was derived by dividing calf survey estimate by total survey estimate. Estimated bull:cow ratio was derived by dividing the survey estimate for adult males by the survey estimate for adult females.

Results

Survey Conditions

The pre-survey telemetry flights were completed over 2 days on June 16-17, 2014 by Larry Davis (Davis Environmental Ltd) and Jim Judeisch (pilot, Lawrence Aviation); search efforts focussed on relocating the VHF radio-collars while satellite data provided coordinates for Iridium GPS collared caribou. The rotary survey followed immediately after and was completed over 4 days from June 18-21, 2014 (Map 1, Appendix 1). The rotary crew included Pat Dielman (navigator), Larry Davis (rear left observer and telemetry), Becky Cadsand (rear right observer) and pilot Steve Goodliffe (pilot, Highland Helicopters). Visibility varied during the survey as small weather systems moved in and out of the area but in general, survey conditions and visibility were considered good. The Itcha Mountains, including meadow complexes around Itcha Lake and east of the mountain range were surveyed on June 18; skies had 20-50% light and high cloud cover with variable 5-10km/hr winds. Satah Mountain area and the Coglistiko Meadows north of the Itchas were surveyed on June 19; conditions were moderate with low ceilings in the morning, lifting to high ceiling and some sun in the afternoon and negligible wind. The weather soured a bit on June 20 during survey of the Ilgachuz Mountains, with scattered cloud and increasing snow flurries in the afternoon; winds upwards of 30 km/hr in the alpine resulted in some modification of flight route when alpine survey had to be temporarily delayed and the flight rerouted to some lower elevation wetland survey while conditions improved.

² Methodology used in previous surveys defined a short-term trend as decreasing or growing with respect to a >20% change in population calculated over one generation length (1 gl) or 7 years; with a ~stable short-term trend as any change in population less than 20% .

Weather improved for the final day on June 21 as light winds and minimal cloud cover provided excellent survey conditions for the remaining area around North Hill.

GPS and Radio-Collars

Thirty-five caribou (11 males and 24 females) had active collars at the time of the post-calving survey; of these, 19 females and 11 males were designated as Itcha-Ilgachuz caribou, 4 females were Rainbow Mountain caribou, and 1 female was affiliated with the Charlotte Alplands herd (Appendix 2). For Mark-Resight survey methodology, only the collared caribou within the defined survey area were considered available for the survey. In 2014 the marked animals within the defined survey area included 17 cows and 6 bulls; the remaining Itcha-Ilgachuz caribou (2 cows and 5 bulls) were outside the survey area and were excluded from the analysis (Table 2). Herd affiliation of caribou was determined by caribou fidelity to calving grounds during previous June post-calving surveys, but was also confirmed during the 2014 survey. Historic and current telemetry data has shown that caribou have fidelity to calving grounds and generally calf in the same mountain range, however some collared caribou have been observed to calf in different mountain ranges over the years. Recent telemetry recorded a collared cow calving in the Rainbow Mountains in 2012, calving in the Charlotte Alplands in 2013, and returning to calve again in the Rainbows in 2014.³

Table 2. Radio-collared caribou in the Itcha-Ilgachuz, Rainbow Mountains and Charlotte Alplands caribou herds in June 2014.

Collared Caribou	Itcha-Ilgachuz		Rainbow ^a		Charlotte Alplands ^a	
	Female	Male	Female	Male	Female	Male
Total # collared caribou	19	11	4	0	1	0
# marked available for survey	17	6	0	0	0	0
# marked seen during survey	9	2	0	0	0	0
# collared cows with calf	12	---	2	---	1	--
Calves per 100 collared cows ^b	(12/19) * 100 = 61.2		-----		-----	

^a Rainbow Mountain and Charlotte Alplands herds were not part of the post-calving survey, but the collared animals were relocated after the Itcha-Ilgachuz survey to assess calf presence.

^b Calves per 100 collared cows uses all collared cows within a herd; due to small collar sample size for Rainbow and Charlotte Alplands herds, the metric may not be reliable.

Surveyors also required knowledge of all potential collars deployed on caribou in the event that a non-working collar was observed during counts. Three deployed collars had non-working, intermittent or undetected VHF signal; these collars were considered ‘fate unknown’ at the time of the survey and were not considered part of the sample available for the Mark-Resight analysis.⁴ In addition to the fate unknown collars, there was potential for surveyors to observe caribou with ear tags but no collar. These caribou may have had a GPS collar self-release or were recaptured to remove a non-functioning collar; in either case, ear tags may still be intact.⁵

³ Caribou ID 33 (151.152)

⁴ Caribou, fate unknown: Caribou ID 19 (150.520), ID 34 (150.223), & ID 40 (150.703)

⁵ Caribou recaptured and collar removed, but may still have ear tags intact: Caribou IDs 36, 38, 41, 44, & 48

Survey Results

A total of 685 caribou were counted during the June 2014 survey (Table 3). Although survey conditions were considered good, the sightability for collared caribou was relatively low at 52.9% for adult cows and 33.3% for adult bulls. An additional 266 caribou were observed post-survey using radio-telemetry to locate missed collared caribou, bringing the minimum count to 951 caribou. Twice as many bulls were observed during post-survey telemetry as were observed during the defined survey period and survey area. The bull ratio using minimum count data was 28.7 bulls: 100 cows. Calves represented 33.0% of the total survey count with an observed calf ratio of 56.6 calves: 100 cows.

The survey estimate for adult cows was 753 (535-1319) and 137 (66-696) for adult bulls (Appendix 3); when pooled, the survey estimate for adult caribou was 809 (201-2015). The total survey estimate, when all classification categories were adjusted for sightability was 1346 caribou. The 2014 population estimate for the Itcha-Ilgachuz herd was 1350 caribou.

Table 3. Survey count, survey estimates, population estimate and population parameters for the June 2014 Itcha-Ilgachuz caribou post-calving survey.

Itcha-Ilgachuz Caribou Survey	Adult Cows	Adult Bulls	Yearlings	Calves	Unsexed Adults	Unclassified	Total
Caribou observed during survey	399	46	12	226	2	0	685
Caribou observed post-survey	106	99	8	53	0	0	266
Minimum Count	505	145	20	279	2	0	951
Total observed during survey (C)	399	46					
Marked seen (R)	9	2					11
Marked Available (M)	17	6					23
Sightability Correction Factor	0.529	0.333	0.478*	0.529 [†]	0.478*	0.478*	0.478
Survey Estimate	753	137	25	427	4	0	1346
95% Confidence Interval	535-1319	66-696	---	---	---	---	---
Survey Estimate (pooled adults)	890 (601-2015)						
Population Estimate	1350						
Observed percent calves						226/685=	33.0%
Observed calf: cow ratio						226/399=	56.6:100
Observed yearling: adult ratio						12/445=	2.7:100
Observed bull: cow ratio						46/399=	11.5:100
Minimum count percent calves						279/951=	29.3%
Minimum count calf: cow ratio						279/505=	55.2:100
Minimum count Bull: cow ratio						145/505=	28.7:100
Estimated percent calves						427/1346	31.7%
Estimated bull: cow ratio						137/753=	18.2:100

* Surrogate Sightability Correction Factor for yearlings, unsexed adults and unclassified is the pooled collared cow and bull sightability

† Surrogate Sightability Correction Factor for calves is the collared cow sightability index

Survey Cost

Costs for the 2014 post-calving survey were summarized in Table 4. For aerial inventory the Itcha Mountains required 7.9 hours, Satah Mountain and Coglistiko Meadows 8.3 hours, Ilgachuz Mountains 8.1 hours, survey clean-up around North Hill and remaining post-survey telemetry took 3.2 hours. Funding was provided by Ministry of Forests, Lands and Natural Resource Operations through the Land Based Investment Strategy - Big Game Inventory Fund (\$30,000) and regional base funds (\$6,825).

Table 4. Survey costs for the June 2014 Itcha-Ilgachuz caribou post-calving survey.

Activity	Hours	Total Cost
Fixed-wing charter (pre-survey telemetry)	14.6	\$5,986.00
Rotary charter	27.5	\$ 25,963.60
Contractor for telemetry services	---	\$3,060.00
Flight Watch Services through Cariboo Fire Centre ^a	3.2	\$ 200
Expenses- Accommodation, Meals & Travel	---	\$1,615.68
Total		\$36,825.28

^e cost estimated

Discussion

Population assessment of the Itcha-Ilgachuz caribou herd was undertaken in mid-June, approximately two weeks following calving season to optimize survey conditions and caribou sightability. At this time, adult and yearling bull groups are taking advantage of the early green-up in lower elevation forest, wetland, and open meadow habitat while cow-calf groups are primarily located in the alpine and have not yet formed large post-calving aggregations.

Survey Area Expansion

Recent expansions to the Itcha-Ilgachuz survey area were undertaken to assess whether a portion of the caribou population was being overlooked during the post-calving inventory. The high-strata areas were surveyed as per usual, but additional survey effort was put towards low elevation habitat. Sightability of caribou in the Coglistiko Meadows was poor; this area was comprised of open meadow and wetlands amongst dense lodgepole pine forest. The trees affected by the Mountain Pine Beetle (MPB) epidemic since 2000 were in grey phase of standing dead trees with needles dropped but lichen remaining on the branches. From the air, surveyors found it difficult to visually detect caribou in the MPB grey phase forested habitat because lichen on the trees created darkness and obstructed line of sight. From a surveyor perspective, caribou sightability in this phase of MPB forest was similar to that of a green forest of dense pine. For areas affected by wildfire, sightability was better because the lichen and needles had burned leaving a landscape of standing tree sticks and fallen trees; however in recent burns, the habitat suitability for caribou is lessened as lichen food source is reduced or destroyed. Telemetry data has shown caribou utilizing habitat outside of previously known range (Young and Roorda 1998, Cichowski 2013, 2014); as caribou spread out on the landscape, forest harvest areas may become a source of food for caribou. Early green-up of cut blocks may decrease the need for caribou to

aggregate in the meadow systems around the Itcha-Ilgachuz Mountains where they have historically been observed during the post-calving survey.

Although caribou were observed in some of the expanded survey areas, the search effort and cost required to locate animals in forested habitat may not be warranted if i) surveyors confidence in sighting, counting and classifying caribou is low and ii) the additional search effort does not increase the survey count substantially. If caribou distribution on the landscape necessitates survey area expansion, it would be practicable to target high caribou suitability habitat that favours sightability and high-grade the open meadow, wetlands and cut blocks in low elevation forested habitat; updated habitat suitability mapping using recent telemetry data may assist in identifying these areas. Survey of forested areas affected by wildfire adjacent to the Itcha and Ilgachuz Mountains may also be considered during spring green-up.

Sightability

Caribou numbers have been decreasing since 2003. The 2014 survey count of 685 caribou was the lowest caribou count during a post-calving survey since the early 1980s (Figure 1; Appendix 4); however, sightability for collared caribou was relatively low at 52.9% for adult cows and 33.3% for adult bulls. In comparison, sightability during the June 2012 survey was 66.7% for collared cows and 50.0% for collared bulls.⁶ Average sightability of collared cow caribou during post-calving surveys conducted between 1996 and 2003 was 75.9%. No bulls were collared prior to 2012, thus information on bull sightability for the Itcha-Ilgachuz caribou herd is limited. Sightability of caribou often varies between survey years and is influenced by survey timing, survey conditions, differences in female and male caribou habitat selection and survey crew experience. Sightability correction factors are also influenced by sample size of marked animals.

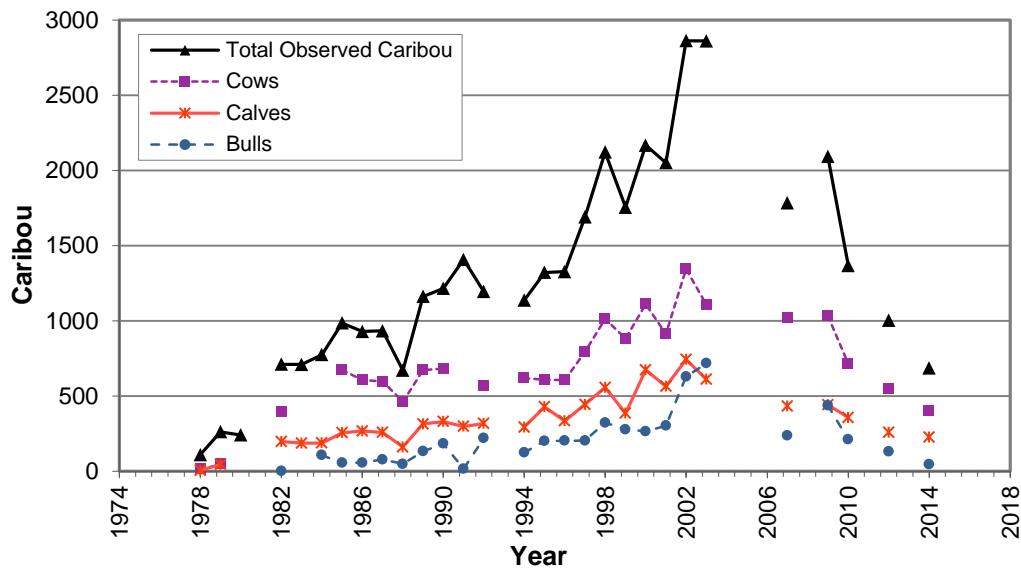


Figure 1. Caribou survey counts for the Itcha-Ilgachuz caribou herd post-calving surveys, 1978-2014.

⁶ In June 2012, 12 of 18 available collared cows and 7 of 14 available collared bulls were observed during the defined survey period within the defined survey area (Dodd 2014b).

Recruitment

In 2014 calves represented 33.0% of the total survey count and the calf ratio was 56.6 calves: 100 cows (Table 3). The collared cows had a slightly higher percent calves at 63.2% (12 calves/19 collars) and a ratio of 61.2 calves:100 cows. In June, percent calves reflect early calf production not annual calf recruitment; the latter is measured after first winter when calves are ~10 months of age. Percent calves and calf: cow ratio observed during the 2014 post-calving survey were comparable to those observed when the Itcha-Ilgachuz herd was increasing in the late 1990s and early 2000s; however, total observed cow and calf numbers are much lower now (Figure 2; Appendix 4). When caribou numbers increased between 1994 and 2003, mean percent calves was 26.4% (range 22-32%, n=10) with 56 calves:100 cows (range 44-70 calves:100 cows). Calves did appear to decline between 2007 and 2012, averaging 45 calves:100 cows; however, this was similar to the 1980s average of 44 calves:100 cows. The observed yearling ratio was 2.7 yearlings: 100 adults (Table 3); yearling classification count is not a reliable measure of recruitment from the previous year because many yearlings are of similar size or slightly smaller than adults and thus, are often misclassified as adults. Consequently, yearling ratios from post-calving surveys always appear low.

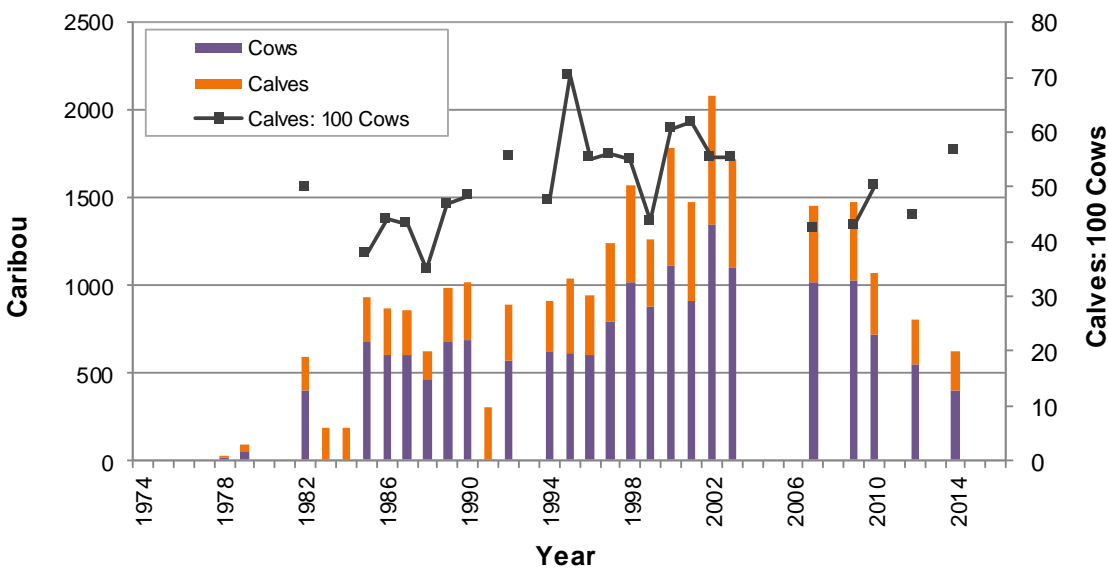


Figure 2. Calf: Cow ratios for the Itcha-Ilgachuz caribou herd post-calving surveys, 1978-2014.

The preferred measure of annual recruitment is percent calves from late winter surveys; late winter calf recruitment was measured at 5.5% in March 2015 (unpublished data). Recent late winter calf recruitment has ranged from 5.5-10.7%, averaging 8.2% (2012-2014, n=4); this is well below the 15-16% (25-26 calves:100 cows) stabilizing recruitment put forth by Bergerud (1992) as necessary to balance natural adult mortality in woodland caribou. During herd growth between 1996 and 2003, average annual calf recruitment was 17% calves (n=8).

Recruitment may not offset recent adult mortality rates in the Itcha-Ilgachuz caribou herd. Observed adult mortality of collared caribou in 2012/13 was 8.7% for adult females and 18.8%

for adult males. The following year (2013/14), the annual mortality rate was 33.3% for adult females and 15.4% for adult males (Cichowski and McLean 2013, 2015).

In summary, total numbers of cow and calves are down and although early calf production rates appear stable, annual calf survival is poor. Calf recruitment may not be sufficient to offset adult mortality.

Sex Ratios

In recent years, the bull component of the Itcha-Ilgachuz herd has appeared slightly under-represented in the post-calving survey area. Although bull counts have declined compared to peak years and the bull:cow ratio has shown greater variability, it was unclear as to whether an actual decline in numbers was occurring and/or a modified distribution of the male component on the landscape (Freeman 2010).

In June 2014 there were 11.5 bulls: 100 cows observed within the survey area during the defined survey period and once adjusted for sightability this increased to 18.2 bulls: 100 cows. Bull groups were often observed in low elevation forested habitat with poor sightability or outside the defined survey area. Both the observed and adjusted 2014 bull ratios were low in comparison to historic surveys (Figure 3). Expansion of the survey area resulted in additional bull groups being observed, however locating collared adult bulls post-survey with telemetry had greater effect on increasing bull counts. For greater sampling of the bull component, the minimum count data was utilized as a more accurate estimate of the bull ratio at 28.7 bulls: 100 cows (Table 3).

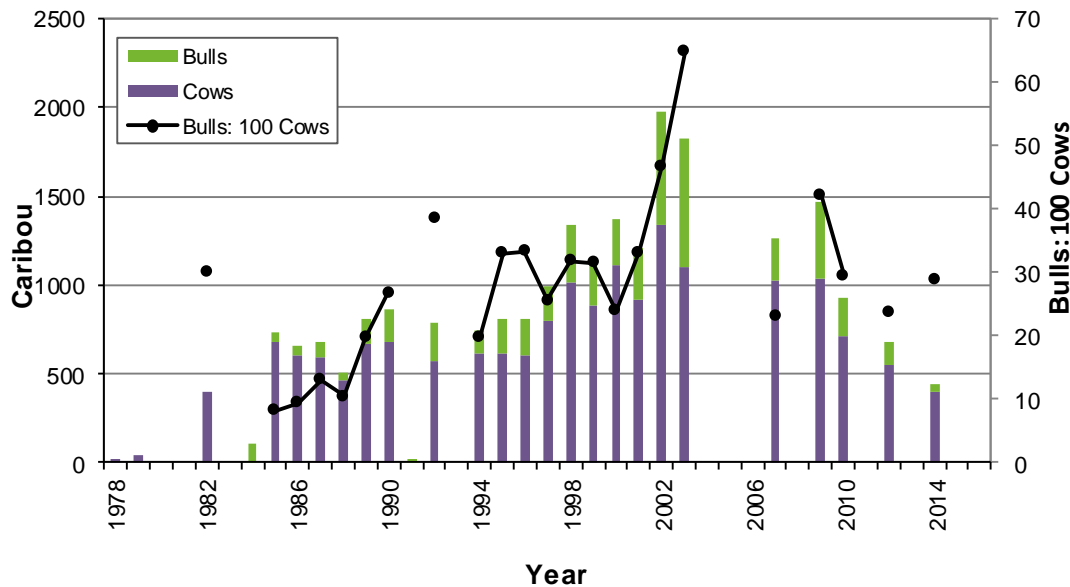


Figure 3. Bull and cow counts for the Itcha-Ilgachuz caribou herd post-calving surveys, 1978-2014

The Provincial Wildlife Harvest Strategy identifies that harvest levels for bull caribou are to be regulated to ensure that adult sex ratios are maintained above 35 bulls: 100 cows post-season (Ministry of Environment, Lands and Parks, 1996). To support the review of the Itcha-Ilgachuz caribou harvest regulations scheduled for 2015, a rut survey was also conducted in October 2014.

The objective of the rut survey was to estimate sex composition when the male and female components of the herd are aggregating for breeding; the bull: cow ratio is calculated by dividing the sum of the survey count of mature, immature and yearling bulls by the sum of adult and yearlings cows. In October 2014, the bull ratio was 29.7 bulls: 100 cows (Figure 4).

Interpretation of bull:cow ratios should consider potential bias associated with classification error; during the rut survey, similar body size and antler development in yearling bulls and young adult cows may result in some yearling bulls being misclassified and counted as cows thereby underestimating the bull: cow ratio.

Bull ratios for the June and October survey were very similar at 28.7 and 29.7 bulls:100 cows, suggesting that counts from the post-calving survey may be used for bull ratios in lieu of a rut survey when an adequate sample of the male component is radio-collared. The presence of collared bulls in the caribou herd provides insight into bull sightability, increased confidence in bull counts, and knowledge of bull distribution on the landscape. Future habitat and population monitoring should consider maintaining a sample of both collared female and male caribou in the herd for both survey efficiency and cost effectiveness.

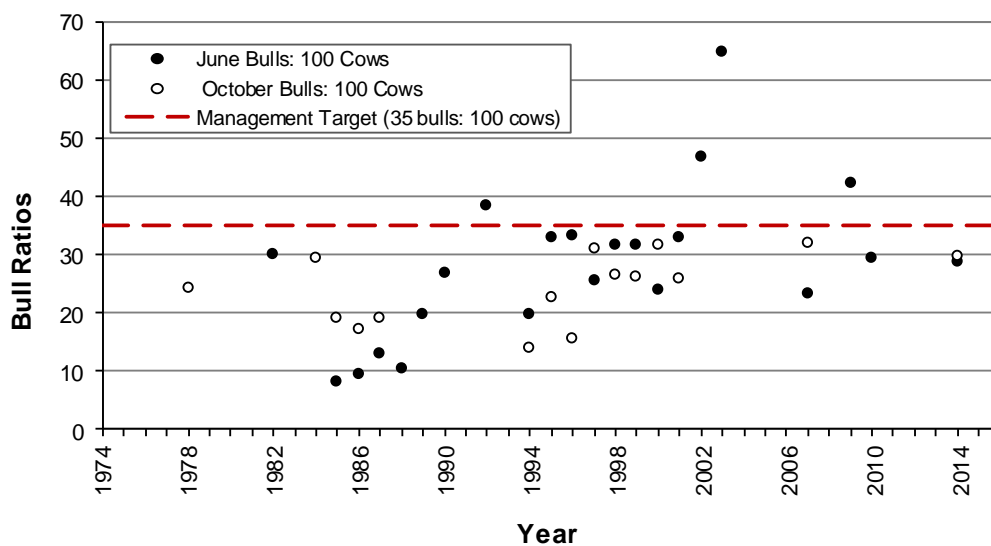


Figure 4. Bull:cow ratios for the Itcha-Ilgachuz caribou herd during June post-calving and October rut surveys, 1978-2014.

Population Trends

The 2014 population estimate for the Itcha-Ilgachuz herd is 1350 caribou. The long-term population trend is *stable* (1994-2014) with change in population size of -11.1%. Although the 20 year trend suggests stability, this does not accurately represent the variability observed in caribou numbers. The Itcha-Ilgachuz caribou herd experienced population growth in the late 1990s and early 2000s with the population increasing from approximately 1500 animals to 2800 between 1995 and 2003. Since then, numbers have steadily declined and the population appears to be similar in size to that of the early 1990s (Figure 5). Change in estimated population size over the past 10 years has averaged -6.4% per annum, consequently the short term population

trend is *decreasing* (2003-2014) with a change in population size of 51.8%. The current trend of surveys done in 2012 and 2014 is *down* with a change in caribou numbers of -15.6%.

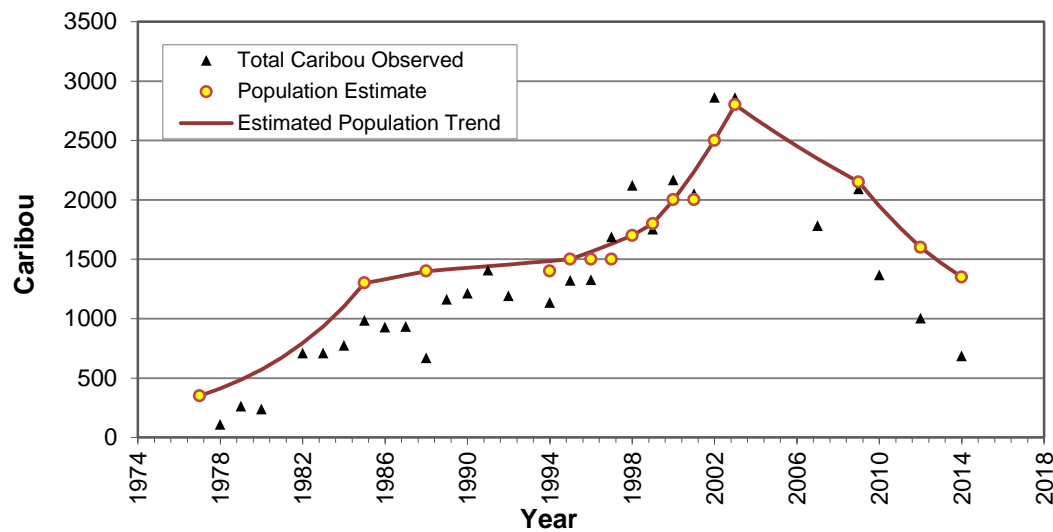


Figure 5. Summary of caribou post calving surveys for the Itcha-Ilgachuz Mountains caribou herd, 1977-2014.

Conclusions

- The 2014 population estimate is 1350 caribou. Total number of caribou has been decreasing since the peak population estimate of 2800 caribou in 2003 and although early calf production rates remain stable, annual calf survival is poor and is likely insufficient to offset adult mortality. Currently, the herd is similar in size to that observed in the early 1990s.
- Long-term population trend of the Itcha-Ilgachuz caribou herd is *stable* with change in population size of -11.1% (1995-2014), while the short term trend over the past 10 years is *decreasing* at an average -6.4% per annum with an overall change in population size of -51.8% between 2003-2014. Current trend of caribou survey counts is *down* 15.6% (2012-2014).
- The 2014 survey count was 685 caribou. An additional 266 caribou were observed post-survey, resulting in a minimum count of 951 caribou. Survey estimate for adult cows was 753 (535-1319) and adult males was 137 (66-696) using mark-resight methods. Combined the adult cows and bulls were estimated at 890 (601-2015).
- Early calf production of 33.0% calves and calf ratios of 56.6 calves:100 cows were comparable to those observed when the Itcha-Ilgachuz herd was increasing from 1996 to 2003. However, annual calf recruitment, which accounts for fall and over-winter calf survival, was 5.5% in March 2015 and averaged 8.2% calves between 2012 and 2015 (n=4), much lower than the average 17% calves (1996-2003, n=8) observed during herd growth.
- The June bull ratio using minimum count data was 28.7 bulls:100 cows. Additional survey in October resulted in a bull ratio of 29.7 bulls: 100 cows. The observed bull ratio is below the provincial management target of 35 bulls:100 cows for post-harvest season.

- Caribou have modified their use of the landscape possibly in response to habitat changes associated with the mountain pine beetle epidemic and/or dispersed to reduce predation risk. Expansion of the survey area may be required in future inventories if caribou distribution continues to shift in the low elevation forested landscape. Targeting high suitability, low elevation habitat that favours sightability will increase survey efficiency and effectiveness; new habitat suitability mapping completed in 2017 may assist in identifying these areas (Apps and Dodd, 2017).

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Appendix 1. Flight lines and survey observations for the 2014 Itcha-Ilgachuz post-calving caribou survey.

Appendix 2. Collar sightability and calf presence for the Itcha-Ilgachuz post-calving caribou survey, 2014

Animal ID	Sex	Collar Type	Frequency	Ear Tag Left	Ear Tag Right	Ear Tag s Verification	Herd	Sighting # (from rotary survey)	June 2014 Available for Survey (Y/N)	June 2014 Marked Seen (during survey) (Y/N)	June 2014 Calf with Collared Female (Y/N)
6	F	VHF	150.081	orange	orange	Y (Mar 2012)	ITCHA-ILGACHUZ	72	Y	Y	Y
12	F	VHF	150.150	blue	green	Y (Mar 2012)	ITCHA-ILGACHUZ	54	Y	Y	Y
13	F	VHF	150.160	orange	green	Y (Jun 2012)	ITCHA-ILGACHUZ	82	Y	N	Y
15	F	VHF	150.320	red	red	Y (Mar 2012)	ITCHA-ILGACHUZ	7	Y	Y	Y
17	F	VHF	150.429	white	red (missing in June2012?)	Need to verify R-red tag may be missing	ITCHA-ILGACHUZ	77	Y	Y	N
19	F	VHF	150.520	blue	red	Y (Mar 2012)	UNKNOWN- Itcha Ilgachuz?	---	N	N	---
22	F	VHF	150.601	red	no tag	Y(Mar 2014)	ITCHA-ILGACHUZ	56	Y	N	N
23	F	VHF	150.610	yellow	yellow	Y(Mar 2014)	ITCHA-ILGACHUZ	49	Y	Y	Y
51	F	Iridium	150.643	white	yellow	Y (2013)	ITCHA-ILGACHUZ	59	Y	N	N
52	F	Iridium	150.683	blue	yellow	Y (Mar 2014)	ITCHA-ILGACHUZ	79	Y	N	N
40	F	Iridium	150.703	orange	white	Y (Jun 2012)	ITCHA-ILGACHUZ	---	N	N	---
1	F	VHF	150.720	orange	yellow	Y (Jun 2012)	ITCHA-ILGACHUZ	55	Y	Y	Y
42	F	Iridium	150.823	pink	no tag	Y (Dec 2013)	ITCHA-ILGACHUZ	49	Y	Y	Y
29	F	VHF	150.840	red	white	Y (Mar 2012)	ITCHA-ILGACHUZ	85	Y	N	N
31	F	VHF	150.921	white or no	white	need to verify	ITCHA-ILGACHUZ	49	Y	Y	Y
53	F	Iridium	150.983	red	pink	Y (Mar 2014)	ITCHA-ILGACHUZ	29	Y	Y	Y
56	F	Iridium	151.144	red	blue	Y (Dec 2013)	ITCHA-ILGACHUZ	48a	Y	N	Y
49	F	Iridium	151.603	white	none	Y (Dec 2013)	ITCHA-ILGACHUZ	80	Y	N	Y
54	F	Iridium	151.903	black	white	Y (Dec 2013)	ITCHA-ILGACHUZ	81	Y	N	Y
28	M	VHF	150.030	yellow	orange	Y (Mar 2012)	ITCHA-ILGACHUZ	62	Y	N	---
8	M	VHF	150.100	red	green	Y (Mar 2012)	ITCHA-ILGACHUZ	93	N	N	---
10	M	VHF	150.130	pink	no tag	Y (Mar 2012)	ITCHA-ILGACHUZ	2	Y	Y	---
34	M	Iridium	150.223	no tag	no tag	Y (Jun 2012)	ITCHA-ILGACHUZ	---	N	N	---
35	M	Iridium	150.282	orange	blue	Y (Mar 2014)	ITCHA-ILGACHUZ	62	Y	N	---
16	M	VHF	150.371	yellow	red	not verified	ITCHA-ILGACHUZ	87	Y	N	---
18	M	VHF	150.470	green	red	Y (Mar 2012)	ITCHA-ILGACHUZ	84	N	N	---
20	M	VHF	150.529	orange	red	Y (Mar 2012)	ITCHA-ILGACHUZ	96	N	N	---
21	M	VHF	150.560	blue	red	Y (Mar 2012)	ITCHA-ILGACHUZ	2	Y	Y	---
25	M	VHF	150.670	green	yellow	Y (Jun 2012)	ITCHA-ILGACHUZ	92	N	N	---
30	M	VHF	150.881	yellow	white	not verified	ITCHA-ILGACHUZ	90	Y	N	---
9	F	VHF	150.119	yellow	green	Y (Sept 2013)	CHARLOTTE ALPLANDS	67	N	N	Y
27	F	VHF	150.019	red	orange	Y (Mar 2012)	RAINBOW	64	N	N	N
47	F	VHF	150.041	white	orange	Y (Mar 2012)	RAINBOW	66	N	N	N
50	F	VHF	150.060	orange	green	Y(Mar 2014)	RAINBOW	65	N	N	Y
33	F	Iridium	151.152	white	pink	Need to verify are tags reversed?	RAINBOW	63	N	N	Y
? Some uncertainty in the herd affiliation											

Appendix 3. Noremark JHE Mark-Resight Population Estimation for Closed Population for the 2014 Itcha-Ilgachuz caribou survey.

Data Input:

Value	Adult Female	Adult Male
Total observed (C)	399	46
Marked Available (M)	17	6
Marked Seen (R)	9	2
Unmarked Seen	30	44

Note: Unsexed adults were NOT redistributed into adult female or male categories.

Adult Females

09/09/14 11:34:27

Mark- Continue -- Do not save estimation output
File -- Estimation output saved to a file
Print -- Estimation output saved to printer

Enter

2014 Itcha-Ilgachuz - Adult Females (unsexed adults NOT redistributed)

Alpha level for confidence interval construction: 0.05
Enter number of sighting occasions: 1

Marked Occ.	Marked Available	Marked Seen	Unmarked Seen	Lin.-Pet. Estimate	95% Confidence Interval
1	17	9	390	719.0	438.9 - 999.1

Minimum number known alive is 407
Population Estimate: 753 95% Confidence Interval: 535 - 1319

The ESC key takes you back one menu screen.
You can get context-sensitive help with the F1 key.

Top Bot Help PgUp PgDn Return ESC

Adult Males

09/09/14 11:35:46

Mark- Continue -- Do not save estimation output
File -- Estimation output saved to a file
Print -- Estimation output saved to printer

Enter

2014 Itcha-Ilgachuz - Adult Males (Unsexed adults NOT redistributed)

Alpha level for confidence interval construction: 0.05
Enter number of sighting occasions: 1

Marked Occ.	Marked Available	Marked Seen	Unmarked Seen	Lin.-Pet. Estimate	95% Confidence Interval
1	6	2	44	108.7	30.1 - 187.3

Minimum number known alive is 50
Population Estimate: 137 95% Confidence Interval: 66 - 696

The ESC key takes you back one menu screen.
You can get context-sensitive help with the F1 key.

Top Bot Help PgUp PgDn Return ESC

Appendix 4. Summary of post-calving survey results and population estimates for the Itcha-Ilgachuz caribou herd, 1977-2014.

Year	Date	Total	Cows	Calves	Bulls	Yearling Cows ^a	Yearling Bulls ^a	Unsexed Yearling ^a	Unsexed Adults	Unclassified	Percent Calves	Population Estimate
1977												350
1978	01-Jun	110	13	5						92	4.5%	
1979	08-Jun	262	45	45						172	17.2%	
1980		240								240		
1981	no survey											
1982 ^b	16-Jun	711	395	197	119 ^c						27.7%	
1983	22-Jun	710		186					524		26.2%	
1984	07-Jul	775		187	107				481		24.1%	
1985	18-Jun	985	675	255	55						25.9%	1300
1986	25-Jun	929	605	267	57						28.7%	
1987	18-Jun	933	597	258	78						27.7%	
1988 ^d	26-Jul	670	461	161	48						24.0%	1400
1989	23-Jun	1162	672	314	132				44		27.0%	
1990	27-Jun	1215	682	330	183			4	16		27.2%	
1991 ^e	12-Jul	1408		298	16				1094		21.2%	
1992	17-Jun	1194	569	317	219			48	41		26.5%	
1993 ^f	no survey											
1994	21-Jun	1136	618	293	123			102			25.8%	
1995	21-Jun	1321	609	428	201	52	31				32.4%	1500
1996	27/29-Jun	1327	606	334	202	68	98	19			25.2%	
1997	20-Jun	1689	794	444	203	81	83	47	37		26.3%	
1998	20-Jun	2121	1012	557	322	4	34	142	50		26.3%	1700
1999	13/14-Jul	1754	882	385	278	13	25	99	72		21.9%	1800
2000	20/21-Jun	2167	1111	673	265	37	58	11	12		31.1%	2000
2001	20-Jun	2051	912	564	302	42	68	31	132		27.5%	2000
2002	20/21-Jun	2862	1344	743	629	12	30	78	26		26.0%	2500

Year	Date	Total	Cows	Calves	Bulls	Yearling Cows ^a	Yearling Bulls ^a	Unsexed Yearling ^a	Unsexed Adults	Unclassified	Percent Calves	Population Estimate
2003 ^g	17/18-Jun	2861	1106	611	717	33	71	99	135	89	21.4%	2800
2004	no survey											
2005	no survey											
2006	no survey											
2007 ^h	18/19-Jun	1784	1021	432	237			90	4		24.2%	
2008	no survey											
2009 ⁱ	22/23/25 Jun	2093	1033	442	437	27	26	48	80		21.1%	2150
2010 ^j	21/22-Jun	1367	714	357	211	8	20	14	42	1	26.1%	
2011	no survey											
2012 ^k	19/20/21 Jun	1003	546	259	130	1	2	22	21	22	25.8%	1600
2013	no survey											
2014 ^l	18-21 Jun	685	399	226	46	2	1	9	2		33.0%	1350

^a Prior to 1994 yearlings were most often grouped with adults. Between 1994 - 2010 attempts to classify yearlings not consistent, thus yearling counts are not a reliable statistic for yearling recruitment given difficulty in classifying yearlings in large caribou groups during post-calving survey. Since 2010 yearlings generally classified as adults.

^b 1982 Change in search effort methodology. Note: total caribou differs from sum of classification categories counts (source Smith & Hebert 1986).

^c 1982 Bull total includes some yearlings

^d 1988 survey was a partial count, only Itcha Mountains surveyed (J. Young, pers comm, Young 1994 Itcha Ilgachuz post-calving report)

^e 1991 survey was conducted in late-July when caribou had formed large aggregations, preventing classification of individual animals

^f 1995 radio-collaring program initiated; VHF collars deployed on female caribou 1995, 1996, & 1998.

^g 2003 Monitoring of radio-collared caribou discontinued (n=11 collars remaining in herd). Limited value for mark-resight of herd estimated at 2800 animals.

^h 2007 survey had late green-up conditions in both the lower elevation meadows and the alpine (with >50% snow coverage in mountains; above normal conditions) which may have influenced spatial distribution of caribou. It is possible that cows may have calved in higher elevation forested habitat if alpine conditions were not suitable and that bull yearling groups were dispersed in lower elevation forested habitat due to late green-up of meadows. If caribou distribution did differ as suggested, these caribou groups would likely not be detected in the post-calving survey, which focusses on meadow habitat, mountain valleys and alpine habitat, rather than forested habitat. Confidence in bull and yearling numbers is low.

ⁱ 2009 survey area was expanded to include additional meadows and cut blocks south of the Itcha Mountains (Punkutlaenkut Lake and Satah mountain area; this added approximately 1 hour of survey time) as anecdotal information from residents suggested that caribou were expanding their range and being sighted in areas where they have not previously been sighted (further east, south east and east of the Itcha Ilgachuz range). An additional 119 caribou (104 bulls, 7 cows, 4 calves, 2 yearling bulls, 2 unclassified yearlings) were observed in the expanded area; these numbers have been included in the 2009 survey totals.

^j 2010 survey area included meadows and cut blocks south of the Itcha Mountains (Punkutlaenkut Lake and Satah mountain area as per 2009 survey boundary). Additional meadow habitat north of the Itcha Lake meadow system was surveyed in 2010; survey of this area counted 8 additional caribou.

^k 2012 collaring program initiated; VHF and GPS collars deployed on female and male caribou allowing for Mark-Resight population estimation of cows and bulls. Collars deployed Dec 2011, Mar 2012 & Dec 2013.

^l 2014 survey area expanded to include the meadow system north and northeast of the Itcha Mountains, bounded to the west by Shag Creek and to the east by the headwaters of the Coglistiko River. Additional time was also spent searching for caribou in the Satah Mountain area and south to Holtry Creek. VHF and GPS collaring program ongoing, allowing for Mark-Resight population estimation.