POPULATION ESTIMATE
CHISANA CARIBOU HERD
2010

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Summary

In October 2010, we conducted a collaborative survey to estimate the composition and size of the Chisana caribou herd. Partner agencies included Yukon Department of Environment, Alaska Department of Fish & Game, and US National Park Service (Wrangell-St. Elias National Park).

The survey was conducted to assess the status of the herd 4 years following the captive rearing project undertaken on the herd, and to provide information set out in the Management Plan for the Chisana caribou herd to determine if harvest of the herd may be resumed.

Key Findings

- There were an estimated 682 animals (90% confidence interval: 622 – 832), in the Chisana caribou herd.
- Based on estimates from 2003, 2005, and 2007, the current trend of the herd is assessed as stable.
- We classified 622 animals to estimate the herd's composition. We found an adult sex ratio of 42 bulls per 100 cows, and a recruitment ratio of 23 calves per 100 cows.
- Overall, calves and bulls made up 14% and 25% of the herd, respectively.
- Based on results from this survey, the status of the herd currently meets the thresholds outlined in the Management Plan to consider resumption of harvest.
- An additional population estimate of the herd is recommended for 2013 to take advantage of the remaining radio-collars on the herd.

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Introduction

From 2003 to 2006, the Chisana caribou herd was the focus of a significant captive rearing program that attempted to halt a perceived decline in the herd's size (Chisana Caribou Recovery Team 2010). Management authorities in both Alaska and Yukon closed the herd to harvest due to this decline. Given the substantial resources devoted to management of the herd, there is considerable interest in its status. The herd's size was most recently estimated in 2003, 2005, and 2007, and was generally stable, ranging from a low of 706 animals in 2005 to a high of 766 animals in 2007 . (US Geological Survey: Adams 2003; Adams and Roffler 2005, 2007).

Additionally, there has been interest by the public in opening the herd to a modest harvest, assuming such a harvest would be sustainable. The interjurisdictional "Management Plan for the Chisana Caribou Herd (2010-2015)" (Chisana Caribou Herd Working Group 2012) outlines a suite of conditions that must be met before any resumption of harvest of the herd would be entertained. These include:

- an assessment that the herd is stable or increasing (based on the October 2010 population estimate);
- a sex ratio of at least 35 bulls: 100 cows observed during fall composition surveys; and
- a rolling 3-year average October calf recruitment of more than 15 calves: 100 cows.

Thus, to provide an assessment of the herd's status 4 years after the large-scale captive rearing program undertaken on the herd, and to inform future harvest management discussions, Environment Yukon, Alaska Department of Fish and Game, and Wrangell-St. Elias National Park coordinated a population estimate and composition survey of the herd in October 2010.

Methods

The general approach used to estimate the herd's size followed that used by Adams and Roffler during the previous 3 estimates (2003, 2005, and 2007). Using radio-collared animals, a sightability model was developed to account for animals missed during the composition survey. Prior to the formal survey, on 8 October 2010 a fixed-wing Piper PA18 Supercub equipped with a radio-telemetry receiver located all (active) radio-collared cows in the herd to delineate a survey area (Figure 1).

During the formal survey (11-15 October 2010), the Supercub again searched for all active radio-collars in the herd, noting the group size associated with a radio-collared female when located. Concurrently, a helicopter (Robinson R44) survey crew conducted a composition survey of the herd.

Without the aid of radio-telemetry receivers we searched the entire herd range based on current radio collar distribution and movement data from prior surveys. When groups were located animals were classified as calves, cows, or one of 3 bull classes: small, medium, or large. Yukon survey crews only distinguished bulls into either a small or large class. The presence of any radio-collared females in an observed group was also noted. Marked groups missed by the helicopter crew were subsequently located, after communication with the fixed-wing pilot, and those animals were also classified.

Data from the fixed-wing survey provided group size of all radio-collared (i.e., marked) groups in the herd. Data from the helicopter survey provided information on the composition of the groups observed (both marked and unmarked). As not all marked groups were observed by the helicopter crew, a sightability model to account for detectability was developed using logistic regression. The group was the basic unit for analysis and the probability of observing a marked group was modeled as a function of covariates. We assumed that the radio-collared females were randomly distributed within the herd. We included 2 possible covariates that may have influenced sightability: group size and survey crew (Alaska or Yukon). We used a model selection approach in which multiple models, with differing combinations of covariates, were compared using AICc values (Burnham and Anderson 2002).

The model with the lowest AICc value was deemed "best". For the analysis, a '1' represented a marked group observed by the helicopter crew and a '0' a marked group not observed by the helicopter crew (but was observed by the fixed-wing flight).

The sightability model was then applied to all groups (both marked and unmarked) observed by the helicopter crew to adjust numbers for detectability. The sum of these adjusted numbers thus represents the estimated herd size. The analysis was conducted using the 'SightabilityModel' package (version 1.0; Fieberg, 2012) for the statistical software R (version 2.15.1; R Core Team, 2012). The sightability correction factor, and associated SE, was calculated using equations provided by Steinhorst and Samuel (1989).

Results

The composition survey took place over 3 days and 14.5 hours of flying. Survey conditions were generally favourable (Table 1). The Alaska portion of the survey took place on 11 and 14 October, with the Yukon portion occurring on 15 October.

We classified 622 caribou during the survey to estimate herd composition (Table 2). Calf recruitment was relatively high at 22.8 calves: 100 cows (see Figure 3 for long-term averages). The overall sex ratio of the herd was 41.8 bulls: 100 cows.

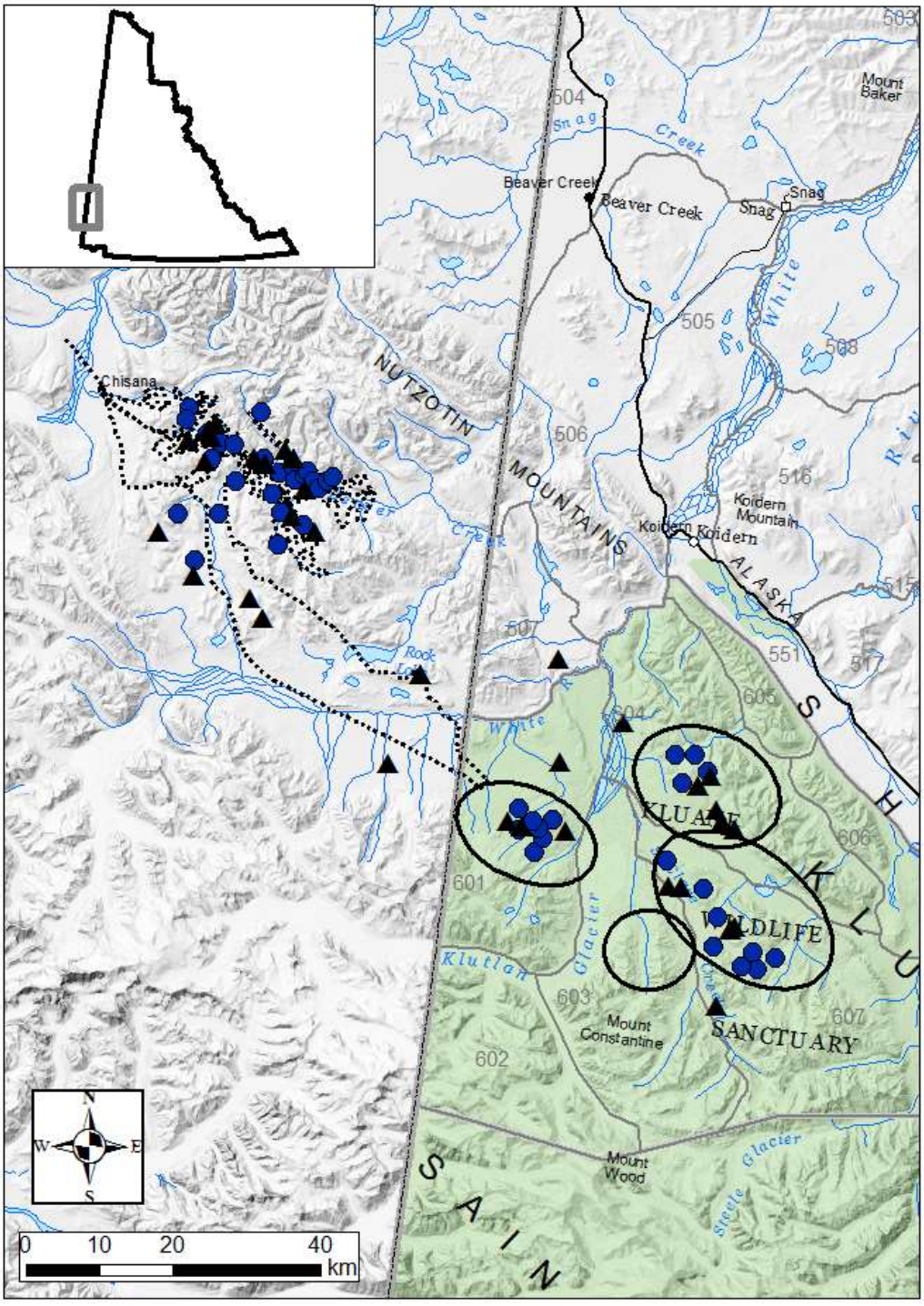

Figure 1. Caribou groups observed during the 2010 Chisana caribou herd population and composition survey.

Animals found during the pre-survey fixed-wing relocation flight are indicated by triangles, animals observed during the composition survey are indicated by circles. The dotted line indicates the survey track for the Alaska portion of the survey. The survey track was unavailable for the Yukon portion of the survey. The areas outlined with a solid black line indicate the key survey areas within Yukon.

Table 1. Survey details for the 2010 Chisana caribou herd.

Date	Hours Flown	Survey Crew	Snow Conditions	Light
11 October	6	Alaska	Patchy at low elevations, full coverage at high elevations	Bright light, high overcast cloud
14 October	3	Alaska	Full cover, fresh snow	Clear
15 October	5.5	Yukon	Snow ~ 2 days old with good coverage	Light cloud cover

Table 2. Composition of the Chisana caribou herd – October 2010.

Parameter	Value
Number of caribou classified	622[a]
Calves: 100 cows	22.8
Total bulls: 100 cows	41.8
Number of calves observed	86
Number of cows observed	378
Number of small bulls observed	47
Number of medium bulls observed[b]	26
Number of large bulls observed	85
% calves in the herd	13.8
% bulls in the herd	25.4

a: This number is higher than the number used to estimate the herd size, as marked groups initially missed by the helicopter crew were revisited for classification; b: Medium bulls only classified by Alaskan crews.

Thirty marked groups (i.e., a caribou group having at least one radio-collared cow) were present in the herd, as identified by the pre-survey fixed-wing telemetry flight. Of these, 22 groups were observed by the helicopter composition crew during the formal survey (Table 3). Using these data on observed and unobserved groups, 4 candidate sightability models were fitted. The model with the lowest AICc value was the null model with no covariates, while the model having group size as a covariate had nearly equal support (Table 4).

The parameter estimates for the second and third ranked models (based on AICc) had very low precision and were not significantly different from zero, while the parameter estimate of the intercept for the null model was significant (Table 5). Thus, while the Group Size model had nearly equal support based on AICc scores, given the high level of parameter uncertainty of its coefficients (Table 5), it was deemed appropriate to use the most parsimonious model (i.e., fewer parameters) and the model with the higher degree of precision in its parameters, as the final sightability model with which to obtain an estimate of the herd's abundance.

Therefore, for the 2010 Chisana population estimate, only one correction factor of 1.245 (SE = 0.107) was applied to all caribou groups observed by the helicopter composition survey crew. It is unclear why the sightability-group size relationship observed in the 2003, 2005, and 2007 estimates was not observed in this survey (Table 7). Future analysis may be warranted in examining differences in population characteristics of the herd, for example, across these 4 years to understand why this relationship was not detected in a significant manner.

Based on this sightability value, the estimated size of the herd, based on groups located *within the survey area,* was 661 (SE = 88). However, 2 marked groups were located outside of the survey area as subsequently located by the fixed-wing crew. Including these 2 groups in the data used to train the sightability model would be inappropriate, as they were not "available" to be observed by the helicopter crew.

This situation also occurred during the 2005 and 2007 population estimates. To account for these groups located outside the survey area we adopted Adams and Roffler's (2007) approach and adjusted the within-survey area population estimate from the sightability model (i.e., 661) by the proportion of all radio-collared females located in the survey area relative to the total number of radio-collars in the herd (Table 3). Three of 96 collars were located outside of the survey area, thus the within-survey area population estimate was inflated by 3.2% (96/93 = 1.032), resulting in a final population estimate of 682 animals (SE = 91). Based on herd composition data (Table 2), there were an estimated 94 calves, 173 bulls, and 415 cows in the herd during the 2010 survey.

Table 3. Observation data used for developing the sightability model and the 2010 population estimate of the Chisana caribou herd.

Variable	Value
Number of radio-collared animals in the herd	96
Number of radio-collared animals in the survey area	93
Number of marked groups in the herd	30
Number of marked groups in the survey area	28
Number of marked groups in the survey area observed by the helicopter crew	22
Total number of animals observed by the helicopter crew	531

Table 4. Candidate sightability models for the 2010 Chisana caribou population estimate (n = 28) with model selection values.

Sightability Model	AICc	K^b
Null[a]	31.25	1
Group size	31.54	2
Survey crew	32.31	2
Group size * survey crew	34.86	4

a: A null model (i.e., intercept-only) with no covariates was fitted as a comparison against the other models; b: Number of parameters including the intercept.

Table 5. Parameter estimates for the top three candidate sightability models (Table 4) for the 2010 Chisana caribou population estimate.

Model	Parameter	Coefficient	Standard Error
Null	Intercept	1.30	0.46
Group size	Intercept	0.32	0.87
	Group Size	0.06	0.06
Survey crew	Intercept	0.81	0.60
	Survey Crew[a]	1.06	0.97

a: The Yukon survey crew was used as the reference category as Survey Crew was a categorical variable.

Table 6. Characteristics of marked groups in the Chisana caribou herd during the 2010 population estimate survey.

Parameter	Value	Standard Error
Typical group size[a]	29.08	17.9
Average group size	17.9	2.6
Group size coefficient of variation	0.80	-
Range	4 – 58	-

a: From Rettie and Messier, 1998.

Table 7. Comparison of survey results of the 2003, 2005, 2007, and 2010 population estimates of the Chisana caribou herd.

Parameter	2003[b]	2005[c,d]	2007[d]	2010
Population estimate	720	706	766	682
90% confidence interval[a]	606 – 833	646 – 792	719 – 823	622 – 832
Group size coefficient for the sightability model	0.166	0.175	0.178	0.06
Number of radio-collared caribou in the herd	39	97	138	96
Number of marked groups used to estimate the sightability model	30	45	30	28
Number of marked groups in the survey area that were observed	20	35	25	22
Average size of marked groups	15.3	10.6	21.5	17.9
Range of marked groups	1 – 54	1 – 34	1 – 65	4 – 58
Proportion of all radio-collared animals located inside the survey area	1.0	0.92	0.96	0.97

a: The lower limit of the confidence interval is truncated at the minimum number of animals known to be alive in the herd during the survey years (see Table 2 for 2010 numbers); b: from Adams (2003); c: from Adams and Roffler (2005); d: from Adams and Roffler (2007).

Implications for Harvest Management

As noted previously, the Management Plan for the Chisana Caribou Herd (the Plan) outlines 3 considerations that must be met before harvest of the herd may be resumed: a stable, or increasing, herd size based on the October 2010 estimate, an adult sex ratio of at least 35 bulls: 100 cows, and a 3-year moving average of October calf recruitment of at least 15 calves: 100 cows. Based on our results, the herd can be considered stable.

When examining the 4 population estimates from 2003 to 2010, and their degree of uncertainty, there is no clear increasing or decreasing trend (Figure 2). Additionally, the slope of the parameter estimating the trend in the herd's size, based on a linear regression, from 2003 to 2010 was not significantly different from zero (β = -3.4, SE = 8.0). The trend coefficient from a linear regression of natural log-transformed abundance estimates was also not significantly different from zero.

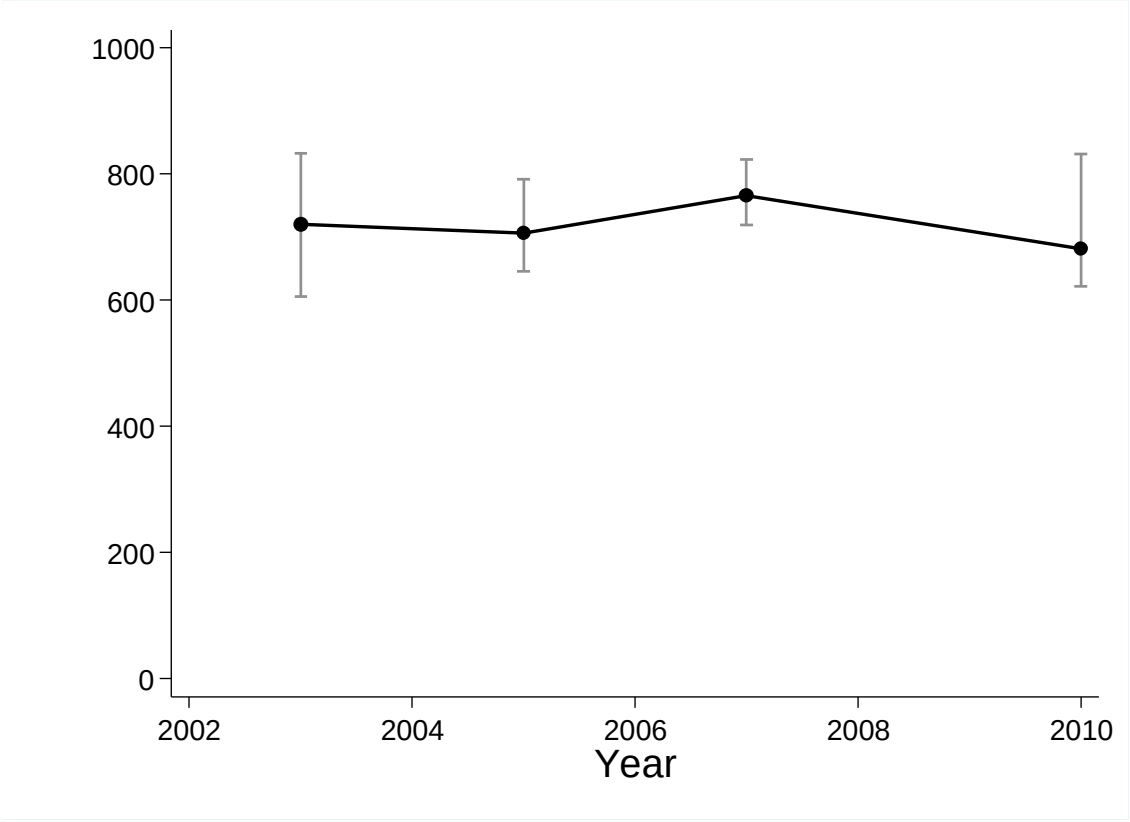

Figure 2. Population estimates of the Chisana caribou herd from 2003 to 2010. The solid black line connects each year's population estimate.

The upper and lower grey lines represent 90% confidence intervals of each year's estimate. Confidence intervals are asymmetric as lower values were truncated by the number of caribou observed during the surveys.

While the Plan calls for a minimum of one census within its life (2010 – 2015), it also recommends that an additional census be conducted. It is recommended to conduct another census in 2013 in order to take advantage of the remaining radio-collars on the herd. Results from this census will also be used to develop a formal sightability model (based on all past mark-resight censuses) such that future population estimates can be obtained without the use of radio-collars. That is, this final sightability model could be applied during annual composition surveys to correct for missed animals and obtain a herd abundance estimate, with a measure of precision.

The adult sex ratio of the herd in 2010 was estimated at approximately 42 bulls: 100 cows (Table 2), greater than the minimum threshold required under the Plan. The 2011 composition survey of the Chisana caribou herd (carried out prior to the preparation of this report) estimated an adult sex ratio of 38 bulls: 100 cows. The 3-year moving average of October calf recruitment was also greater than the 15 calves: 100 cows threshold indicated in the Plan (Figure 3), with a value of 19.7 in 2010 and 18.0 in 2011.

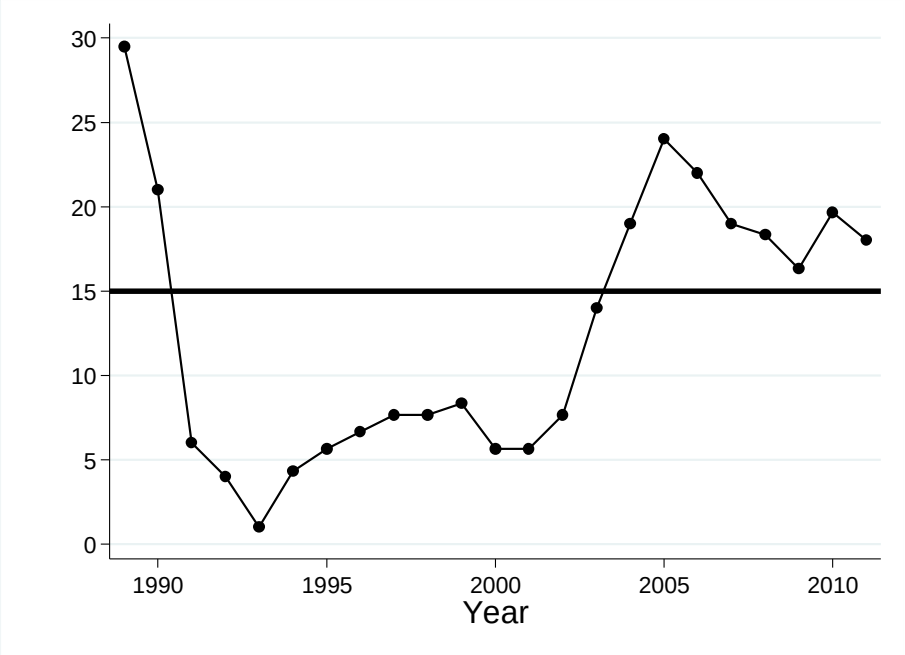

Figure 3. Three-year moving average calf recruitment (calves: 100 cows) from 1987 to 2011.

The year value on the x-axis indicates the final year for each 3-year average. As this analysis was conducted after the 2011 composition survey of the herd was conducted, those data are also included here. The solid black horizontal line indicates the threshold of 15 calves: 100 cows required to resume harvest of the herd.

Literature Cited

ADAMS, L. G. 2003. Chisana Caribou Census – 19-20 October 2003. Us Geological Survey, Anchorage, Ak. Unpublished Report. 10pp.

ADAMS, L. G., AND G. H. ROFFLER. 2005. Chisana caribou census – 15-16 October 2005. US Geological Survey, Anchorage, AK. Unpublished report. 9pp.

ADAMS, L. G., AND G. H. ROFFLER. 2007. Chisana caribou census – 13-13 October 2007. US Geological Survey, Anchorage, AK. Unpublished report. 9pp.

BURNHAM, K. P., AND D. R. ANDERSON. 2002. Model selection and multimodel inference: a practical information-theoretic approach, 4th edition. Springer, New York, New York.

CHISANA CARIBOU HERD WORKING GROUP. 2012. Management plan for the Chisana caribou herd: 2010–2015. Government of Yukon, Whitehorse, Yukon, Canada. 48pp.

CHISANA CARIBOU RECOVERY TEAM. 2010. Recovery of the Chisana caribou herd in the Alaska/Yukon borderlands: Captive-rearing trials. Yukon Fish and Wildlife Branch Report TR-10-02. Whitehorse, Yukon, Canada.

FIEBERG, J. 2012. SightabilityModel: Wildlife Sightability Modeling. R package version 1.0. http://CRAN.R-project.org/package=Sightability Model.

R CORE TEAM. 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. www.R-project.org/

RETTIE, W. J., AND F. MESSIER. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

STEINHORST, K. R., AND M. D. SAMUEL. 1989. Sightability adjustment methods for aerial surveys of wildlife populations. Biometrics 45: 415-425.