Jasper National Park Aerial Elk Survey, January 2013

2014

Mark Bradley and Layla Neufeld

Jasper National Park

Parks Canada Parcs Canada

Approvals

Recommended by: _____
John Wilmshurst, Manager
Resource Conservation

8 May 14
Date

Approved by: _____
Greg Fenton, Superintendent
Jasper National Park

13-05-14
Date

Executive Summary

We conducted an aerial elk survey from January 13th to January 28, 2013 in Jasper National Park. We used logistic regression to estimate sightability. We estimate that there were 317 elk (90% confidence interval = 39) in the main study area, which included the Athabasca valley, some of the Rocky River valley and the Snake Indian valley. There has been a decline in elk since 2009 (population estimate of 435, 90% confidence interval = 67). We could not find enough elk in the Brazeau valley study area to calculate a population estimate.

Table of Contents

List of Figures

List of Tables

Introduction

Elk have long been a key species in the history of wildlife management in Jasper National Park. At the time of park establishment (1907), overhunting was thought to be the cause of the almost total absence of elk in both Jasper National Park and Alberta as a whole. In 1920, the superintendent of the day brought 88 elk from Yellowstone National Park in the U.S.A. and introduced them into Jasper. Wildlife management practices of that era included predator control, so the introduced elk soon reached high population numbers – more than three thousand by 1930. High elk numbers prevailed for many decades, and were responsible for vegetation degradation and a decline in Aspen *(Populus tremuloides)* recruitment (McTaggart-Cowan 1946, Beschta and Ripple 2007)). Rather than allow predators to return, park managers instituted elk culls in an attempt to prevent further range degradation – almost 3,000 elk were killed over the course of 26 years (the meat was given to needy people). After predator control was finally halted in 1959, wolves gradually became more numerous and elk numbers began a long-term decline (though with considerable variation in both elk and wolf numbers) that continues to this day. We believe that these management actions dramatically altered the relationships among elk, vegetation, wolves and people, and have contributed to the long-term decline of caribou in Jasper National Park.

Over time, the remaining elk in Jasper National Park have become habituated to human presence – many elk no longer leave the vicinity of the town or highways. As such, elk require aggressive management to prevent both vehicle strikes and aggressive encounters with people. Elk population size has been identified as an important ecological indicator for Jasper National Park (Hebblewhite et al. 2007, Jasper National Park 2008, 2010). Precise estimates of elk population size are therefore important for park managers.

We describe in this report a population estimate for elk in Jasper National Park, calculated from data obtained during an aerial survey in January of 2013. Aerial surveys were also flown in 2008 and 2009. The 2008 and 2009 surveys were designed to estimate both elk and moose

populations, but poor precision led us to abandon the attempt to estimate moose abundance and we concentrated solely on elk in 2013.

Methods

Study Area and Stratification

Aerial surveys followed guidelines established by Unsworth et. al. (1999). In 2008 we delineated a study area to encompass most moose and elk range within Jasper National Park – the Snaring and Brazeau drainages were excluded from the study area because the Snaring was thought to contain too few elk, and the Brazeau was too distant to be surveyed with the available budget. The 2008 study area was divided into 30 sample units ranging from 23 km^2 to 39 km^2 (mean = 29.9 km^2) (Figure 1). Stratification is the process of assigning the sample units into groups of similar relative densities (e.g. high, medium, and low) prior to the survey, as a means of increasing survey precision through the efficient allocation of survey effort (see Unsworth et. al. (1999) for a more complete explanation). Our sample unit stratification was based on *a priori* knowledge of elk distribution gained mostly through roadside surveys, but also included Jasper National Park's ecological land classification (Holland et al. 1983). The stratification of survey units changes prior to every survey, based on insights gained in the previous survey. For the 2013 survey, we discarded 11 survey units that had been included in the 2008 and 2009 survey areas because we could find no evidence of elk within them during the 2008 and 2009 surveys – 19

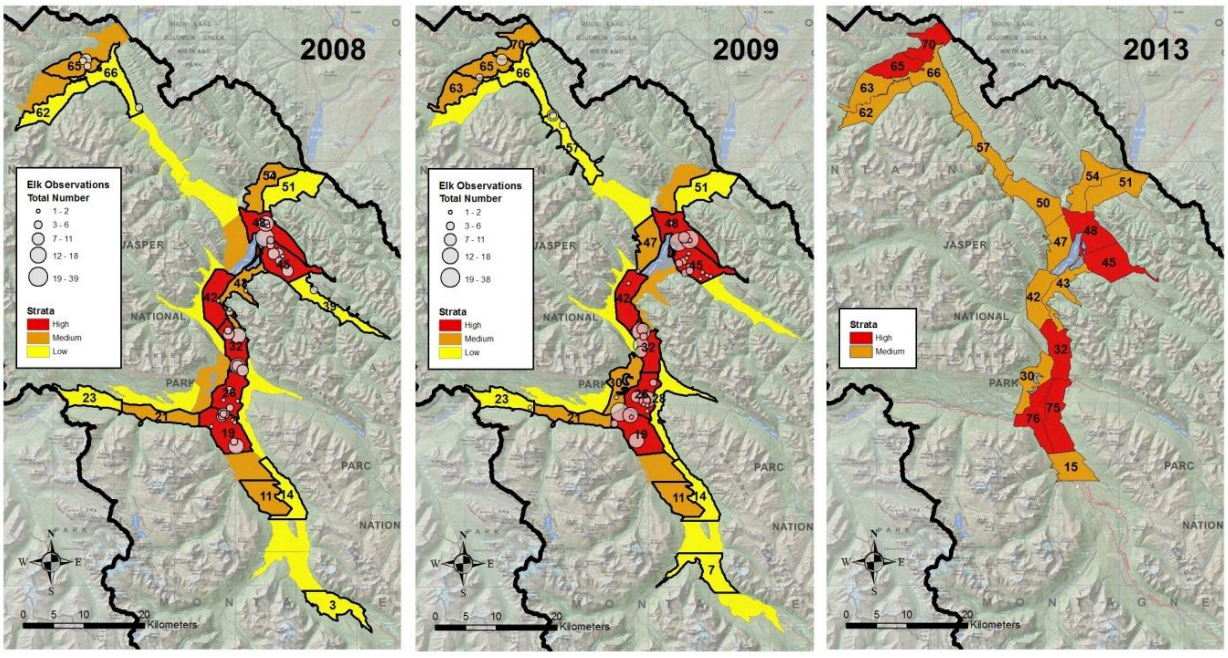

Figure 1. The 2013 study area, sample units and stratification (far right). The 2013 study area and stratification are based on the 2008 and 2009 survey results, depicted on the left. The sample units from 2008 and 2009 that were surveyed are shown with a bold border.

survey units remain (Figure 1). Many of the sample units excluded in 2013 had been included in 2008 and 2009 in an attempt to survey moose. In 2008 and 2009 each sample unit was classified into a high, medium, or low stratum for both elk and moose prior to the survey, but in 2013 we simplified the stratification scheme into just two strata: high and medium. Also, some sample unit boundaries were redrawn to increase survey efficiency. A comparison of the study areas for the three years and their sample units is shown in figure 1.

Also for 2013, we added a disjunct study area in the Brazeau River drainage that was not part of the 2008 or 2009 study areas (Figure 2). The Brazeau study area was 213 km^2, and contained 7 sample units ranging from 19 to 38 km^2, with a mean of 30 km^2. Because there were only 7 sample units, they were all assigned to one stratum. We considered the Brazeau study area to be completely separate from the main study area, because with 100 elk/years of radio-telemetry data, no elk had ever moved from the main area to the Brazeau study area.

We randomly selected 15 of the 19 sample units in the main study area for surveying. All seven of the sample units within the high stratum were selected, as well as 8 of 12 sample units in the medium stratum. Five of the 7 sample units in the Brazeau study area were randomly chosen for surveying. In addition to elk, observations of moose, deer, wolves, and bighorn sheep were recorded during the survey although these observations were not sightability corrected.

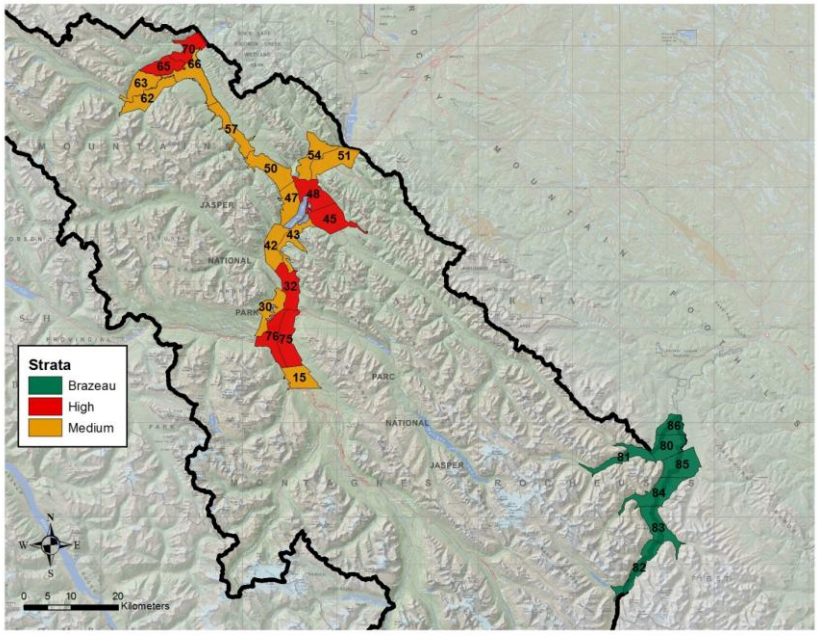

Figure 2. The Brazeau elk study area, in relation to the main study area.

Sample units were flown in transects approximately 300 m apart, at a speed of 60 to 80 km/hr as dictated by terrain and animal density (Unsworth et al. 1999). When animals were sighted, the location and total number of animals observed in the group were recorded. Groups were then

classified into sex and age classes (branched bull, spike bull, cow, calf), or documented as unclassified. The activity of the first animal observed (bedded, standing, moving), as well as vegetation class (Open/water, deciduous shrub, deciduous trees, conifers), percent snow cover, and percent canopy cover were recorded at each observation (Unsworth et al. 1999). The area used to estimate vegetation and snow cover was a circle enclosing each group, plus 30 feet. In sample units where no animals were sighted, zeroes were entered in all fields for analysis.

We will also compare our aerial population estimates to annual roadside elk counts. The roadside counts are conducted each winter when elk are concentrated in the valley bottoms near roads. Roadside counts are not corrected for sightability, and are therefore just a minimum number of elk seen, but given their habit of occupying open habitats in large groups, we feel that sightability is likely high. For the purposes of comparison, we used only elk that were in sample unit 42 and south, because elk north of sample unit 42 were usually unavailable for counting from the road.

Data Analysis

We calculated a population estimate using Unsworth et al's Aerial Survey program (Unsworth et al. 1999). Aerial Survey calculates three types of variance: sampling, sightability, and model. Sampling variance is variation due to difference among sample units within each stratum. Sightability variance is variation due to differences in sightability of groups, estimated by parameters such as activity, vegetation class, snow cover, and canopy cover. Model variance is variation attributed to deviation from the chosen model. Sightability of elk was corrected using the Elk Hiller 12-E Idaho model (Unsworth et al. 1999). The Hiller model uses stepwise logistic regression to identify variables that significantly influence visibility bias. The Hiller model was developed over 10 years in four locations in Idaho. We felt that this model was the closest match for our study area. We collected sightability data during our survey (i.e. kept track of collared elk observed, and went back and found collared elk that we did not observe), so we will eventually be able to construct a sightability model based on data collected in our study area.

Results

Survey Conditions

Survey conditions (temperature, wind, snow cover and cloud cover) during sample unit searches were acceptable for aerial surveys.

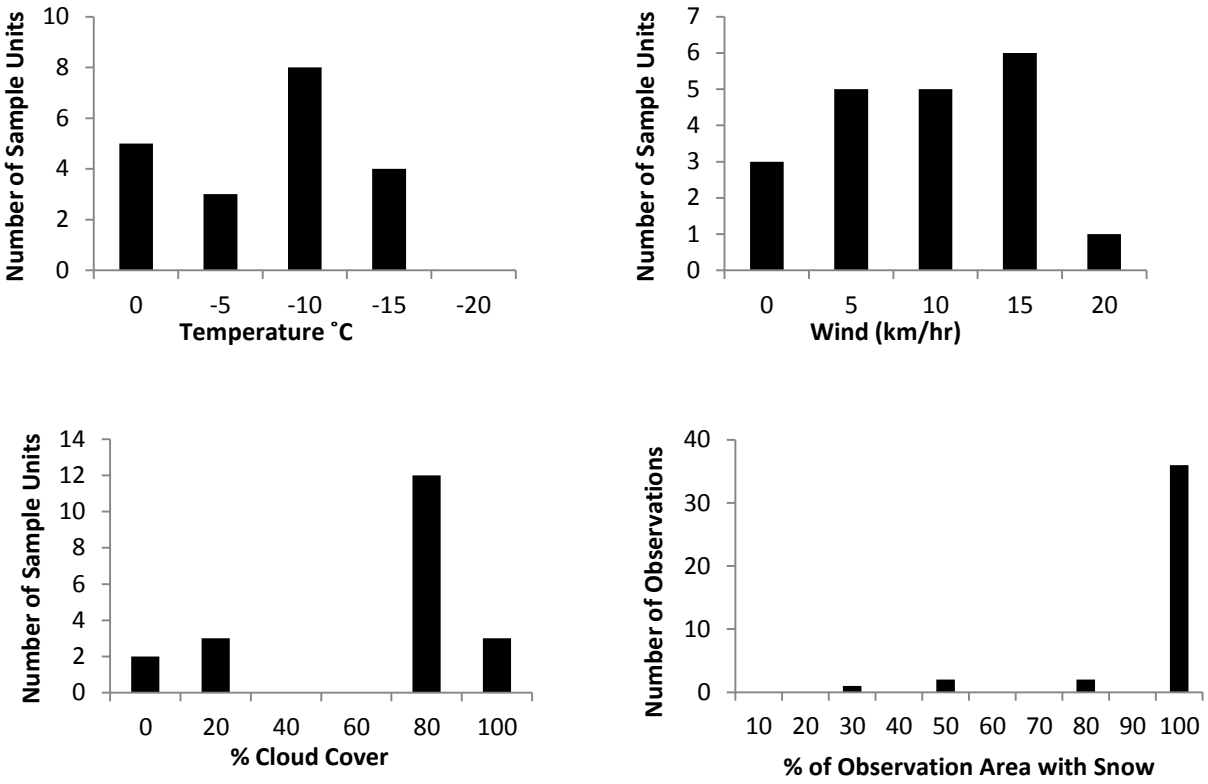

Figure 3. Histograms of temperature, wind and cloud cover by sampling unit, and a histogram of % snow by observation.

Brazeau

The Brazeau survey was conducted on January 26th and January 27th, 2009. Five of the seven sample units were flown, and a total of 7 elk were observed, all of them bulls (table 2). One more bull was seen within the study area while flying over an unsurveyed sample unit.

Because the number of elk observed was so small, we did not attempt to calculate a population estimate based on sightability. During previous work in the area, numerous elk tracks were seen to the east of our study area

Table 1. Counts by species for the Brazeau study area, 2013.

Species	Count
Elk	7
Moose	6
Bighorn Sheep	66
White-tailed Deer	5
Mule Deer	0
Wolves	0

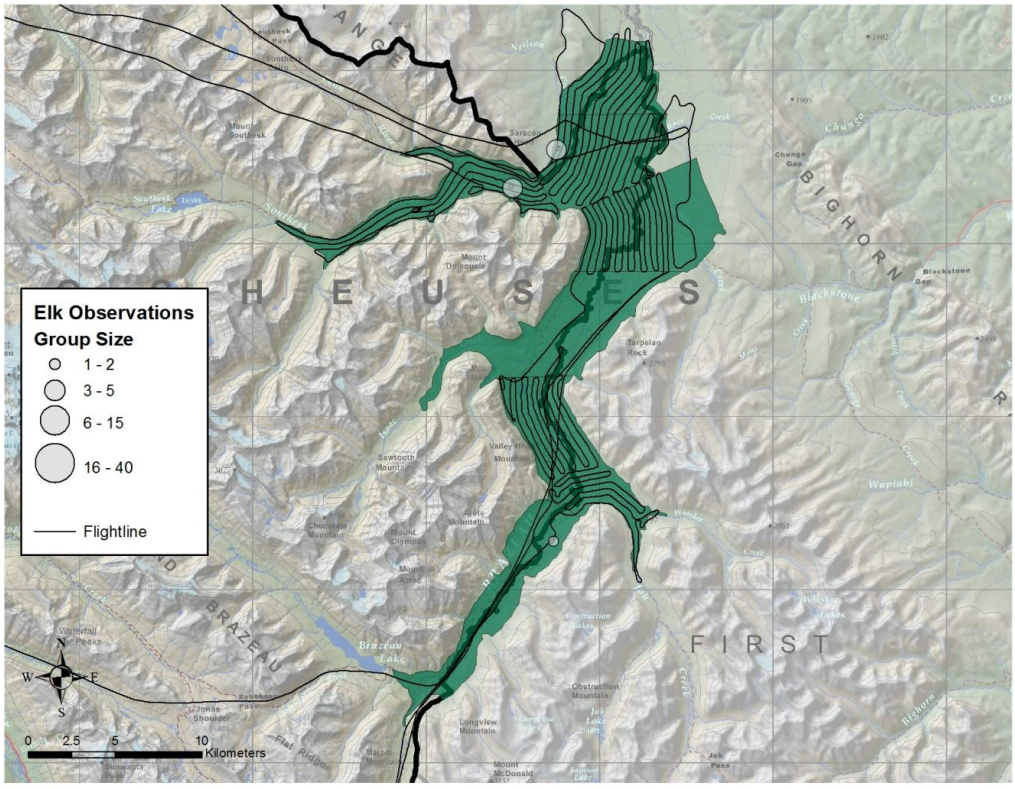

Figure 4. Elk observations and flight lines for the Brazeau study area, 2013.

Main Study Area

The main study area was surveyed over 5 days between January 13th, and 25th (Figure 4). Inclement weather prevented us from flying on consecutive days. Adjacent sample units 57 and 66 were flown 8 days apart, but we used tracks and group composition to ensure that we did not double count elk (Figure 3).

We counted a total of 290 elk within the sample units (Table 3). **We calculated a population estimate of 317 elk, with a 90% confidence interval of 39** (Table 4). Most of the variance was due to differences among sample units (sampling variance) rather than sightability variance. Sampling variance in stratum 1 was zero because we surveyed all of the sample units in that stratum.

Table 2. Counts by species of main study area, 2013.

Species	Count
Elk	270
Moose	53
Bighorn Sheep	67
White-tailed Deer	31
Mule Deer	14
Unclassified Deer	3
Lynx	4
Wolves	13

Table 3. Number of elk of each sex/age class counted in each stratum.

	# of Sample Units		Number counted within each class				
Stratum	Population	Sample	Total	Cows	Calves	Bulls	Spikes
1 (High Density)	7	7	230	146	23	53	8
2 (Low Density)	12	8	40	18	2	19	1
Total	19	15	270	164	25	72	9

Table 4. Population estimate for the main study area, 2013.

	# of Sample Units		Population	Variance		
Stratum	Population	Sample	Estimate	Sampling	Sightability	90% C.I.
1 (High Density)	7	7	245	0	88	15
2 (Low Density)	12	8	72	407	59	36
Total	19	15	**317**	407	147	**39**

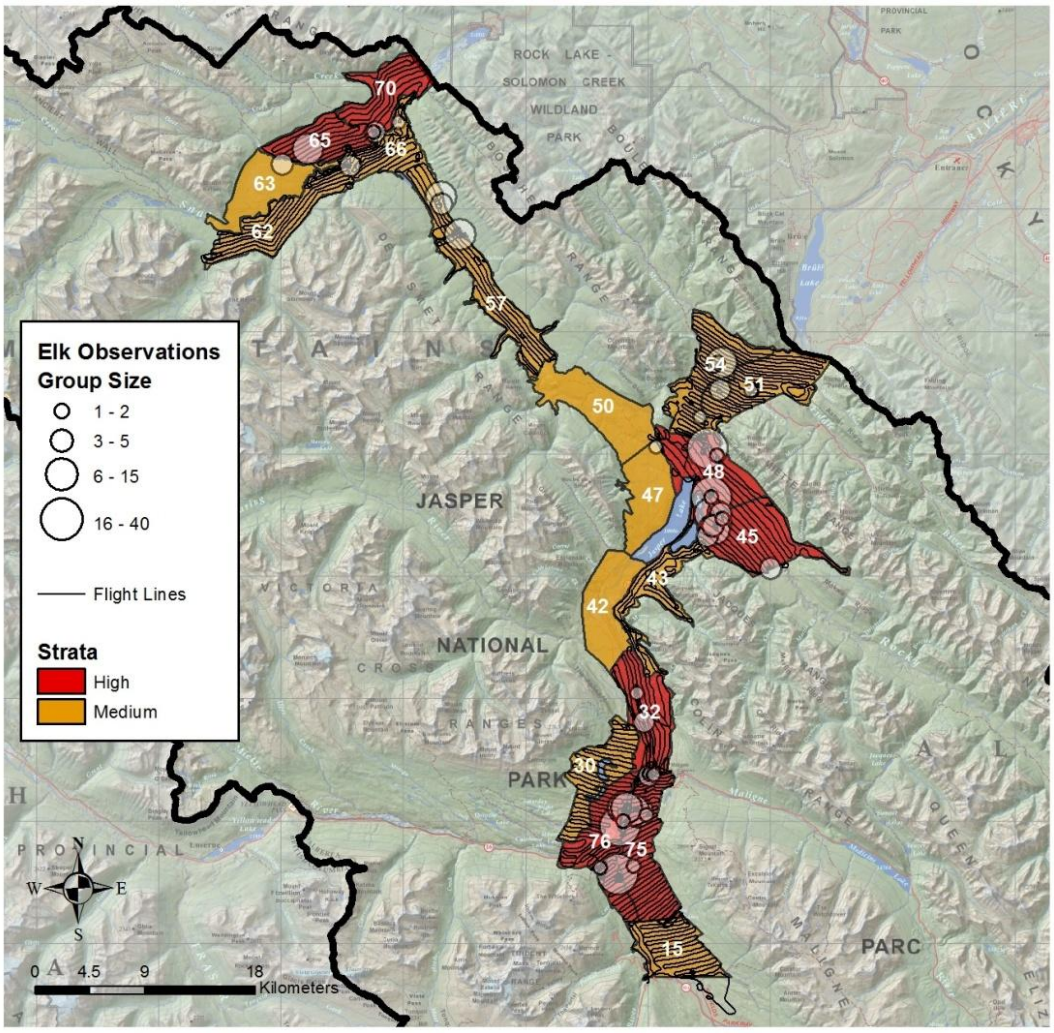

Figure 5. Elk observations and flight lines for the main study area.

Population Trend in the Main Study Area

The population estimates calculated in 2008 and 2009 did not differ, as illustrated by the overlapping confidence intervals (Figure 5). There was a statistically significant decline between 2009 and 2013, as demonstrated by the disjunct confidence intervals (Figure 5). Figure 6 compares a subset of the population estimates with annual roadside counts (we discarded data on elk north of sample unit 42, because those elk were usually unavailable for counting from the roadside).

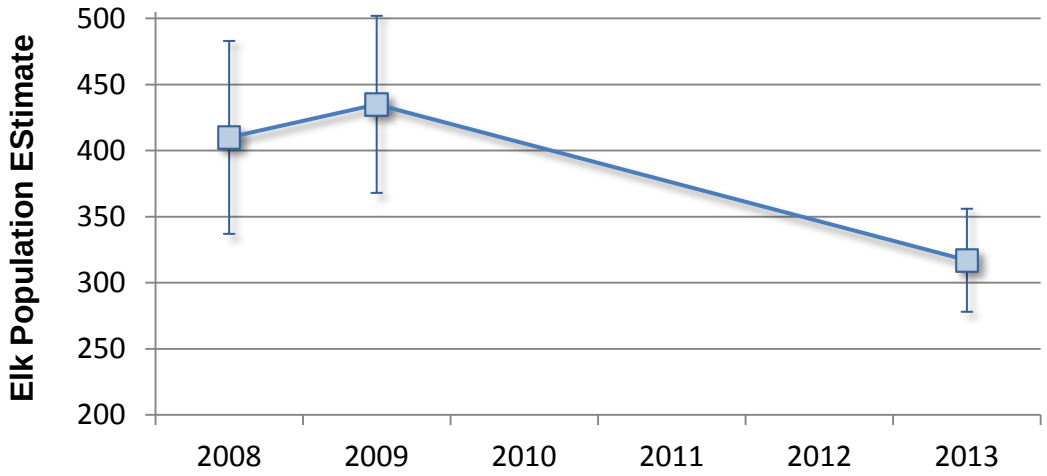

Figure 6. A comparison of population estimates from 2009 to 2013 (note: y axis does not include zero).

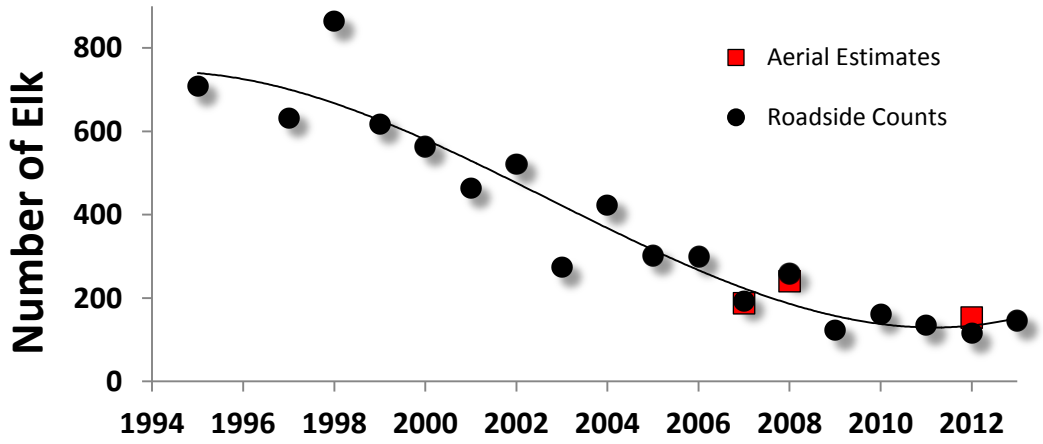

Figure 7. A comparison of Jasper National Park roadside elk counts and a subset of our aerial population estimates. The line is a polynomial regression of the roadside counts ($y = 0.2557x^3 - 1536.4x^2 + 3E+06x - 2E+09$, $R^2 = 0.9043$).

Discussion

The elk population estimates produced by the Elk Hiller 12-E Idaho model (Unsworth et al. 1994) appear to be consistent and reliable. As noted after the last survey in 2009 (Robinson et al 2009), we produced similar population estimates in both 2008 and 2009 despite low snow cover in 2008, and high snow cover in 2009. While the good snow cover in 2009 enabled us to achieve a higher count compared to 2008, the model accounted for the change in sightability and produced a similar population estimate (Figure 6). In 2013 we also had excellent snow cover, and the precision of our estimate was high. We believe that the good survey conditions and increased sampling intensity likely produced the tighter confidence intervals in 2013. We sampled 15 out of 19 sample units (79%) in 2013, compared to 18 out of 30 in 2008 (60%), and 19 out of 30 sample units in 2009 (66%).

We improved precision for the 2013 survey, but was the decline in abundance that we report in this study accurate? The only other data source we have is the roadside elk count (Figure 7). We restricted both datasets (aerial population estimates and roadside counts) to the geographic areas common to both data sources. There are only 3 datapoints, so uncertainty is still high, but the two datasets seem to represent the same trend in elk numbers, so we believe that the drop in elk abundance is genuine.

The original funding for conducting the 2008 and 2009 elk surveys was provided by the Kinder Morgan Corporation as part of the mitigation for twinning their oil pipeline through Jasper National Park. We had thought that the pipeline twinning would result in an increase in elk forage along the pipeline right of way, and would therefore cause an increase in elk. These aerial population estimates were not specifically designed to look at elk abundance in relation to the pipeline, and many other factors could also have changed between 2009 and 2013 besides the pipeline, however the elk population has declined, so the overall situation for elk has not resulted

in a net population increase. Further investigation into the effects of the pipeline is warranted, perhaps using our GPS collar data and a resource selection analysis.

The funding for the 2013 elk survey was provided by Parks Canada's National Office to provide information on predator/prey dynamics in relation to our threatened caribou populations. The accepted mechanism of caribou decline across the country, and in Jasper National Park is apparent competition – the decline of one prey population (in this case, caribou) because of the high density of a second prey population (in this case, elk) that share a common predator (in this case, wolves) (Holt 1977, Rettie and Messier 1998, Wittmer et al. 2007, DeCesare et al. 2009). Hebblewhite et al. (2007) created a model that estimated the effect of apparent competition on caribou in both Banff and Jasper national parks. Based on their model, they correctly predicted the demise of the Banff population (extirpated in 2009), but failed to predict the further decline of the three Jasper populations. A re-examination of apparent competition in Jasper National Park is therefore warranted, and the elk density we report here will represent an important part of the information required.

We included a survey of the Brazeau River valley in this year's study, because we thought that we would find substantial numbers of elk, and the area had been excluded from the previous study areas. We found very few elk however. There were elk tracks nearby in Alberta, and parks staff have seen elk in the area at other times. It seems therefore, that large numbers of elk are not always within the area we surveyed, so a proper evaluation of elk abundance in the Brazeau area would have to consider a much larger study area that included nearby provincial lands. Such a study area was outside the scope of the current study, and was too ambitious for our budget. In the future, perhaps we could participate in provincial elk studies on adjacent lands.

Our use of sightability models developed in Idaho may introduce bias in our population estimates. Presumably this bias is constant and therefore can be ignored when comparing among between years, however it would be ideal to develop our own sightability model based on locally obtained parameters. Observations of collared and un-collared elk made during the 2013 survey will be used to develop a sightability model specific to Jasper National Park.

Literature Cited

Beschta, R. L. and W. J. Ripple. 2007. Wolves, elk, and aspen in the winter range of Jasper National Park, Canada. Canadian Journal of Forest Research 37:1873-1885.

DeCesare, N. J., M. Hebblewhite, H. S. Robinson, and M. Musiani. 2009. Endangered, apparently: the role of apparent competition in endangered species conservation. Animal Conservation **13**:353-362.

Hebblewhite, M., J. Whittington, M. Bradley, G. Skinner, A. Dibb, and C. White. 2007. Conditions for caribou persistence in the wolf-elk-caribou systems of the Canadian Rockies. Rangifer Special Issue **17**:79-90.

Holland, W., G. Coen, G. Holroyd, and K. Van Tighem. 1983. Ecological (biophysical) land classification of Banff and Jasper National Parks. Page 540.

Holt, M. E. 1977. Predation, apparent competition, and the structure of prey communities. Theoretical Population Biology **12**:197-229.

Jasper National Park. 2008. Jasper National Park of Canada State of the Park Report. Page 64 *in* P. Canada, editor. Parks Canada, Jasper, Canada.

Jasper National Park. 2010. Jasper National Park Management Plan.*in* Parks Canada Agency, editor., Jasper, Canada.

McTaggart-Cowan, I. 1946. Report of wildlife studies in the Rocky Mountain National Parks in 1945. Page 34.

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.

Unsworth, J. W., F. A. Leban, E. Garton, D. J. Leptich, and P. Zager. 1999. Aerial survey for Windows (Aerial survey: user's manual). Online Report:67 pgs.

Wittmer, H. U., B. N. McLellan, R. Serrouya, and C. D. Apps. 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. Journal of Animal Ecology **76**:568-579.