

**INVENTORY STUDIES
KLAZA CARIBOU HERD
2012 ACTIVITIES**



**Prepared By:
Troy Hegel**



January 2013

INVENTORY STUDIES KLAZA CARIBOU HERD 2012 ACTIVITIES

Yukon Fish and Wildlife Branch PR-13-01

Acknowledgements

The Environment Yukon capture crew for both capture sessions consisted of Kyle Russell, Martin Kienzler, and Joe Bellmore. The composition survey crew consisted of Kyle Russell and Joe Bellmore (Environment Yukon) and Gary Wheeler (community observer). A number of people participated on the resighting surveys: Environment Yukon (Julia Ahlgren, Matt Clarke, Kathi Egli, Shelley Marshall, Heather Milligan, Mark O'Donoghue, and Kyle Russell), Canadian Wildlife Service (Shannon Stotyn), Environmental Dynamics Inc. (Graeme Pelchat and Kelsey Russell), and local community observers (Alex Charlie and Gary Wheeler). Funding for the collaring activities was provided by Environment Yukon and Aboriginal Affairs and Northern Development Canada. Funding for the composition survey was provided by Environment Yukon. Funding and in-kind support for the mark-resight survey was provided by Environment Yukon, Casino Mining Corp., and Yukon Department of Energy, Mines and Resources. We acknowledge the Little Salmon/Carmacks and Selkirk First Nations whose traditional territories this work occurred in and for their support of the project. Mark O'Donoghue provided comments on an earlier draft of this report. Air charter support was provided by Heli-Dynamics Ltd. (resighting surveys and late-winter animal captures) and Kluane Helicopters (composition survey and fall animal captures).

© 2013 Yukon Department of Environment

Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5R
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-3645, Fax (867) 393-6405
Email: environmentyukon@gov.yk.ca

Also available online at www.env.gov.yk.ca

Suggested citation:

HEGEL, T. 2013. Klaza caribou herd inventory studies: 2012 activities. Yukon Fish and Wildlife Branch report PR-13-01. Whitehorse, Yukon, Canada.

Summary

A large-scale inventory study of the Klaza caribou herd (west of Carmacks) began in 2012 due to concerns regarding the level of industrial activity taking place in the herd's range.

- During the winter and fall of 2012, 30 GPS radio-collars were deployed on adult female caribou.
- In late-September 2012 a composition survey was conducted for the first time since 2003. Calf recruitment for the herd was low (14 calves per 100 cows), which may be due to the harsh winter that this area experienced prior to calving in May of 2012. The adult sex ratio (bull: cow) of the herd (27 bulls per 100 cows) was also lower than previously observed. The reason for this is currently unknown.
- Licensed harvest of the herd, managed as a permit hunt, was relatively modest with an average of 6.7 bulls per year.
- A population estimate for the herd was completed in late October 2012, yielding an estimate of 1179 animals. We could not assess whether the herd had changed in size from previous estimates given the lack of a comparable survey area with the previous work.

Table of Contents

Acknowledgements.....	Inside Cover
Summary.....	i
Table of Contents.....	ii
List of Tables.....	ii
List of Figures.....	ii
Introduction.....	1
Collaring Activities.....	2
Composition Survey.....	2
Population Estimate.....	3
Future Activities.....	15
Literature Cited.....	17

List of Tables

Table 1. Summary statistics of the 2012 fall composition survey of the Klaza caribou herd.....	6
Table 2. Numbers of marked and unmarked caribou observed during the four resighting surveys of the Klaza caribou herd (October 2012).	9
Table 3. Mark-resight models fitted to the resighting survey data to estimate the abundance of the Klaza caribou herd.	9
Table 4. Estimates of abundance and resighting rate of the Klaza caribou herd from the most supported mark-resight model (see Table 2).....	9

List of Figures

Figure 1. Capture locations during radio-collar deployment activities on the Klaza caribou herd (March and September/October 2012).	4
Figure 2. Locations of caribou groups observed during the 2012 composition survey of the Klaza caribou herd (Sept. 28, 2012).....	5
Figure 3. Calf recruitment (calves:100 cows) in the Klaza herd (1987 – 2012). .	6
Figure 4. Adult sex ratio (bulls:100 cows) in the Klaza caribou herd (1987 – 2012).....	6
Figure 5. Annual licensed bull harvest (resident + non-resident) of the Klaza caribou herd (1995 – 2012).....	7
Figure 6. Survey blocks used for the mark-resight survey of the Klaza caribou herd. Survey times (minutes) are labelled within each block.....	10
Figure 7. Caribou observations and survey tracks for resight session 1.	11
Figure 8. Caribou observations and survey tracks for resight session 2.	12
Figure 9. Caribou observations and survey tracks for resight session 3.	13
Figure 10. Caribou observations and survey tracks for resight session 4.	14
Figure 11. Recommended revisions to resighting survey blocks.	16

Introduction

Mineral exploration and industrial development is proceeding rapidly in the area west of Carmacks (Yukon), and has been the focus of interest since the 1980s (Farnell et al. 1991). The Klaza caribou herd occurs in this area and there is a high potential and significant risk that this population could be impacted by these activities. In 2011, Environment Yukon biologists conducted a conservation assessment of all mountain caribou herds in Yukon. The Klaza herd ranked highest with respect to the level of conservation threats affecting the herd and its range. Obtaining additional information about the Klaza herd was also a top priority of the Little Salmon/Carmacks Community Based Fish and Wildlife Management Plan (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011). Additionally, the Klaza herd is a member of the Northern Mountain Population of woodland caribou which is federally listed as a Species of Special Concern under Canada's *Species at Risk Act* (SARA).

Collectively, the above factors lead to the initiation of a large-scale baseline assessment of the herd through collaboration with the Government of Yukon and industry partners.

The goals of this assessment are to gather information on the herd including abundance, demographic, range use, and habitat information.

With the exception of broad landscape-level late-winter surveys conducted in 2010 and 2011, the most recent distribution data for the herd are from the 1990s while demographic data for the herd was last established from a fall composition survey in 2003. The most recent estimate of the herd's size is based on a fall composition survey from 2000 in which 651 animals were observed. Given that this represents a minimum count and the survey was not intended to estimate abundance (i.e., there was no way to adjust the number of animals observed to account for detectability), Environment Yukon's working estimate of the herd's size has been 700 animals, acknowledging the uncertainty surrounding this number. Thus, our best available information on the herd's size was over 12 years old.

The objectives of the 2012 fieldwork were to:

- deploy GPS radio-collars to increase our understanding of the seasonal distribution of the herd and to aid in the development of habitat models for use in environmental assessment and mitigation;
- conduct a fall composition survey of the herd to assess both recruitment (calf:cow ratio) and sex ratio (bull:cow ratio); and
- estimate the size of the herd.

Collaring Activities

In February 2012, 30 GPS radio-collars were purchased from Advanced Telemetry Systems.

These collars are linked to the Iridium satellite system and were programmed to record a location every 8 hours (i.e., 3 locations per day). Collars were to be deployed on adult females in the herd, distributed across the entire herd's range. Captures were conducted via helicopter net-gun. In March 2012 we initiated capture operations using a Bell 407 helicopter. Due to the deeper snow levels at higher elevations, animals were generally located in low elevation, heavily forested areas and only 4 collars were deployed because of difficulty locating animals in areas where they could be safely captured (Figure 1). In late-September 2012 we re-initiated capture operations using an A-Star helicopter (AS350 B1) to deploy the remaining 26 collars from 29 September to 3 October (Figure 1).

All collars began transmitting data after deployment. However, roughly 2 weeks post-capture, one collar (deployed in February) failed and no additional data have been recovered from it. Additionally, one animal captured in February moved south of the Nisling River and has remained in areas generally considered to be the Aishihik herd. As of December 2012, one collar was in mortality mode. We have not yet been able to retrieve that collar. Therefore, as of January 2013, there are effectively 27 active collars in the Klaza herd.

Composition Survey

To assess both recruitment and the adult sex ratio of the herd, a fall composition survey was completed via helicopter (AS350 B1) on 28 September 2012, immediately prior to the capture operations. High elevation alpine and subalpine areas were surveyed to locate breeding groups consisting of bulls and cows/calves (Figure 2). Twenty-one groups of caribou were observed during approximately 8 hours of survey time covering approximately 1200 km of linear flight path. Results of the composition survey are summarized in Table 1.

Calf recruitment in 2012 was the lowest since composition surveys began in 1987 (Figure 3). The low recruitment was also corroborated by the lack of any calves at heel among the 26 cows captured during the collaring activities. This may have been due to the higher than average snow pack during the 2012-13 winter. March 2012 precipitation in the Carmacks area was 200 - 250% greater than the long-term average (Yukon Snow Survey Bulletin and Water Supply Forecast, Water Resources Branch, April 2012). The Pacific Decadal Oscillation (PDO; a large-scale climate index) in May, which has been shown to influence calf recruitment via a positive relationship (Hegel et al. 2010), was the second lowest since 1987. The winter (November to April) PDO value was the third lowest since 1987. Generally, the lower the PDO value the higher the amount of snowfall.

Additionally, a higher PDO value in spring generally indicates an earlier snow-free period. Deep and/or late snowfall at higher elevations limits the mobility of parturient females to move to high elevation calving sites away from potential predators.

The adult sex ratio, measured as the ratio of bulls to cows, was also the lowest observed since 1987 (Figure 4). Given that the most recent composition survey was in 2003 it is difficult to assess if this represents a declining trend in sex ratio, however the sex ratio estimated during the previous surveys typically ranged from 40 to 50 bulls per 100 cows (Figure 4). Licensed resident harvest of the herd is under a permit hunt authorization and currently only 12 permits are issued annually. There is also a non-resident quota for the herd. From 1995 to 2012 the average number of animals harvested by licensed hunters was 6.7 (Figure 5). Temperatures in late September in the area were much higher than normal, which may have influenced the aggregation of animals to the breeding areas. An additional composition survey may be warranted within the next year or two to validate the questionably low adult sex ratio.

Population Estimate

We adopted a mark-resight approach (White 1996, McClintock and White 2012) to estimate the size of the Klaza herd, using the collared animals as the “marked” sample.

From 16 to 24 October 2012 we conducted 4 resight surveys with independent crews using a Bell 206L2 helicopter. Prior to the survey, the study area was divided into survey blocks based on terrain and drainage features. For each resight survey we initially allocated 550 minutes (9.2 hours) of survey time and allocated that total time among the different survey units based on their size and previous caribou observations in them. After the first resight session we realized that we had insufficient time for refuelling ferries and the survey times per block were adjusted, to a total of 495 minutes (8.25 hours) of survey time (Figure 6). The purpose of allocating a survey time per block was to ensure that there was some standardized amount of effort across all resight sessions. We began the resight surveys in mid-October as we assumed that by this time, breeding groups would have dispersed. This was an important consideration as we wanted to ensure that the group sizes in which animals were marked (i.e., collared) were different from those when the resighting surveys took place, so as not to bias our sightability of marked animals by a group size effect. This bias could occur if animals that were marked while they were in large groups also had a higher sightability during the resighting sessions because they remained in those large groups.

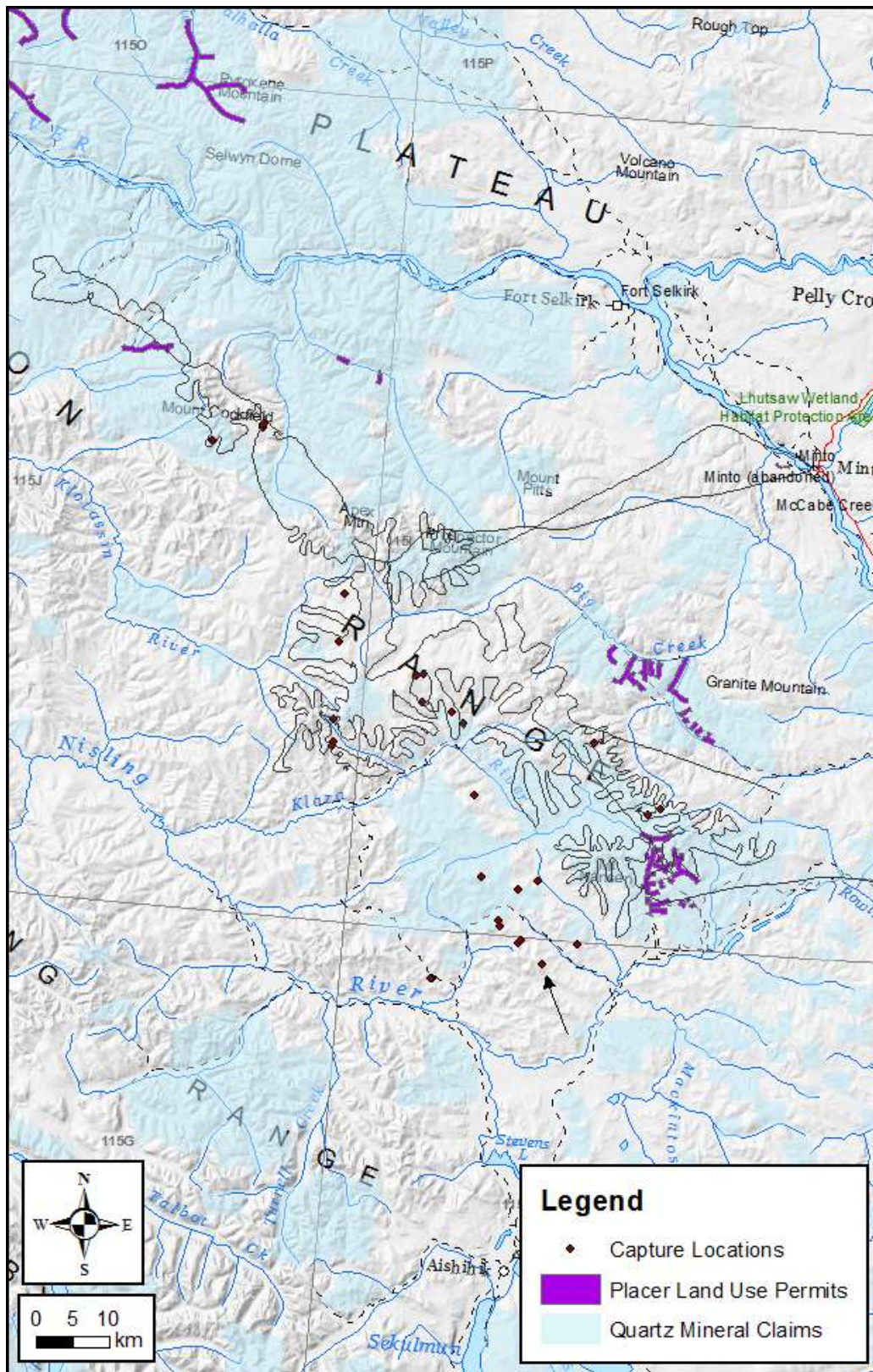


Figure 1. Capture locations during radio-collar deployment activities on the Klaza caribou herd (March and September/October 2012). The arrow indicates the capture location of the animal which subsequently moved to the south.

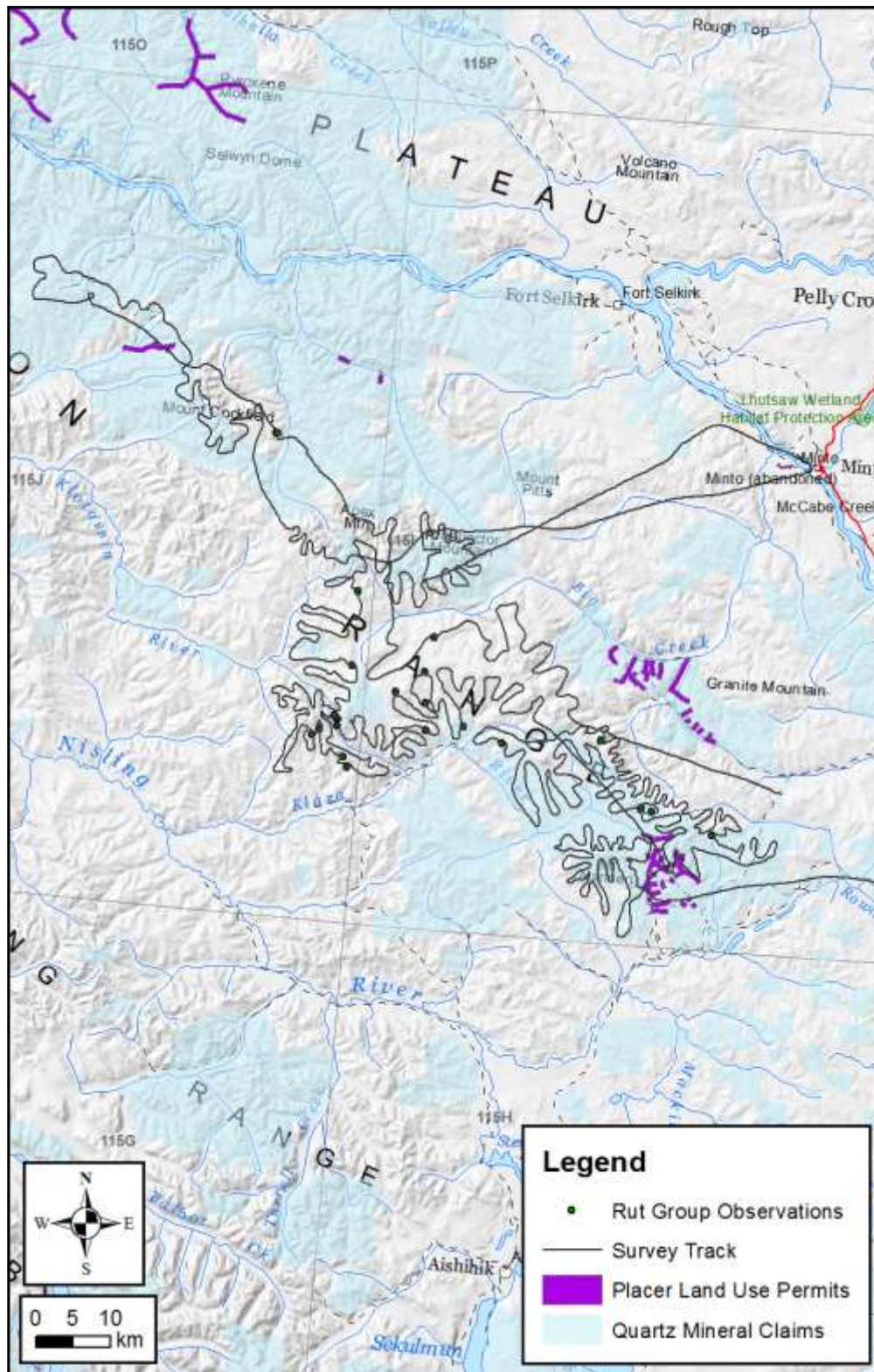


Figure 2. Locations of caribou groups observed during the 2012 composition survey of the Klaza caribou herd (Sept. 28, 2012).

Table 1. Summary statistics of the 2012 fall composition survey of the Klaza caribou herd.

Variable	Value
Number of caribou observed	258
Mean group size (range)	12.3 (1 – 37)
Calf:cow ratio	0.14
Percent calves	9.7%
Bull:cow ratio	0.27
Immature:mature bull ratio	0.81

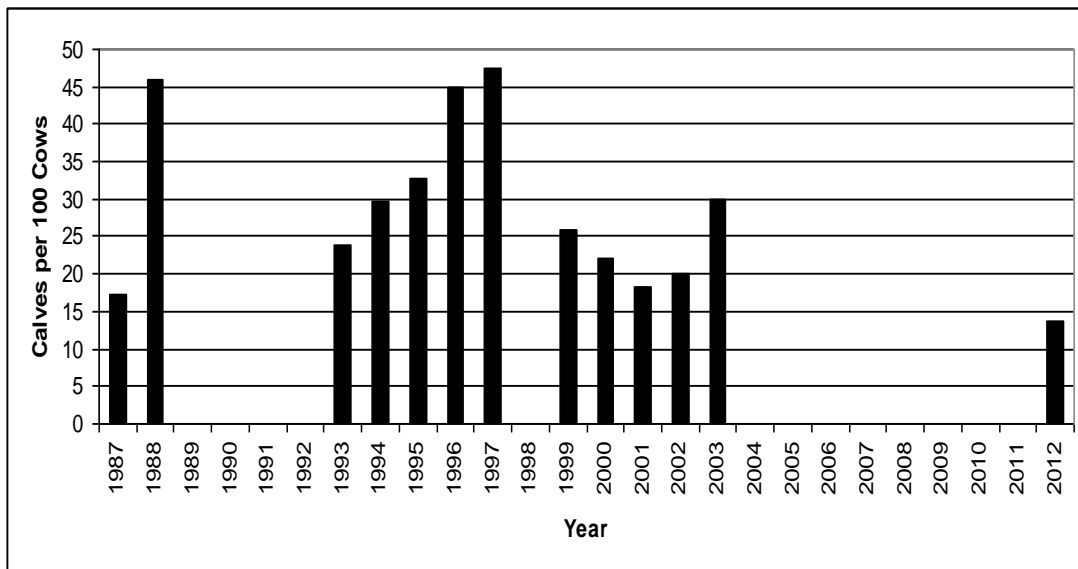


Figure 3. Calf recruitment (calves: 100 cows) in the Klaza herd (1987 – 2012).

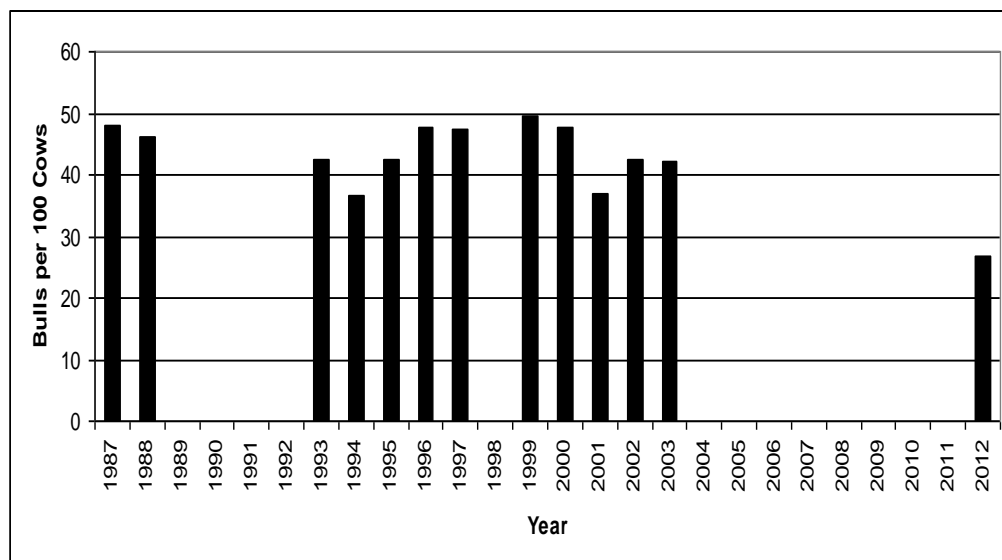


Figure 4. Adult sex ratio (bulls: 100 cows) in the Klaza caribou herd (1987 – 2012).

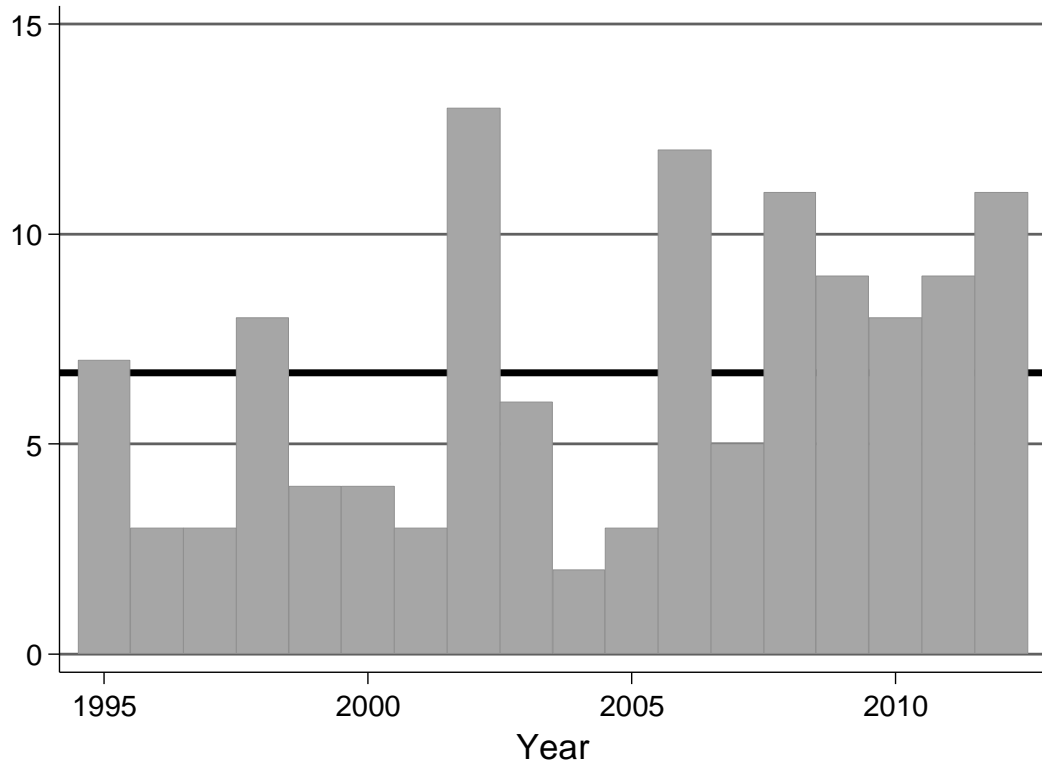


Figure 5. Annual licensed bull harvest (resident + non-resident) of the Klaza caribou herd (1995 – 2012). The solid horizontal line indicates the long-term average harvest (6.7 animals).

Within each survey block crews surveyed areas in subalpine and alpine habitats deemed to have a high probability of caribou occurrence. There were no pre-determined flight tracks or any other formal survey methodology, as that is not required under the mark-resight approach. When a group of caribou was observed, the numbers of marked and unmarked animals were recorded (Table 2) and a waypoint taken using a handheld GPS unit (Figures 7 to 10).

Data analysis was conducted in Program Mark (version 6.2; White and Burnham 1999) using the mixed-logit normal approach described by McClintock et al. (2009). This approach allows information from individually identifiable marked animals to be used to better estimate resighting probability and allows for individual heterogeneity in resighting rates to be estimated. Individual heterogeneity in resighting probability recognizes that all animals may not have equal resighting rates due to, for example, different behavioural or habitat use patterns. We assumed that marked animals would be individually identifiable based on their locations recorded from the GPS radio-collars compared to the locations of marked animals identified during the resight surveys. During the actual resighting surveys, individuals could not be uniquely identified by their collars alone.

While we had the locations of collared animals, we could not identify with certainty which marked caribou were seen during the resight surveys. Animals aggregated after the collaring activities and, in many instances, too much time had passed between when the GPS radio-collar location was recorded and when the resighting crews observed marked animals. We therefore fixed the individual heterogeneity parameter (σ) to equal zero. While we recognize that there are likely differences among individuals' resighting probabilities, we did not have the data to adequately estimate it.

We fitted 3 separate models to the data (Table 3) and ranked them using AIC values adjusted for sample size (AICc; Burnham and Anderson 2002). The model with the lowest AICc value (i.e., $\Delta\text{AICc} = 0$) had the greatest support and was subsequently used to estimate the herd's size. Given that σ was fixed, only 2 parameters remained to be estimated: N (abundance) and p (resighting probability). The 3 models we compared represented different parameterizations of p . The model representing a separate p for the first resighting session (Table 3) was specified because this session had a different survey intensity than the other 3 sessions, as described above. We had insufficient data to adequately model individual resighting rate (i.e., using individual covariates).

The model representing constant resighting probability across all resighting sessions had the greatest support (Table 3). Of note, N was robust to model selection uncertainty and was the same for all 3 models. Based on the estimated herd size of 1179 (Table 4) and the

composition of the herd (Table 1), we estimate there were 114 calves, 226 bulls, and 839 cows in the herd. However, given the concern regarding the lower bull: cow ratio, these adult numbers should be viewed cautiously.

Table 2. Numbers of marked and unmarked caribou observed during the four resighting surveys of the Klaza caribou herd (October 2012).

Resight Session	Dates	Unmarked Animals	Marked Animals*
One	16-17 Oct.	298	10
Two	18-20 Oct.	617	12
Three	21-22 Oct.	331	12
Four	23-24 Oct.	595	12

* 28 marked animals were present in the survey area during the surveys.

Table 3. Mark-resight models fitted to the resighting survey data to estimate the abundance of the Klaza caribou herd.

Model	Description	$\Delta AICc$	K^*
$N p.$	Constant p across all resighting sessions	0	2
$N p_1$	Different p for resighting session 1, with constant p for resighting sessions 2-4	2.0	3
$N p_t$	Different p for each resighting session	6.0	5

* Number of estimated parameters.

Table 4. Estimates of abundance and resighting rate of the Klaza caribou herd from the most supported mark-resight model (see Table 2).

Parameter	Value	SE	95% Confidence Interval
N	1179	129	952 – 1461
p	0.42	0.05	0.33 – 0.51

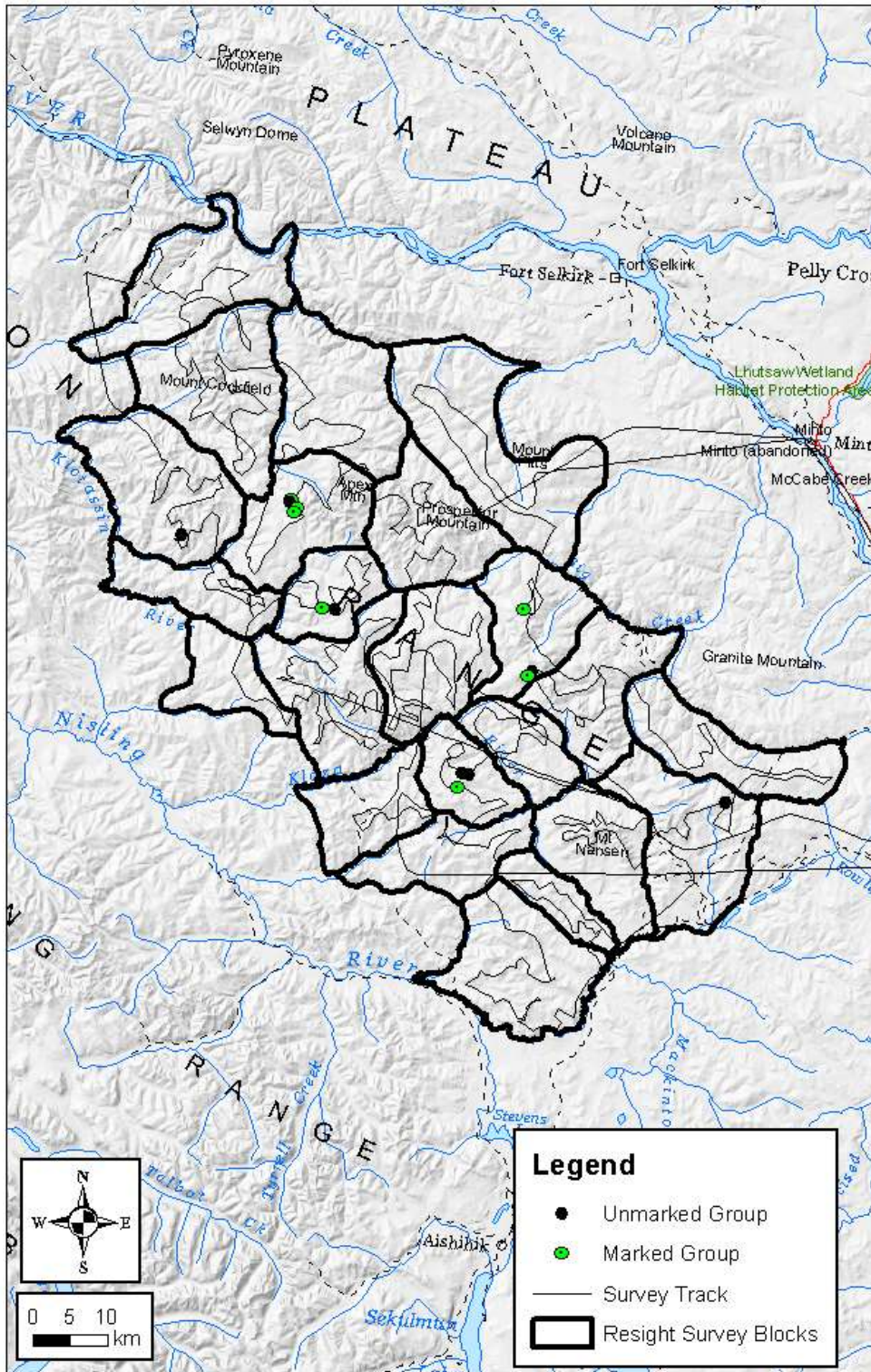


Figure 7. Caribou observations and survey tracks for resight session 1.

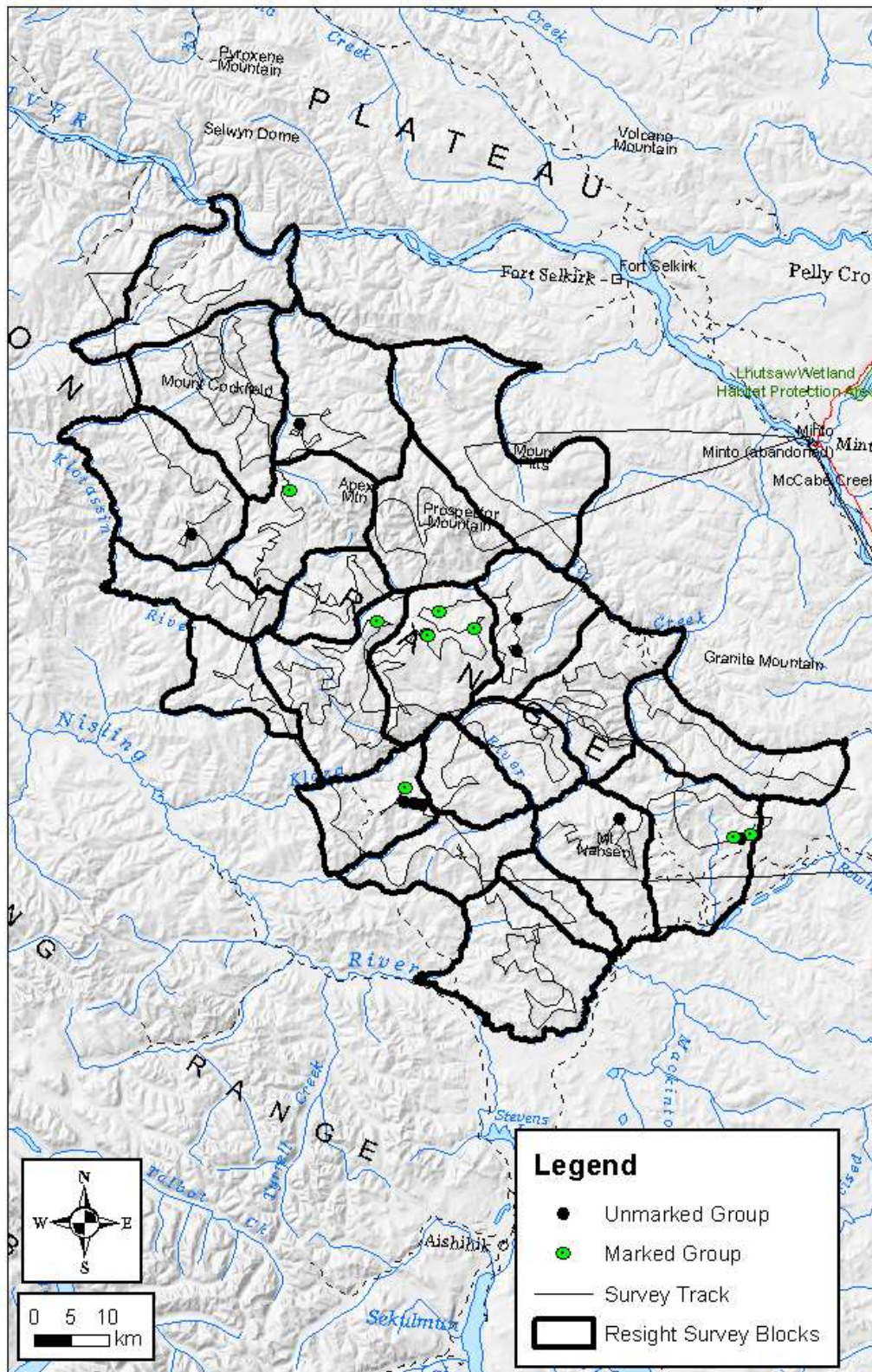


Figure 9. Caribou observations and survey tracks for resight session 3.

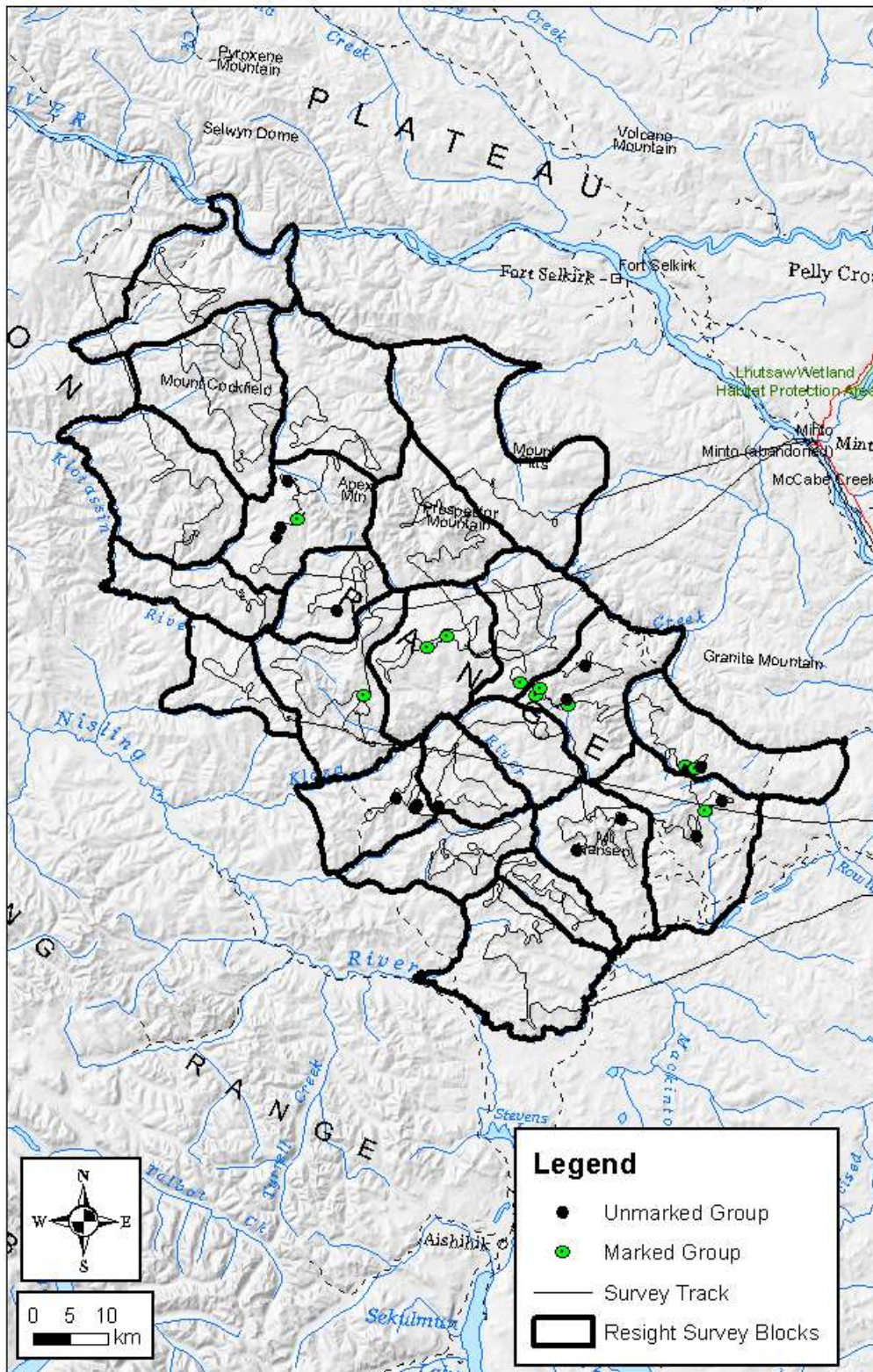


Figure 10. Caribou observations and survey tracks for resight session 4.

The most recent working estimate of the Klaza herd's size was from 2000 when 651 animals were observed during a fall composition survey, leading Environment Yukon staff to estimate a minimum of 700 animals in the herd. However, as with any minimum count, there was no estimate of the numbers of animals missed and thus these working estimates are used cautiously. Even with the 1179 animals estimated in this study (Table 4), the most caribou observed during any single resight session was 629, and the number of caribou observed across all resight sessions varied substantially (Table 2). Consequently, we need to treat caribou herd minimum counts with caution, as in this case we observed 50% or fewer of the estimated population.

A population estimate of 441 was estimated in 1989 (Farnell et al. 1991), however that survey did not include the southern portion of the herd's range that was included in the present survey and thus the 2 estimates are not directly comparable. A population estimate was also attempted in 1996, although no estimate was formally provided. Thus, we are unable to assess the current trend of the Klaza herd given no comparable past population estimates.

Following analysis of the resighting and radio-collar data, it was apparent that not all survey blocks initially identified needed to be surveyed. For future surveys during October, a revised survey block map was developed (Figure 11) removing 3 blocks deemed to have a

near zero likelihood of observing, or containing, caribou.

Future Activities

Data from the active GPS radio-collars will continue to be received throughout 2013-14. During the life of the project, calf survival will be monitored periodically through the year by tracking individual cows and assessing whether or not they have a calf at heel. The first survey will occur in late-May or early-June. A goal of this component of the project will be to relate female habitat use patterns to calf survival. An additional composition survey may be warranted to reassess, or confirm, the low adult sex ratio observed in the herd in 2012. Additional habitat work is planned for 2013 including mapping surface disturbances and an assessment of the current landcover map (EOSD) for the area. This will be necessary for future habitat modeling activities.

It may be prudent to consider activities that may be useful for longer term monitoring of the herd. Taking advantage of the current radio-collars in the herd, a sightability model could be developed during fall composition surveys. This approach has been adopted for the Chisana herd whereby radio-collared animals are noted during a composition survey (Hegel et al. 2013). This model can then be applied during surveys when collared animals are not active or available to estimate the herd's size. A minimum of three separate sightability surveys (i.e., three years) would likely be required to develop a robust model.

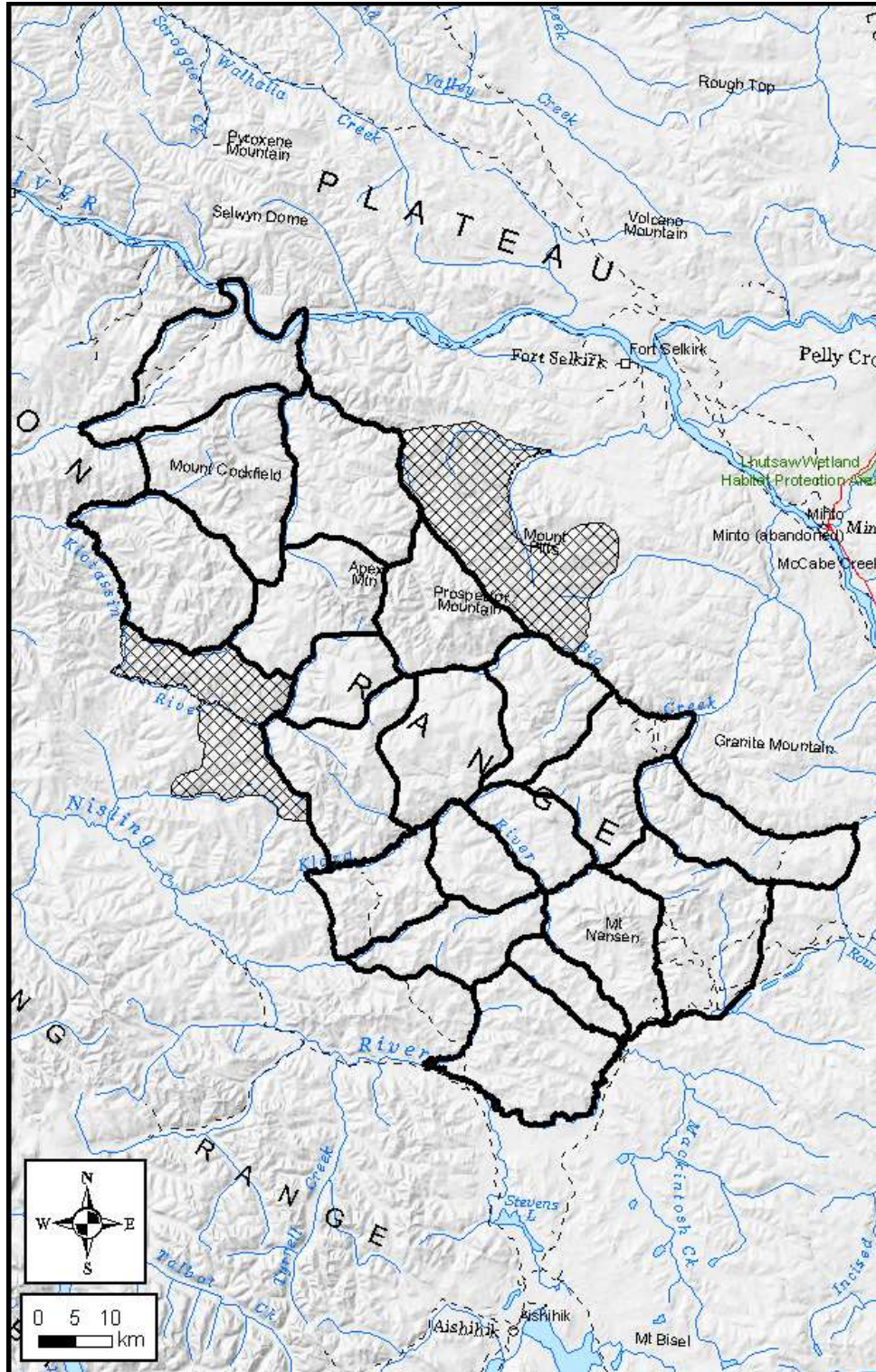


Figure 11. Recommended revisions to resighting survey blocks.

Hatched blocks are those that are recommended for exclusion during future fall (late-September and October) surveys.

Literature Cited

- BURNHAM, K. P. AND D. R. ANDERSON. 2002. *Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach*, 2nd ed. Springer-Verlag, New York, USA.
- FARNELL, R., R. SUMANIK, J. McDONALD, AND B. GILROY. 1991. The distribution, movements, demography, and habitat characteristics of the Klaza caribou herd in relation to the Casino Trail development, Yukon Territory. Yukon Fish and Wildlife Branch Report TR-91-3. Whitehorse, Yukon, Canada.
- HEGEL, T., T. BENTZEN, J. PUTERA, T. PRETZLAW, AND L. LAROCQUE. 2013. Chisana caribou herd population estimate, 2010. Yukon Fish and Wildlife Branch Report TR-13-07. Whitehorse, Yukon, Canada.
- HEGEL, T. M., A. MYSTERUD, T. ERGON, L. E. LOE, F. HUETTMANN, AND N. C. STENSETH. 2010. Seasonal effects of Pacific-based climate on recruitment in a predator-limited large herbivore. *Journal of Animal Ecology* 79: 471-482.
- LITTLE SALMON/CARMACKS FISH AND WILDLIFE PLANNING TEAM. 2011. Community based-fish and wildlife work plan for the Little Salmon/Carmacks First Nation Traditional Territory (2012 – 2017). Environment Yukon, Whitehorse, Yukon, Canada. 36 pp.
- MCCLINTOCK, B. T., G. C. WHITE, K. P. BURNHAM, AND M. A. PRYDE. 2009. A generalized mixed effects model of abundance for mark-resight data when sampling is without replacement. Pages 271-289 *in*: Modeling Demographic Processes in Marked Populations, D.L. Thomson, E.G. Cooch and M.J. Conroy, editors. Springer, New York, New York, USA.
- MCCLINTOCK, B. T. AND G. C. WHITE. 2012. From NOREMARK to MARK: software for estimating demographic parameters using mark-resight methodology. *Journal of Ornithology* 152: 641-650.
- WHITE, G. C. 1996. NOREMARK: population estimation from mark-resighting surveys. *Wildlife Society Bulletin* 24: 50-52.
- WHITE, G. C. AND K. P. BURNHAM. 1999. Program MARK: survival estimation from populations of marked animals. *Bird Study* 46 (Suppl.): 120-138.