

Itcha-Ilgachuz Northern Caribou Population Estimate: June 2012 Survey

Prepared by:

Steven F. Wilson, Ph.D., R.P.Bio.

steven.wilson@ecologicresearch.ca

Prepared for:

Ministry of Forests, Lands and Natural Resource Operations

Williams Lake, BC

17 December 2012

Introduction

This report presents a population estimate for the Itcha-Ilgachuz northern caribou population of west-central British Columbia. The estimate is based on data collected during an aerial survey conducted in June 2012.

Methods

Analysis Considerations

Population estimates from mark-resight surveys are usually calculated using either the Lincoln-Petersen Index or the Joint Hypergeometric Maximum Likelihood Estimator (JHE; White and Garrott 1990, White 1996). Mark-resight estimators make the following assumptions:

1. Marked individuals represent a random sample of the population to be surveyed;
2. Individuals are sampled without replacement (i.e., can be counted only once during a survey);
3. There is no individual heterogeneity in resighting probabilities; and,
4. The population is geographically closed (i.e., all marked individuals are in the study area and there has been no immigration or emigration between the time animals were marked and when they were surveyed).

In caribou populations assumptions 1-2 are reasonable but assumptions 3-4 are complicated by the different sex and age classes surveyed. In most situations adult females are the only segment of the population radio-collared and analyses either assume that all sex and age classes have the same sightability (e.g., McLellan et al. 2008, Hegel and Russell 2009, Steenweg et al. 2009) or that unmarked segments of the population have 100% sightability (Hatter and Young 2004). Assuming equal sightability inflates the population estimate by including individuals that are assumed to have had the same probability of being marked as the rest of the population, when their probability of being marked was actually zero. Generally this bias is small if adult males and females are using similar habitats during surveys and if calves and yearlings constitute a small proportion of the population. This is true of many caribou populations that are surveyed in March.

The assumption of geographic closure can be addressed by conducting a pre-survey radio-tracking flight to determine the number of radio-collars functioning in the study area.

The survey of the Itcha-Ilgachuz northern caribou population differs from the above scenario in three important ways:

1. Adult males are well-represented in the radio-collared population;
2. The survey was conducted in June, resulting in separate counts for not only adult males, adult females and calves, but also subadults (i.e., 1-year olds);
3. Also because the survey was conducted in June, there was a large proportion of calves observed; and,
4. There was a component of the surveyed population that could not be classified confidently according to sex and/or age.

These characteristics required specific accommodation in the analysis:

1. Separate population estimates were calculated for adult males and adult females because a sufficient proportion of each class was marked by radio-collars;

2. Population estimates for unmarked age classes (i.e., subadults and calves) were corrected for sightability to reduce bias in the total population estimate; and,
3. The sex-age classes of unclassified caribou were estimated from the sex and age ratios of classified caribou observed on the survey and were included in analyses.

Mark-resight Population Estimates for Adult Females and Adult Males

A pre-survey radio-tracking flight was conducted prior to the main survey to determine the number of radio-collared caribou in the study area; therefore, the population was assumed to be demographically closed for the purposes of calculating a population estimate.

I calculated Lincoln-Petersen Index estimates for adult male and adult female components of the population. I chose the Lincoln-Petersen Index over JHE for the following reasons:

1. It is computationally simpler and easily understood; and,
2. Unlike JHE, a normally distributed variance can be calculated, which is required to calculate valid confidence intervals for summed population estimates (see below).

A Lincoln-Petersen population estimate is simply MC/R , where M is the number of marked animals in the population, R is the number of marked animals resighted on a survey, and C is the total number of animals observed during the survey. Variance is estimated as $[(M+1)(C+1)(M-R)(C-R)] / [(R+1)^2 (R+2)]$ and standard confidence intervals can be calculated from this variance (Chapman 1951).

I included caribou that could be identified as adults but not as males or females (i.e., “unclassified adults”) in the counts of unmarked animals according to the adult bull:cow ratio of classified caribou observed during the survey. Other unclassified caribou (where neither sex nor age were known) were included in the unmarked counts according to the bull:cow ratio and the subadult:adult ratio of classified caribou observed on the survey. I assumed there were no calves among unclassified caribou.

Population Estimates for Subadults and Calves

Because few subadults were classified by sex and the sex ratio of subadults was unknown (and might not be similar to adults), all subadults were pooled for analyses. Unlike adult females and males, a mark-resight population estimate could not be calculated for subadults because they were not radio-collared; however, I assumed that subadults had the same sightability on the survey as adults (pooled among males and females) and I estimated the total subadult population to be O/S , where O was the number of subadults observed on the survey and S was their estimated sightability.

Similarly, a mark-resight population estimate could not be calculated for calves because they were not part of the marked population. I used the equation above to calculate a calf population estimate but assumed that calves had the same sightability as adult females. This is likely a conservative assumption because young calves can often be eclipsed by adult females and missed on surveys. The result is that the calf population estimate might be low.

Total Population Estimate

A post-survey flight was conducted to locate radio-collared caribou not observed during the survey. This flight located a number of additional radio-collared and unmarked caribou. These post-survey observations were added to the mark-resight and sightability population estimates. Unclassified caribou were assigned to sex-age classes as above.

The total population estimate was simply the sum of estimates of adult females, adult males, subadults

and calves. Variances were summed for the adult female and adult male estimates, but variances were zero for the subadult and calf population estimates. Confidence intervals were calculated from the summed variances of the adult female and adult male estimates.

Results

Sightability was higher for radio-collared females than for males during the survey (Table 1). In total 1003 caribou were observed, with the majority being adult females and calves (Table 2). Very few subadults were observed.

Table 1. Radio-collared caribou in the Itcha-Ilgachuz study area during the 2012 survey.

	Females	Males	Pooled
Radio-collared adult caribou in survey area	18	14	32
Observed during survey	12	7	19
Sightability (%)	66.7	50	59.4

The observed bull:100 cow ratio was 22 and the calf:100 cow ratio was 49 (Table 3). Mark-resight population estimates for adult females and adult males were 870 (700-1140) and 276 (216-336), respectively (Table 4). After estimating the sex and age classes represented in the unclassified component of the count, and adding post-survey observations, the total estimated population was 1685 (1431-1791).

Adjusting for differences between adult male and adult female sightability, the bull:100 cow ratio was 30 and the calf:100 cow ratio was 45.

Table 2. Northern caribou observed during the June 2012 survey in the Itcha-Ilgachuz study area. A post-survey flight was conducted to locate radio-collars not detected during the main survey. This resulted in a number of additional observations (“post-survey” column).

	Survey	Post-survey	Total
Adult females	546	49	595
Adult males	130	0	130
Unclassified adults	21	25	46
Calves	259	32	291
Subadult females	1	0	1
Subadult males	2	0	2
Unclassified subadults	22	1	23
Other unclassified	22	0	22
Total observed	1003	107	1110

Table 3. Sex-age class ratios from northern caribou observed during the Itcha-Ilgachuz survey in June 2012.

	Observed ratio	Normalized
Bulls:cows	130:595	21.8:100
Calves:cows	291:595	48.9:100
Subadults:adults (excluding unclassified)	26:771	3.4:100

Table 4. Population estimates based on mark-resight analyses of 2012 Itcha-Ilgachuz survey data.

	Adult females	Adult males	Subadults	Calves	Total
Observed during survey	546	130	25	259	960
Estimated from surveyed unclassified adults	17	4	NA	NA	21
Estimated from surveyed unclassified	17	4	1	NA	22
Total survey estimated observed (<i>C</i>)	580	138	26	259	1003
Marked observed during survey (<i>R</i>)	12	7	0	0	19
Marked available during survey (<i>M</i>)	18	14	0	0	32
Estimated population from sightability	NA	NA	44	388	432
Mark-resight estimate	870	276	NA	NA	1146
Confidence interval	700-1140	216-336	NA	NA	NA
Observed post survey	49	0	1	32	82
Estimated from post-survey unclassified adults	21	4	NA	NA	25
Total population estimate	940	280	45	420	1685
Confidence interval	770-1210	220-340	NA	NA	1431-1791

Discussion

Calculation of an Itcha-Ilgachuz population estimate is complicated by the timing of the survey, which results in observations of both subadults and a large number of calves that are not part of the marked population. These age classes must be excluded from the mark-resight analysis of adults and then added to the population estimate. Rather than assuming 100% sightability of these age classes, I estimated sightabilities and used them as a basis for generating a population estimate for these unmarked age classes. Similarly, rather than assuming 100% sightability for unclassified caribou I used sex and age ratios calculated from survey observations to assign sex and age classes to the unclassified caribou and included them in population estimates. These adjustments increased the population estimate compared to assuming 100% sightability; however, if the estimated sightability of subadults and calves, and the sex

and age ratios of unclassified caribou are reasonably accurate, the total population estimate should be less biased than assuming 100% sightability. Most reports fail to provide details regarding the unmarked caribou included in their mark-resight analyses (c.f., Hatter and Young 2004) and, consequently, biases are rarely acknowledged.

An alternative approach that accommodates unmarked components of a population is to use an estimator that assumes that the population is subject to immigration and emigration (e.g., Immigration/emigration JHE; White 1996). Using this approach, subadults and calves are considered immigrants. This technique can be applied only where more than one survey is conducted.

The proportion of subadults observed during the survey was very low. This suggests that either recruitment is far below the 15% required for a stable population (Bergerud 1988), or else some subadults were misclassified as adults on the survey, which would inflate the population estimate by underestimating the sightability of adult caribou.

Literature Cited

- Bergerud, A. T. 1988. Caribou, wolves and man. *Trends in Ecology and Evolution*. 3:68-72.
- Chapman, D. G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. *University of California Publications in Statistics* 1:131-160.
- Hatter, I., and J. A. Young. 2004. An assessment of the risk from hunting and translocations for the Itcha-Ilgachuz herd in the southern mountain population of woodland caribou. BC Ministry of Water, Land and Air Protection Wildlife Bulletin No. B-121.
- Hegel, T., and K. Russell. 2009. Aishihik and Kluane northern mountain caribou herds census, 2009. Yukon Department of Environment, Whitehorse.
- McLellan, B., R. Serrouya, and K. Furk. 2008. Population censuses of caribou in the North Columbia Mountains. BC Ministry of Forests, Revelstoke, unpublished.
- Steenweg, R. W., D. C. Heard, and M. P. Gillingham. 2009. Parsnip caribou recovery trial - report on activities during 2008-9. Peace/Williston Fish & Wildlife Compensation Program Report No. 332.
- White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, New York, NY.
- White, G. C. 1996. NOREMARK: population estimation from mark-resighting surveys. *Wildlife Society Bulletin* 24:50-52.