ANNUAL REPORT

Enhancing Calf Survival to Help Avert Extirpation of the Klinse-Za Caribou Herd

FWCP Project No. PF16-W22
EC Project No. 2015AFSAR2597

R.S. MCNAY[1], L. GIGUERE[1], B. PATE[1], AND E. DUBMAN[1]

MAY 05, 2016
(REVISED JULY 25, 2016)

[1]Wildlife Infometrics Inc., PO Box 308, Mackenzie, BC, V0J 2C0, wild_info@wildlifeinfometrics.com

Prepared for :
BC Hydro Fish and Wildlife Compensation Program - Peace Region, Contribution Agreement Project No. **PF16-W22**
Environment Canada Pacific Region, project number 2015AFSAR2597

CITATION: McNay, R.S., L. Giguere, B. Pate, and E. Dubman. 2016. Enhancing calf survival to help avert extirpation of the Klinse-Za caribou herd. Wildlife Infometrics Inc. Report No. 527. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

EXECUTIVE SUMMARY

The Klinse-Za caribou herd in northern British Columbia is part of the endangered Southern Mountain population of caribou and has declined in size from 198 animals in 1995 to a low of 16 animals in 2013. The herd suffers from unsustainable levels of predation (mostly by wolves) and was predicted to have become extirpated by 2015. Maternity penning was implemented in 2014 as a measure to avert extirpation of the herd. In combination with wolf removals conducted by First Nations and the BC Government, the pen project has helped to arrest the steep decline in the Klinse-Za population and the combined Klinse-Za and Scott East caribou herd size has increased by 19% from 42 individuals in 2015 to 50 in 2016. An unexpected outcome of the maternity pen project was the mixing of the Klinse-Za and Scott East herds which, prior to penning, were fairly distinct. After two years of maternity penning it is now impossible to partition the caribou into separate herds. Although difficult to directly compare the relative benefits of maternity penning and wolf removals, the maternity pen does appear to effectively contribute to population increase. This conclusion was drawn by contrasting adult survival and the number of calves/100cows in the wild with that of the pen after the natal period in early July and again nearing the calf recruitment period in mid-March. Although adult survival was equal (100% for both penned and wild animals), survival of the penned calves exceeded that of the wild calves. We concluded that the population growth of eight animals was due to five calves born in the pen, two born in the wild, and one adult radio-collared immigrant from the Kennedy Siding caribou herd. The maternity pen project in 2015-16 was assessed on a number of criteria and judged to be successful (see text for details). Despite the apparent success, one of our several recommendations is to temporarily discontinue penning animals after the 2016 capture (i.e., 3rd year of penning). The intent of the pause is to potentially learn more about the contribution of wolf removal to herd recovery without the confounding effect of maternity penning (assuming wolf removal continues). We expect that caribou population demographics will continue to be monitored during the pause, and that re-initiating maternity penning may be required in the future.

TABLE OF CONTENTS

EXECUTIVE SUMMARY I
LIST OF FIGURES III
LIST OF TABLES III
INTRODUCTION 1
STUDY AREA 1
METHODS 3
Husbandry of caribou cows and calves 3
Planning 3
Preparation 3
Implementation 4
Effectiveness Monitoring 4
Extension and Reporting 5
RESULTS 6
Husbandry of caribou cows and calves 6
Monitoring, feeding, and protection 6
Calving 6
Release 7
Caribou capture and transport 7
Effectiveness Monitoring 9
Pregnancy, parturition, neonatal mortality, recruitment 9
Population size and mortality rates 10
Non-target effects 11
Extension and Reporting 14
DISCUSSION 14
Reversing the historical decline 14
Extension 15
Measures of success 15
RECOMMENDATIONS 16
ACKNOWLEDGEMENTS 17
REFERENCES 18
APPENDIX A. MAT PEN DAILY MONITORING REPORT 20
APPENDIX B. COMMERCIAL CARIBOU PELLET INGREDIENTS 22
APPENDIX C. LAB REPORTS FROM DEAD CALF NECROPSIES 23
APPENDIX D: CARIBOU CAPTURE PARTICIPANTS LIST 30
APPENDIX E. PROJECT COSTS AND SPONSORSHIPS 32

LIST OF FIGURES

Figure 1. Location of the Klinse-Za caribou herd range and maternity pen in northern British Columbia. 2

Figure 2. Locations within the Klinse-Za caribou herd area where wolves were removed as a component of a caribou protection program in northern British Columbia, January to March, 2016. The hatched area represents a priority zone for wolf removal. 7

Figure 3. Blood progesterone levels obtained from 11 caribou cows captured and held within a maternity pen located in the Klinse-Za caribou herd area in northern British Columbia, March 20 to July 26, 2015. 8

Figure 4. Collar deployment, collared-animal penning history, and survival status of adult caribou cows at a maternity pen situated in the Klinse-Za caribou herd area in northern British Columbia, 2014-2016. Green nodes are unpenned or wild cows and blue nodes are penned cows. 8

Figure 5. Trend in survival (calves/100cows) for caribou calves from inception to recruitment, within the Klinse-Za caribou herd area, northern British Columbia, October 2015 to March 2016. Numbers in parentheses represent the cows from the herd that were held within a maternity pen and the number of cows remaining in the wild. 10

Figure 6. Observations of caribou groups recorded during a census of the Klinse-Za and Scott East caribou herd areas in northern British Columbia, March 2016. Caribou group sightings align with observation number (Obs_no) presented in Table 2. 11

Figure 7. Minimum population size of the Klinse-Za (orange line) and combined Klinse-Za Scott East (purple lines) caribou herds in northern British Columbia, 1990-2017. Dashed/dotted lines represent either interpolated or predicted trends. 12

Figure 8. The difference in distance to capture site and distance to pen taken on September 01 about a month after release of caribou cows that were captured and held in a maternity pen. 13

Figure 9. Pre- and post-penning relocations from radio-collared caribou (Wims_id) available to address potential effects of maternity penning on post-release movement and habitat selection. Stippling is the absolute abundance of data for each animal, each dot representing a relocation. 13

LIST OF TABLES

Table 1. Monitoring parameters used to evaluate effectiveness of a maternity pen to protect caribou cows and their calves during the natal period, Klinse-Za caribou herd area, northern British Columbia, 2015-16. 9

Table 2. Observations of caribou group numbers and sex/age class recorded during a census of the Klinse-Za and Scott East caribou herd areas in northern British Columbia, March 2016. Observation numbers (Obs_no) align with caribou group sightings presented in Figure 6. 12

INTRODUCTION

The Klinse-Za caribou (*Rangifer tarandus caribou*) in northern British Columbia (BC) are part of the Southern Mountain population of caribou which was listed as Threatened under Schedule 1 of the federal *Species at Risk Act* (Environment Canada 2014). The Klinse-Za herd has undergone significant population decline, are further threatened by unsustainable levels of predation, and are unlikely to persist without immediate population management. The population in 2013 was 16 caribou (Seip and Jones 2015), down from 23 in 2012, 35 in 2011, and 189 in 1995 (Cichowski et al. 2012). The number of calves available for recruitment into the breeding population was ~15% or above in the early 2000's but recently has been below 10%, and only 5.7% in 2011 (Seip and Jones 2015). The population is below the minimum viable size (NCTAC 2004), below population objectives recommended in an implementation plan for the ongoing management of caribou in the area (Aitkens 2013), and is below the goal of a recent Recovery Action Plan for the Klinse-Za herd (McNay et al. 2013). The unsustainable level of predation, primarily by wolves (*Canis lupus*) (Seip and Jones 2015), has presumably resulted from conversion of habitat to early-seral plant communities which support more primary prey and hence, more wolves. Also, the road infrastructure required for industrial activity in the area can apparently lead to increased coincidental encounter rates between predators and caribou (review of GA 2010).

The BC Government has a legal mandate to develop a recovery action plan for the herd, but no formal obligation to recover it to any particular level. Furthermore, it is unlikely the BC Government has the internal capacity to implement the full suite of recovery measures that are presumed to be necessary (McNay et al. 2013), but if action is not undertaken, the herd may soon be extirpated. Successful recovery of the Klinse-Za herd therefore depends on commitment and cooperation from many different constituencies. Maternity penning was proposed as a near-term (1-5 yrs) emergency recovery measure to be implemented immediately (McNay and Sittler 2015), within the context of implementing other, complementary and simultaneous, mid-term (6-10 yrs) and long-term (40-60 yrs) recovery actions. The objective was to reduce mortality of pregnant cows and their calves through the calving period with the intended outcome of reversing the historical decline in the size of the herd (McNay and Sittler 2015). Other objectives were to conduct effectiveness monitoring of the maternity pen, and to provide extension and reporting about the recovery effort. West Moberly First Nations (WMFN) and Saulteau First Nations (SFN) partnered with Wildlife Infometrics to implement the project based on sponsor funding (see Acknowledgements). The project was conducted under a BC Wildlife Act permit which granted authority to Wildlife Infometrics Inc. for capturing and holding caribou in a maternity pen and to protect penned caribou against predators (Permit FJ14-93094). A Lands Act, Special Use Permit (Permit S25789) was granted to West Fraser Mills Ltd. for construction of the maternity pen protection facility.

STUDY AREA

The site chosen for the maternity pen was on Mt. Bickford, about 11kms north off Highway 97 along a logging access road, 50km west of Chetwynd, in northern British Columbia (Figure 1). The pen is located at ~1200m asl in a natural subalpine meadow that historically was used by caribou during the calving period.

The Klinze-Za herd area is approximately 3,291km^2 and is located in the Rocky Mountains of northern BC. The herd area is bounded in the north by the Peace Arm of the Williston

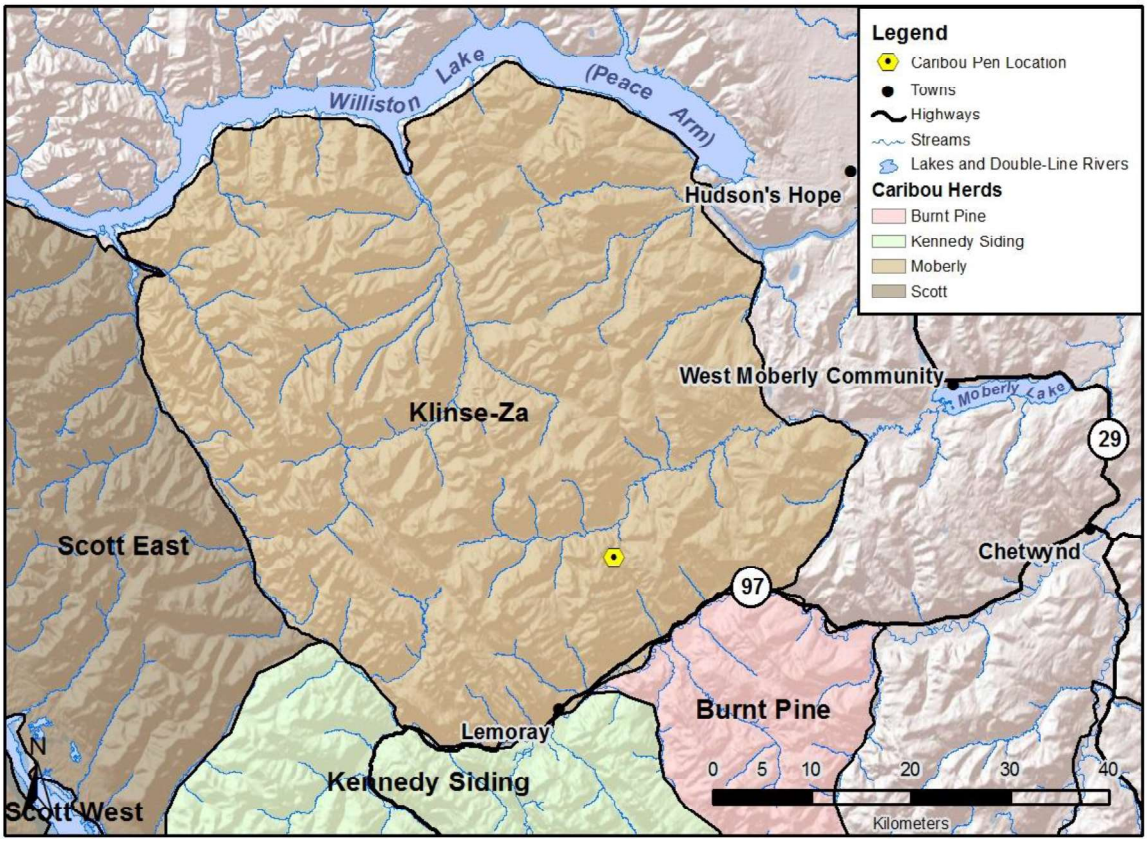


Figure 1. Location of the Klinse-Za caribou herd range and maternity pen in northern British Columbia.

Reservoir, in the south by provincial Highway 97, to the east by lowland agricultural areas around Moberly Lake, and to the west by steep mountains separating the Klinse-Za from the adjacent Scott East caribou herd (Figure 1). The Klinse-Za herd area is characterized by mountains and rolling hills, forest cover of lodgepole pine (*Pinus contorta*) and hybrid white-spruce (*Picea glauca x engelmannii*) forests at lower elevations, and subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) forest at higher elevations. Alpine summits occur from 1400m to 2090m. Four biogeoclimatic zones (Meidinger and Pojar 1991) occur within the herd area: Sub-Boreal Spruce (SBS), Boreal White and Black Spruce (BWBS), Engelmann Spruce-Subalpine Fir (ESSF), and Alpine Tundra (AT).

Predators of caribou in the area include gray wolf (*Canis lupus*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos*), wolverine (*Gulo gulo*) and potentially lynx (*Lynx canadensis*) and cougar (*Puma concolor*), although both the latter predators would occur only rarely. Moose (*Alces alces*), elk (*Cervus canadensis*), and deer (*Odocoileus spp*.) also occur in the area, particularly in the eastern portions of the caribou's range where the landscape tends be less mountainous and more anthropogenically disturbed. Levels of industrial-based disturbance to caribou range in the region are relatively high, affecting 89% and 34% of low-elevation range and the entire herd area, respectively[1]. Modification of range is caused by forestry, wind power

[1] Disturbance was calculated as the area covered by a 250-m buffer around the footprint of all anthropogenic features (WMFN 2014).

generation, mining, hydro-electric power generation, oil and gas pipelines, and roads and other facility infrastructure.

METHODS

Husbandry of caribou cows and calves

Planning

Until this project, and another maternity pen near Revelstoke, BC (Serrouya et al. 2015), *In situ* penning to protect caribou from predators had yet to be tried in BC. Two other trials of a similar nature were implemented elsewhere; in the Chisana caribou herd in Yukon (Farnell 2009) and in the Little Smokey herd in Alberta (Smith and Pittaway 2011). Our planning for the Klinse-Za maternity pen drew extensively on the experience of those two projects and the biologists who implemented them. Although our team had extensive experience in handling caribou, we acknowledged a lack of experience or knowledge about holding animals captive in a pen for long periods of time. For this reason we assembled a team of experienced professionals to help guide the project. This team was composed of members of other pen trials, local and provincial-level veterinarians, nutrition specialists, a member each from the two First Nations communities, and selected members of the BC provincial government.

Preparation

In the Chisana and Little Smokey trials, terrestrial lichen was collected and fed to penned caribou to facilitate slowly changing their diet away from natural forage to a commercial pelleted ration upon entering the pen, and then back to natural forage prior to release. Lichen collection (primarily *Cladina* spp and *Cladonia* spp) was therefore one of our first steps in preparing for the project. Details of the collection and storage techniques undertaken for the first year of collections were provided by Robin et al. (2013). Collection in subsequent years was conducted largely by SFN using these same or similar methods.

Selection of the pen site was considered to be crucial because caribou apparently become semi-habituated to the pen and/or the pelleted ration they receive while penned (Smith and Pittaway 2011). If animals returned to the maternity pen site after release, they could be placing themselves at greater risk of predation depending on the pen location. A site at Mt. Bickford was selected (Figure 1) primarily because: 1) it occurs within the natural, historically used calving range of the Klinse-Za herd (Jones et al. 2007), 2) it is within a 10min helicopter flight from currently used calving range, 3) it is reasonably accessible for project staff/members (11km by snowmobile along an unploughed road), 4) a cabin[2] exists at the site which tended to ease logistics, and 5) release of cows and their calves should be relatively easier than other locations. More detail on the methods for pen site selection was provided by McNay et al. (2014).

[2] The *in situ* cabin was judged to be inappropriate for extensive use due to its proximity to the pen and likely disturbance to the penned caribou and so two tent frame camps were established about a kilometer away from the pen.

We followed a pen design and construction method similar to that used on the Little Smokey project. Basically, the 7ha[3] pen was constructed as a fence made of geotextile fabric, looped over three strands of wire rope; one wire hung at 2-3m above snowpack and tightened around trees, a middle supporting wire, and the third wire positioned as close to the ground as possible. The geotextile fence was fortified by a 2m high, 8-stand electric fence placed approximately 0.5m along the exterior perimeter of the geotextile. The pen was initially constructed in early- to mid-March 2014, expanded to the current size in March 2015, and reinforced in March 2016.

Implementation

Prior to implementation, questions arose as to how many cows should be captured and where they should come from. We used population demographic modeling results to help assess the number of penned cows that would be required for the project. Model results demonstrated that, although it would be difficult to make a material difference in population demographics with penning in large caribou herds, penning at least half the cows in relatively small herds could be beneficial. The project team initially set an arbitrary goal of capturing 10 cows for the maternity pen but realized this would be close to all the remaining cows in the Klinse-Za herd. The team concluded it would be simply too risky (and probably logistically impossible) to capture and pen all remaining cows, and therefore settled on penning about half the remaining cows (n = 5) in the Klinse-Za herd and augmenting that number with 5 cows from the adjacent Scott East herd; making the commitment to return the same number of animals to the donor herd if possible.

Captures, determination of pregnancy status, collaring, and transport by helicopter to the pen were all to be conducted by experienced crews under RISC standard protocols in late March under veterinarian supervision and First Nations monitoring. Details on capture and translocation methods were provided by Sittler et al. (2014). Calves were to be captured 1-2 days after birth and fitted with an expandable, rot-away collar equipped with a VHF transmitter. Collars used for adults and calves met Animal Care guidelines for weight restrictions.

Penned caribou were monitored 24hrs/day, seven days a week (alternating crews, 8 days on to provide crew overlap and 6 days off), from the time when caribou cows were captured (i.e., mid- to late-March) to when cows and calves were released (early July in 2014 and mid-July in 2015). Monitoring was conducted by two First Nations crews of two members each; the crews were supported by professional biologists and veterinarians were on call to address any dietary or health issues. Responsibilities during monitoring were to visually assess the penned caribou for signs of nutritional or behavioral distress, to look for structural compromises to the pen, search for signs of predators, take any corrective actions that may be necessary regarding any observations made, and to log all observations and/or corrective actions daily.

As a component of caribou protection, WMFN and SFN sponsored a program to remove wolves from the Klinse-Za herd area for the 2015/2016 winter season. Wolves were either trapped or shot over bait or when encountered during hunting. All wolf removals were conducted according to regulated guidelines.

Effectiveness Monitoring

Effectiveness of maternity penning as a population recovery measure was assessed in the context of the following objectives: arresting population decline and effective extension. Population demographic parameters (i.e., population size and calf recruitment) of penned

[3] The pen in the first year of operation, 2013-14, was ~4ha in size.

caribou were observed daily during captivity. Observations of penned and non-penned (hereafter, wild) caribou were made using aerial surveys conducted in July, October, and March. Basic population demographics, however, were judged to be an imperfect indicator of effectiveness due to confounding effects of other simultaneous recovery efforts, such as predator removal. We therefore posed additional and refined indicators of effectiveness as follows:

- Pregnancy and parturition rates – Penned cows should have pregnancy and parturition rates that are not less than what would be expected in the wild population.
- Cow and calf survival – Penned cows and their calves should survive better than cows and calves in the wild population. This was measured as number of cows surviving annually and calves/100cows surviving at end of June and mid-March (in their first year).
- Habitat use – Once released, penned cows should travel and use habitat in a similar pattern as to their pre-penning period and in a similar pattern to caribou that were not penned. Use of habitat by penned and wild cows during the "released" period (August-February) was contrasted based on movement parameters (e.g., step length, turning angles, and fidelity to site) and selection (i.e., preference or avoidance) of biophysical environmental factors (e.g., landcover, elevation, aspect, etc.). Observations of location coordinates were collected by GPS-equipped collars deployed on caribou during capture.
- Apparent nutritional status – Penned cows and their calves should not suffer nutritionally while in captivity. We assessed nutritional status by monitoring forage intake rates, contrasting weight during captivity to weight measured at capture, and observations of a visual body condition score.

Extension and Reporting

We pursued a variety of extension and reporting outlets to make sure that a broad audience was well informed about the maternity pen project including the following: social media (web pages, Facebook, Twitter, blogs), news journalists and reporters, magazine and television journalists, presentations at technical workshops and meetings, and informal newsletters. See 'Extension and Reporting' in Results, below. All costs for the project were tracked, categorized to project phase, reconciled against revenue, and reported to project sponsors. The effectiveness of extension was assessed by:

- Opposition to the maternity pen – Opposition was measured by the number of negative media events recorded from national, regional, or local sources (e.g., newspapers, periodical publications, television, and social media such as web pages, Facebook, twitter, or personal blogs).
- Opportunities to present maternity pen results – Opportunities were measured by the number and frequency of outputs conducted to relay results of the pen to technical and non-technical audiences.

RESULTS

Husbandry of caribou cows and calves

Monitoring, feeding, and protection

At start of Fiscal year (April 2015), 11 cows were in the pen and being monitored by the monitoring crews. Daily observation sheets for the protection period (n = 136) were properly completed and filed; an example of a completed sheet is presented in Appendix A. There were no significant observations of feeding-related issues, behavioral incidents, or predator occurrences to report and all 11 cows and 5 surviving calves were released in healthy condition (see Release below). There were occasional unplanned visits made by members of the public to the Mt. Bickford site during penning, but all visitors were informed of the need for minimal disturbance to the penned caribou, and all congenially agreed to leave the site.

During initial days of captivity, ~10 bags of terrestrial lichens were consumed per day by the caribou. Feeding thereafter consisted of ~40 kg/day of pelleted food equating to ~3.6 kg/animal/day (assuming equal access). Nutrient content of the commercial pellets is provided in Appendix B. Although we attempted to record weights of individual caribou, the weigh scale did not function properly most of the time and data were therefore not recorded on a regular basis. Access to water was not a problem for the penned caribou but we anticipated a shortage could have occurred and, with some modifications to a stream outlet near the pen, water was freely available throughout the penning period.

WMFN and SFN members removed 10 and 24 wolves, respectively from inside a designated removal zone (Figure 2). West Moberly removed five more wolves just outside the removal zone and a private rancher removed seven wolves in the zone for a total of 41 wolves removed from ground-based hunters and trappers. The average distance of the removal sites was 25 km from the pen; no wolves were taken within 20 km of the pen (Figure 2). There was little to no attempt to remove wolves closer to the pen due to lack of sign or other evidence that wolves were using the area. Removal of bears from the general area was not a component of the overall protection program but one black bear that came near the pen was removed.

Calving

Blood progesterone levels indicated that 8 of the 11 cows were likely to be pregnant, one was potentially pregnant, and two were not pregnant (Figure 3). Because the one potentially pregnant cow did produce a calf, we determined the pregnancy rate to be 82% (i.e., 9 of 11 cows). Both cows that were not pregnant were recaptures from the 10 cows penned in 2014. The third recapture from 2014 was pregnant. All three of these recaptured caribou lost their calves early in the previous year, two to wolves and one to a vehicle collision.

Seven calves (5♂ and 2♀) were born from May 14 to May 29, 2015. However, the first birth (♂) was stillborn and two cows must have aborted their fetuses, based on them having the second and third highest levels of blood progesterone. One calf (♂) died about 3-days after birth with no known cause of death. Lab reports for the stillborn calf and the one death after birth are provided in Appendix C. Capture and collaring of calves was accomplished without incident; all but two calves were caught about 24hrs after birth, the remaining two were caught about 48hrs after birth.

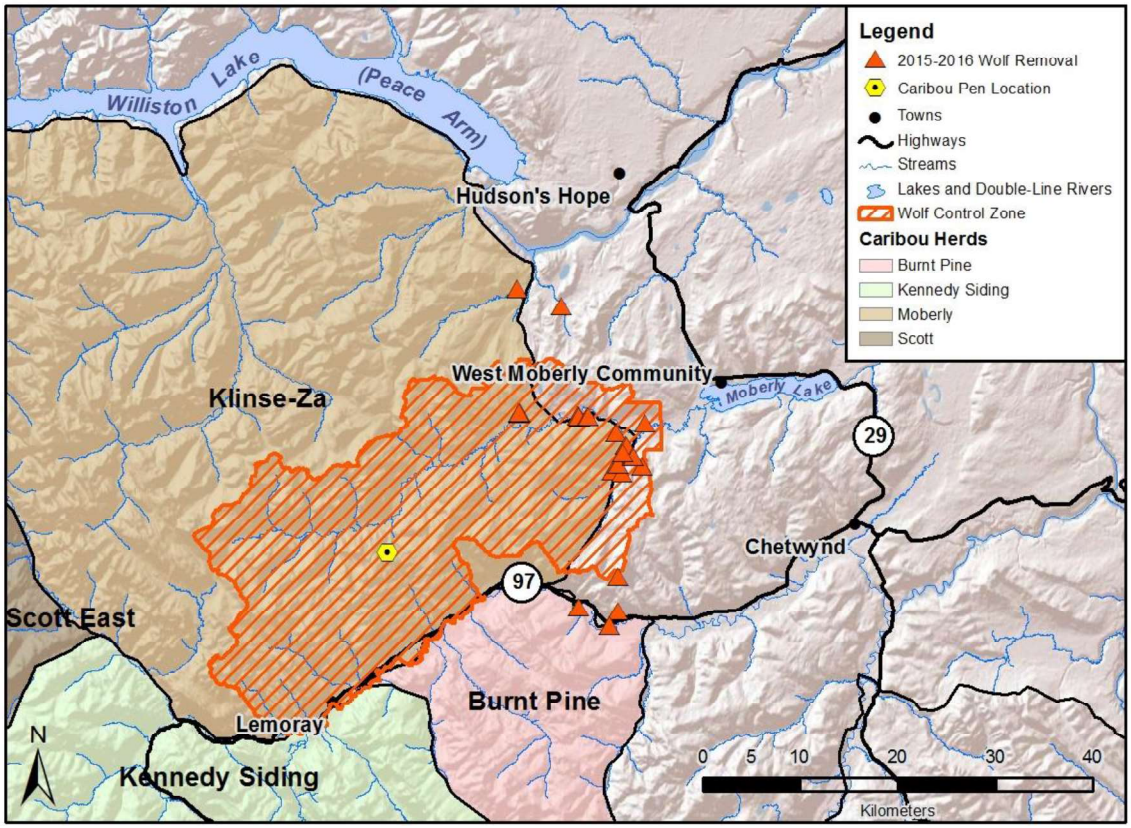


Figure 2. Locations within the Klinse-Za caribou herd area where wolves were removed as a component of a caribou protection program in northern British Columbia, January to March, 2016. The hatched area represents a priority zone for wolf removal.

Release

Penned caribou (11 adults and 5 calves) were released from the pen on July 26, 2015. This was a relatively "soft"[4] release (see Methods) and the caribou made their way up in elevation, heading northwest to the alpine area of Mt. Bickford. The average distance from the pen at September 01, 2015 just over a month after release, was 15.4km (n = 11, SD = 4.9). Average distance from the capture site on the same date was similar, although with more deviation among individuals; 16.6km (n = 11, SD = 16.2)

Caribou capture and transport

Caribou cows from the Klinze-Za and Scott West herd areas were captured and collared for the 2016 pen over three days in March 2016 (16th to 18th). A total of 19 cows were caught, 14 of which were without calf at heel and were successfully transported to the maternity pen (blue nodes in Figure 4). Three collared caribou with calf at heel were re-collared and left with their calves in the wild. Two other cows that were not previously collared, were collared and left in the wild, one due to transport length being too long and the other because she was a juvenile

[4] A "soft" release refers to a situation involving little disturbance to animals by way of avoiding methods that instigate movement through direct handling or indirectly invoking movement through the use of loud noise, etc.

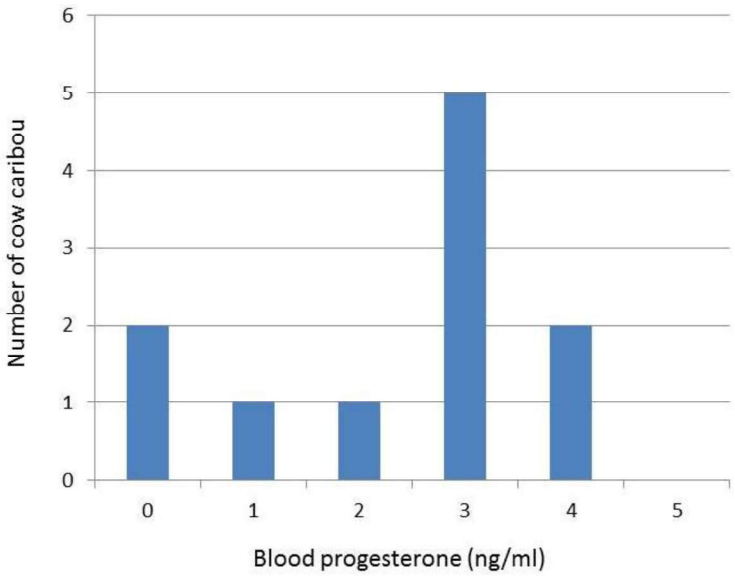


Figure 3. Blood progesterone levels obtained from 11 caribou cows captured and held within a maternity pen located in the Klinse-Za caribou herd area in northern British Columbia, March 20 to July 26, 2015.

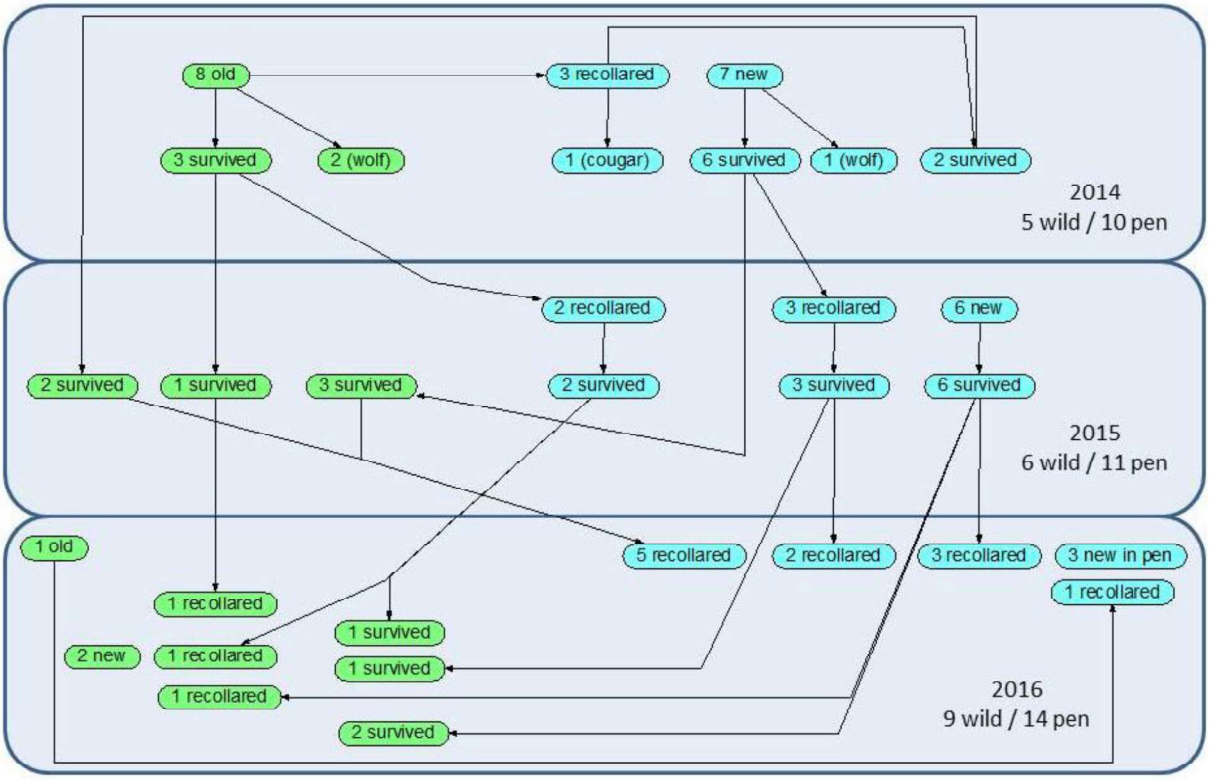


Figure 4. Collar deployment, collared-animal penning history, and survival status of adult caribou cows at a maternity pen situated in the Klinse-Za caribou herd area in northern British Columbia, 2014-2016. Green nodes are unpenned or wild cows and blue nodes are penned cows.

and unlikely to be pregnant (green nodes in Figure 4). Four collared cows that were penned in 2015 were left in the wild and not re-collared due to anticipated capture difficulties. Of the 14 penned caribou, five had been penned in 2014 but not in 2015, two had been penned in both 2014 and 2015, three had been penned only in 2015, and four had not been penned before (Figure 4). After the capture session there were a total of 14 collared caribou in the pen and 9 collared caribou in the wild.

Effectiveness Monitoring

Pregnancy, parturition, neonatal mortality, recruitment

Rates for pregnancy, parturition, and calf survival to July for penned caribou are provided in Table 1. Pregnancy and parturition rates were not available for the wild population. Although

Table 1. Monitoring parameters used to evaluate effectiveness of a maternity pen to protect caribou cows and their calves during the natal period, Klinse-Za caribou herd area, northern British Columbia, 2015-16.

Data stratum	Parameter	Year: 2015-16
Pen	Number of radio-collared cows	11
	Number of collared cow mortalities	0
	Adult female survival	1.00
	Pregnancy	0.82
	Parturition	0.64
	Calf survival to Jul	0.45
	Calf survival to next Mar	0.45
	Number added to population	5[a]
Wild	Number of radio-collared cows	6
	Number non-collared cows	8
	Number of collared cow mortalities	0
	Adult female survival	1.00
	Pregnancy	NA
	Parturition	NA
	Calf survival to Jul	NA
	Calf survival to next Mar	0.21
	Number added to population	2[b]
Census	Number of cows	29
	Number of males	13
	Number of calves	8
	Total population (end of year)	50
	Known immigration	1
	Adult mortality	0.00
	Calves	0.19
	Calves less adult mortality	0.19

a – calculated as number of surviving calves – number of adult mortalities
b – calculated as change in population – number added by pen – known immigration

we have collected data on calf survival from birth to July for the wild population in the past, the 2016 survey was terminated early because caribou were mostly using ESSF habitat and observations to obtain numbers and age class were impossible. Penned calf survival to March (i.e., assumed here to be recruitment) was double that of the wild population (Table 1). The hazard function or trend in survival of penned calves (calves/100cows) from inception through to recruitment is plotted in Figure 5.

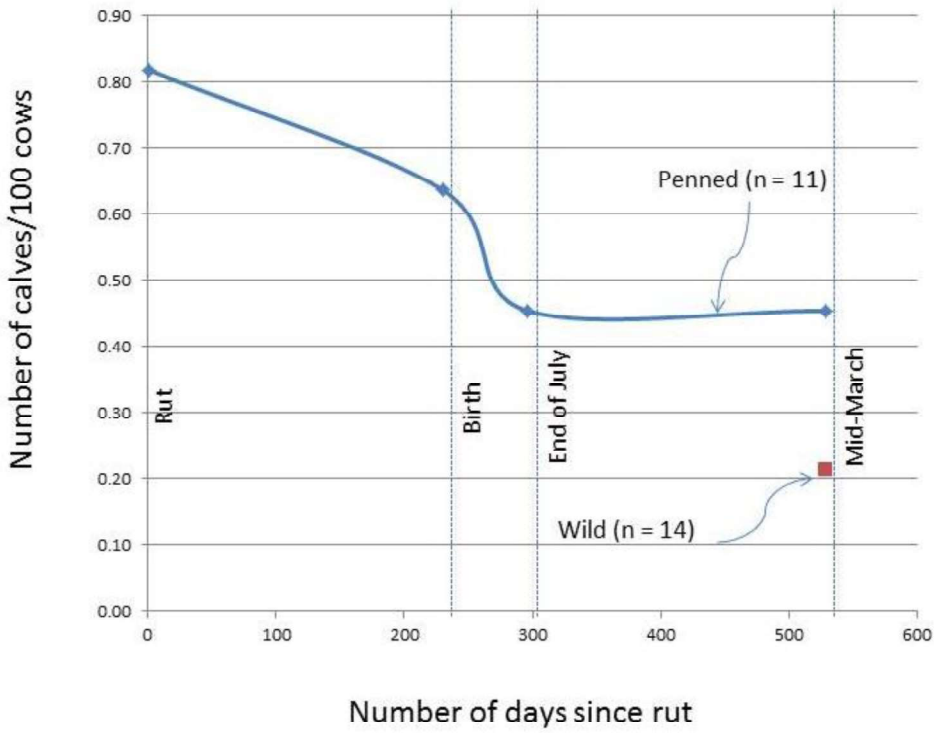


Figure 5. Trend in survival (calves/100cows) for caribou calves from inception to recruitment, within the Klinse-Za caribou herd area, northern British Columbia, October 2015 to March 2016. Numbers in parentheses represent the cows from the herd that were held within a maternity pen and the number of cows remaining in the wild.

Population size and mortality rates

A caribou population survey was conducted on March 13, 2016 within the Klinse-Za and Scott East caribou herd areas and we observed 13 adult males, 26 adult females, 3 juveniles (assumed to be cows), 5 calves from the 2015 maternity pen, and 3 wild calves for a total minimum population size of 50. Four additional animals were counted but later determined to be within the Kennedy caribou herd (Figure 6 and Table 2) and so those animals were excluded from the population estimate. There were no deaths of adult, radio-collared caribou. There was an annual increase in the herd of eight animals (19%), five from the pen, two from the wild, and one radio-collared immigrant from the Kennedy Siding herd. The overall population trend is provided in Figure 7 for both the Klinse-Za herd (until 2013) and the combined Klinse-Za/Scott

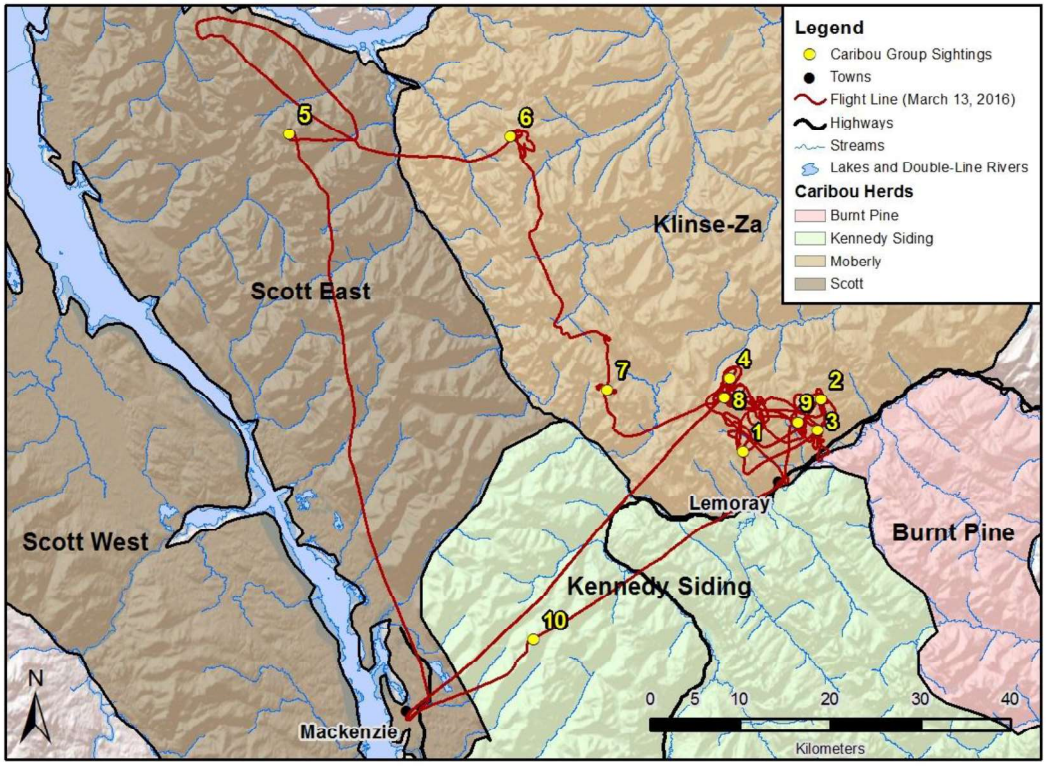


Figure 6. Observations of caribou groups recorded during a census of the Klinse-Za and Scott East caribou herd areas in northern British Columbia, March 2016. Caribou group sightings align with observation number (Obs_no) presented in Table 2.

East herds (from 2011[5] to 2016). The population trend shows stabilization in 2014 and gradual increase thereafter (Figure 7).

Non-target effects

In 2015, caribou behavior was subjectively noted as having been likely affected by penning. Once released from the pen, caribou (cows and calves) tended to use the Mt. Bickford area more than they would have prior to being penned. On September 01, approximately a month after release, the differences between the distances to their original capture site and the distance to the pen (Figure 8) were small by comparison to what was observed in 2014. Other than two exceptions, this was because the capture sites tended to be closer to the pen and animals did not venture far away from the pen after release, remaining closer to the pen than to their original capture site in 2015 (Figure 8).

We have not yet been able to assess the potential impacts of the pen on post-penning habitat use and selection but have collected sufficient data to do so (Figure 9).

[5] The Scott East herd was only surveyed in 2007 (Giguere and McNay 2007) and then again in 2013 (Seip and Jones 2013) with a minimum count of 22 in each case. We therefore assumed the herd stable at 22 between those years.

Table 2. Observations of caribou group numbers and sex/age class recorded during a census of the Klinse-Za and Scott East caribou herd areas in northern British Columbia, March 2016. Observation numbers (Obs_no) align with caribou group sightings presented in Figure 6.

Obs_no	Adult Unk	Adult Male	Adult Female	Juvenile	Penned Calf	Wild Calf	Total
1		1	2			1	4
2		1	4		2		7
3			1		1		2
4		6					6
5		1	3			1	5
6		1	3	1			5
7		2	2	1			5
8		1	7	1	2		11
9			4			1	5
10			3			1	4
Total[a]	**0**	**13**	**26**	**3**	**5**	**3**	**50**

a – totals do not include observation 10 from the Kennedy siding caribou herd area.

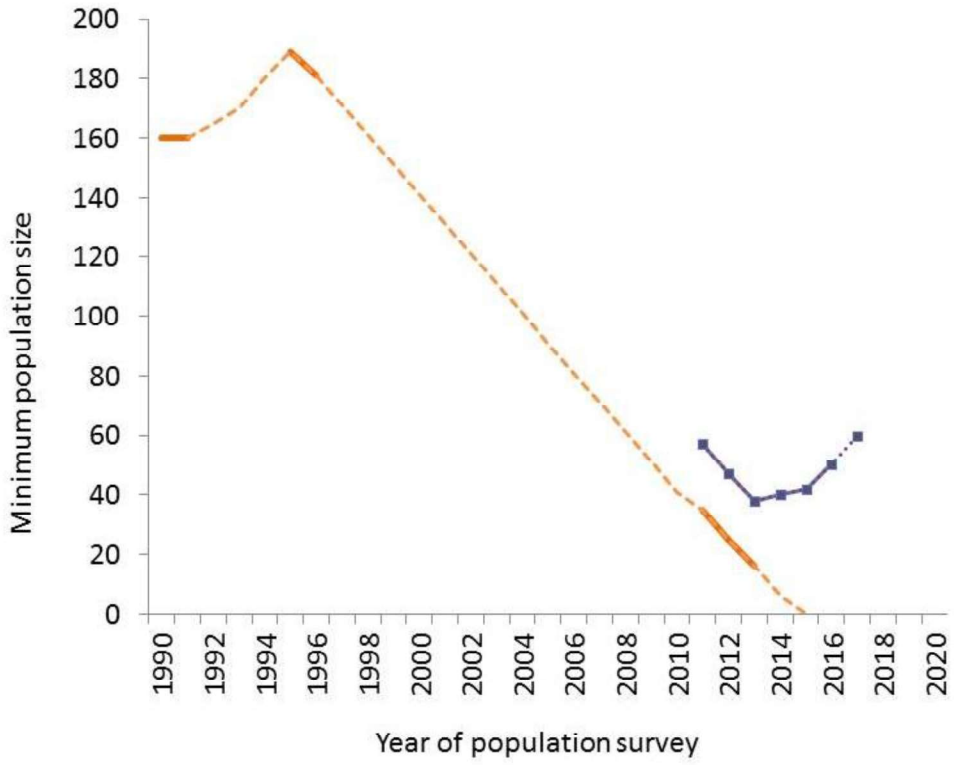


Figure 7. Minimum population size of the Klinse-Za (orange line) and combined Klinse-Za Scott East (purple lines) caribou herds in northern British Columbia, 1990-2017. Dashed/dotted lines represent either interpolated or predicted trends.

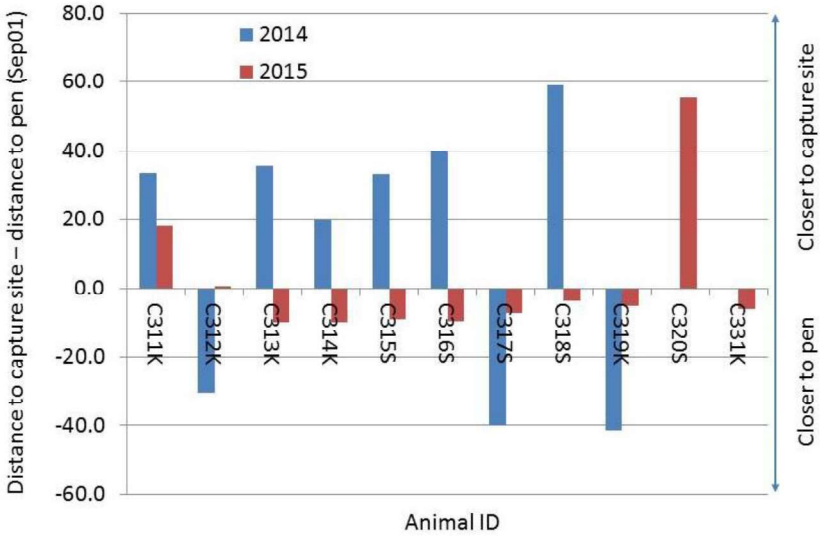


Figure 8. The difference in distance to capture site and distance to pen taken on September 01 about a month after release of caribou cows that were captured and held in a maternity pen.

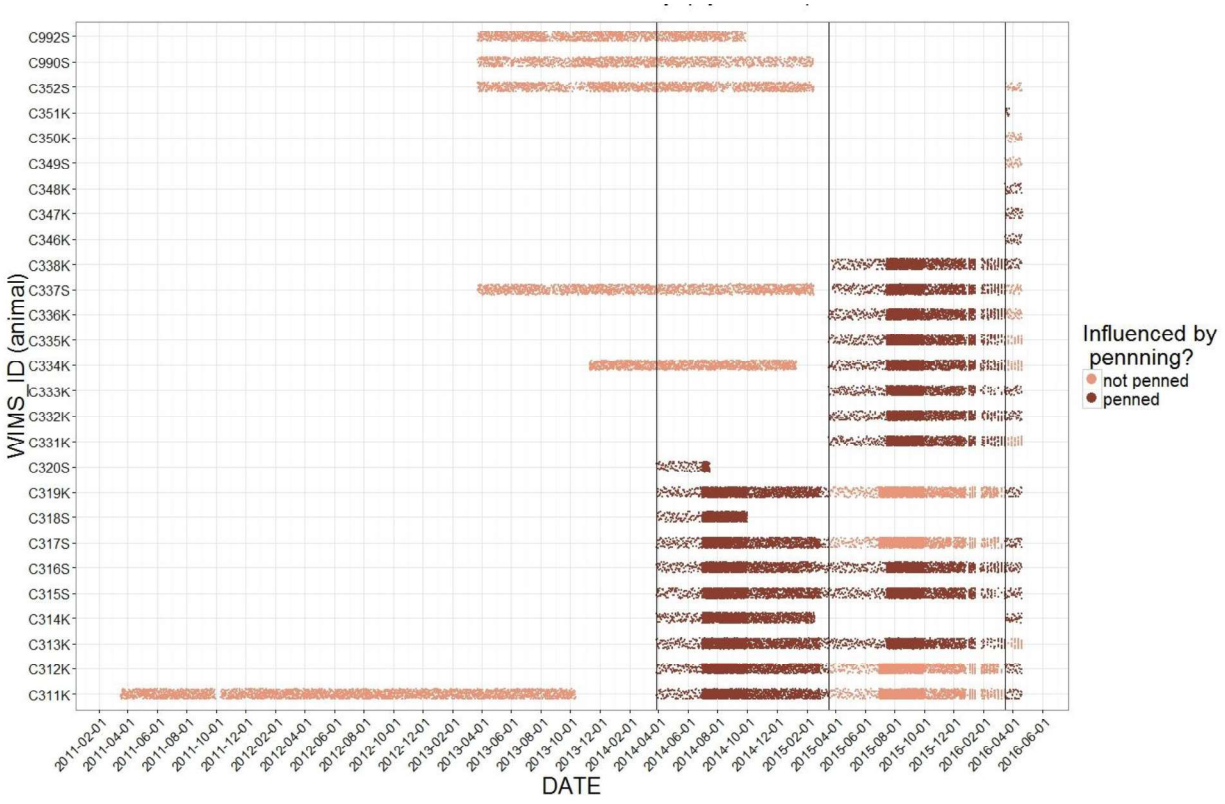


Figure 9. Pre- and post-penning relocations from radio-collared caribou (Wims_id) available to address potential effects of maternity penning on post-release movement and habitat selection. Stippling is the absolute abundance of data for each animal, each dot representing a relocation.

Extension and Reporting

The following is a chronological listing of extension and reporting events, concerning the maternity pen project, which occurred during the 2015-16 fiscal year[6]:

- Welcome page posting "Feature: What it takes to save mountain caribou", no date http://www.tidelife.ca/
- National Geographic article "Airlifting pregnant caribou away from wolves" posted 150903 http://news.nationalgeographic.com/2015/09/150903-saving-woodland-caribou-wolves-British-Columbia/
- Oral presentation to a CMI(Columbia Mountains Institute)-hosted workshop "An external review of caribou population management", held 151124 in Revelstoke, BC
- Oral presentation at an IUCN-facilitated workshop on Boreal Caribou Population Conservation in Western Canada, held 160126 in Calgary, AB.
- Oral presentation to Spectra Energy staff, 160128 in Calgary, AB
- Oral presentation to TransCanada staff, 160128 in Calgary, AB
- Newsletter post capture, emailed 160325
- Regular updates our Facebook page https://www.facebook.com/pncaribou

In addition, the media present at the maternity pen are expected to produce the following extension activities in the next fiscal year:

- CTV news and the Discovery channel are expected to air short segments;
- The Wilderness Awareness Committee is anticipating a variety of blog postings and film segments; and
- National Geographic is working on story lines and a film segment.

Costs of the maternity pen are reported in Appendix E.

DISCUSSION

Reversing the historical decline

An unexpected outcome of the maternity pen project is that, by penning animals from both the Klinse-Za and the adjacent Scott herds, it is now impossible to distinguish between the two. Notwithstanding the unintentional mixing of the herds, the maternity pen and partial removal of wolves from the area has been effective in arresting the decline of the Klinse-Za caribou herd. This is the second year in a row that the population size of the combined herds has increased and in the past year there appears to have not been any mortality. Although it is difficult to partition the effects of the two recovery measures, the maternity pen does appear to have a positive contribution to population growth. Survival of calves is better inside the pen compared to outside and that survival is maintained past the natal period after calves have been released back into the wild population. Both the pregnancy and parturition rates of penned animals were lower in 2015 compared to 2014 but we think this is likely to be a small sample size issue. More data are likely to demonstrate that the rates are, on average, not different than we'd expect

[6] As confirmation of recognition for sponsorship, sponsor logos were included in each of these events on an acknowledgement page or mentioned orally during interviews.

based on wild population parameters. Despite the low pregnancy and parturition, calves/100cows in March was higher for the penned population compared to the wild and the contribution to population growth was higher for the penned population.

We still do not fully understand the actual nutritional or health status of penned caribou. Apparently, they are of sufficient nutritional and health status to survive and reproduce successfully but there could be longer-term effects that we are currently unaware of. Also, we know anecdotally that penned animals appear somewhat naïve about the habitat directly around the pen area but have yet to demonstrate that with robust analysis. We also know that, depending on the occurrence of predators, that naivety can have important consequences once penned animals are released. The nativity is potentially an important side-effect of the maternity pen that should be demonstrated in a quantitative manner.

The wolf removal program in 2015 complemented the maternity pen project even though wolves were not removed close to the pen itself. The ground-based efforts most likely removed wolves that would have become immigrants to the herd area since wolf occupancy of the area was apparently quite low and dispersal from neighbouring packs would have been high. In addition to the 41 wolves removed from ground-based methods, we know that 40 more wolves were removed north of highway 97 through the BC Governments aerial-based, wolf removal program (Pers. Comm.; Dale Seip, BC Min. of Environ.; Prince George, BC).

After two years of operation, it has become obvious that the maternity pen recovery measure is best used in emergency situations such as the Klinse-Za. In 2015, we achieved a 19% increase in population size but the maternity pen added only five animals at a unit cost exceeding $100,000/animal. While helping to avert extirpation of the herd, it is unlikely the return on investment could be defended in populations that are less at risk. Also, unless the pen area was expanded to accommodate a larger number of penned animals, we'd expect a steep diminishing return to a growing population, hence a declining rationale for maternity penning. That said, it is noteworthy that in such emergency situations (i.e., steeply declining, small populations), sponsors appear willing to support maternity penning as a recovery measure where we speculate they might not be as willing to support other recovery measures.

Extension

We consider our extension efforts to be adequate. The Facebook page and website continue to receive regular attention, First Nation communities and local municipalities are aware of the project, and semi-annual newsletters and annual reporting help to maintain awareness within the more technical audience. In most, if not all of these outreach programs, sponsor logos are used to acknowledge the support and interest that is provided by a wide range of industrial and public institutions.

Measures of success

We established an a priori list of criteria upon which to assess project success. These criteria are addressed as follows:

- Planning
    - Funds and permits in place – done.
    - 3-year plan – done.
    - No material delays – none.
- Implementation

    - Forage collected and ready for use – done.
    - Pen renovations completed prior to animal capture – done.
    - 15-20 cows in the pen annually – captured 14.
    - Animal handling time <1hr – done.
    - No deaths during capture and transport – none.
- Husbandry
    - No deaths in the pen -- although not successful in this regard, the mortality rate is less than what would have been expected without the maternity pen.
    - No compromises to integrity of the pen structure – none.
    - Fidelity to range after release – animals did not demonstrate any disassociation with their normal range after release.
- Monitoring
    - Total count conducted – done.
    - Estimate of calves in the wild – done.

RECOMMENDATIONS

We make the following recommendations:

- Consider the Scott East and Klinse-Za caribou herds as one,
- Take steps to compare pregnancy and parturition rates of penned animals with the rates from wild populations,
- Have monitors assess nutritional status of penned caribou using a body condition index (e.g., Gerhart et al. 1996, Taillon et al. 2011),
- Use relocations from collared caribou to better understand possible unintentional effects of penning (e.g., naive to habitat conditions), and
- Continue penning for one more year then, while continuing to monitor population demographics, take two years off with the option of re-initiating maternity penning if necessary.

The purpose of discontinuing penning is an attempt to learn more about the relative contribution of maternity penning and wolf removal (i.e., we assume that wolf removal will continue). Other positive outcomes of a pause in penning are: reduction in cost of the overall project, the vegetation inside the pen will have an opportunity to rejuvenate after three years of intensive foraging by the penned caribou, and the herd cows will perhaps benefit from lack of the intrusiveness of the project. Despite the opportunity to learn and the other positive outcomes, the recommendation to pause the maternity penning poses some risk for caribou. Other projects that have attempted to recover caribou populations using a single recovery measure (e.g., wolf removals or primary prey reductions) have not led to significant positive effects on caribou population demographics other than to slow or stop the decline (Hervieux et al. 2014, Serrouya et al. 2015). We therefore consider there to be a high likelihood of needing to re-initiate maternity penning in the future.

ACKNOWLEDGEMENTS

We would like to acknowledge the tremendous support provided by a long list of individuals (Appendix D) during the single biggest event of the maternity pen project in 2015-2016 -- capture and transport of adult cows. The capture event involves dozens of participants ranging widely in their fields of expertise and all very skilled at what they do. The "team" performed an awesome job of handling each caribou in the most professional and humane manner possible. Thanks to everyone for a great job. The "keepers of the caribou", Ryan Desjarlais, Harley Davis, Steven Desjarlais, Dakota Davis, and Dion Alison, should be especially congratulated and genuinely thanked for their continued support to this project and to the caribou. Theoren (River) Walker (now deceased) was a "keeper of the caribou" and he too deserves the same credit – we know he would be proud of the success that he contributed towards. More than anyone else, the "keepers of the caribou" personally make a difference to the recovery of caribou each day that they spend monitoring the cows and calves while they are penned. Their dedication to the caribou, and to the contribution that caribou make to their way of life, is something we know they care about strongly. We thank Chiefs Roland Willson (WMFN) and Nathan Parenteau (SFN) for their continued, unwavering support for recovery of caribou in their traditional territories. I know both Chiefs are proud (and they should be) of the engagement their respective communities have had in the recovery of the Klinse-Za caribou herd. Thanks also to the enormous efforts of the Lands staff, George Desjarlais (WMFN) and Naomi Owens and Carmen Marshall (SFN), who make the project work.

Finally, this project could, of course, never have happened without the financial and in-kind support from a long list of sponsors; we thank each sponsor for their support and willingness to work with us to make the maternity pen project a success. The Peace-Williston Fish and Wildlife Compensation Program funding is on behalf of its program partners BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders who work together to conserve and enhance fish and wildlife impacted by existing BC Hydro dams.



REFERENCES

Aitkens, F. 2013. Implementation plan for the ongoing management of South Peace northern caribou (Rangifer tarandus caribou pop.15) in British Columbia. Draft Rep., British Columbia Min. of Environ., Victoria, BC. 16pp.

Cichowski, D., S. McNay, and B. Muir. 2012. A plan for sustaining Wah stzee (Caribou) in the Moberly area of British Columbia. West Moberly First Nations Lands Dept., Moberly Lake, British Columbia. 156pp.

Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 103pp.

Farnell, R. 2009. Three decades of caribou recovery programs in Yukon: A paradigm shift in wildlife management. Dept. of Environment, Whitehorse, YK.

GA (Golder Associates). 2010. Caribou "State of the Science" 2010 Update. Canadian Association of Petroleum Producers. Calgary, AB.

Gerhardt, K.L., White, R.G., Cameron, R.D., and Russell, D.E.1996. Estimating fat content of caribou from body condition scores. J. Wildl. Manage. 60: 713–718.

Hervieux, D., M. Hebblewhite, D. Stepnisky, M. Bacon, and S. Boutin. 2014. Managing wolves (*Canis lupus*) to recover threatened woodland caribou (*Rangifer tarandus caribou*) in Alberta. Can. J. Zool. 92:1029-1037.

Jones, E.S., M.P. Gillingham, D.R. Seip, and D.C. Heard. 2007. Comparison of seasonal habitat selection between threatened woodland caribou ecotypes in central British Columbia. Rangifer 17: 111-128.

NCTAC (Northern Caribou Technical Advisory Committee). 2004. A Strategy for the Recovery of Northern Caribou in the Southern Mountains National Ecological Area in British Columbia. Version 1.0. Ministry of Water, Land and Air Protection, Victoria, B.C. 108p.

McNay, R.S. and K.L. Sittler. 2013. Enhancing calf survival to help avert extirpation of the Klinse-Za caribou herd. Wildlife Infometrics Inc. Report No. 453. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

McNay, R.S., L. Giguere, E. Beckie, C. Marshall, and N. Owens. 2014. Enhancing the survival of caribou calves within the Moberly caribou herd area. Wildlife Infometrics Inc. Report No. 459. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

McNay, R.S., D. Cichowski, and B.R. Muir. 2013. Action Plan for the Klinse-Za herd of woodland caribou (*Rangifer tarandus caribou*) in Canada [Draft]. *Species at Risk Act* Action Plan Series. West Moberly First Nations, Moberly Lake, British Columbia. 28 pp.

Meidinger and Pojar 1991. The ecosystems of British Columbia. Special Report Series No. 6. British Columbia Ministry of Forests. Victoria, BC, Canada. 330pp.

Robin, J., K. McNay, and R.S.. McNay. 2013. Lichen collection trial for caribou penning project: plan and implementation. Wildlife Infometrics Inc. Report No. 451. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada

Seip, D., and E. Jones 2015. Population status of caribou herds in the Central Mountain Designatable Unit within British Columbia, 2015. Unpub. Rep., British Columbia Min of Forests, Lands, and Natural Resource Operations, Prince George, BC.

Serrouya, R., K. Bollefer, K. Furk, and C. Legebokow. 2015. Maternal penning in the Northern Columbia Mountains: Revelstoke Caribou Rearing in the Wild's first-year pilot and results of the 2015 calf census. Version 2.0.

Serrouya, R., M. wittmann, B. McLellan, H. Wittmer, and S. Boutin. 2015. Using predator-prey theory to predict outcomes of broadscale experiments to reduce apparent competition. Am. Nat. 185:665-679.

Sittler, K.L., R.S. McNay, L. Giguere, E. Beckie, C. Marshall, and N. Owens. 2014. Protocols for maternity penning to enhance the survival of caribou calves within the Moberly caribou herd area. Wildlife Infometrics Inc. Report No. 461. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Smith, K.G. and L. Pittaway. 2011. Little Smoky woodland caribou calf survival enhancement project. Rangifer Special Issue No. 19:97-102

Taillon, J., V. Brodeur, M. Festa-Bianchet, and S. Cote. 2011. Variation in body condition of migratory caribou at calving and weaning: Which measures should we use? Ecoscience 18:295-303.

WMFN (West Moberly First Nations). 2014. Population and distribution objectives and identification of critical habitat for seven herds of woodland caribou in the South Peace area of British Columbia. West Moberly First Nations, Moberly Lake, British Columbia.

APPENDIX A. MAT PEN DAILY MONITORING REPORT

Klinse-Za Caribou Maternal Pen Project

Crew Name: (Full Names) Ryan D / Steven D Date: May 27/15

Visitors: (Full Names) Nik, Jeff, Brian

CARIBOU

ID#	Freq. #	RIGHT Ear Tag	LEFT Ear Tag	Observ. AM * (V-H-NS-NH)	Observ. PM * (V-H-NS-NH)	Healthy (Y-N-Unk)	Comments
C331K	[redacted]	Red 1	None	✓			
C316S		Green 1	None	✓			
C315S		None	Green 2	✓			
C332K		Yellow 799	None	✓			
C333K		None	Yellow 800	✓			
C334K		Orange	White 1	✓			
C335K		Green	White 2	✓			
C313K		Orange 1	None	✓			
C336K		Red 7	Green 6	✓			
C337S		Orange	Green 8	✓			
C338K		Yellow 805	Green 9	✓			

*Codes for Observation: V=VIsual, H=Heard, NS=Not Seen, NH=Not Heard *Codes for Healthy: Y=Yes, N=No, Unk=Unknown (not sure of her health)

Comments all seen today at morning feed.
9 and 2 calves at evening feed.

FEEDING

Time	Food Type (Y or N) Lichen	Food Type (Y or N) Pellets	Amount Bags	Amount Buckets	Feeder trough last feeding condition (examples: small amount of food left, food hardly touch, only lichen eaten, lots of pellets left and all wet so removed old food and add fresh, birds feeding in trough, just a small amount left, ...)
9:40 AM		Y		3/4	
7:00 PM		Y		1.5	

Comments:

DISTURBANCE

Time	Event *	Location *	Actions & Comments
10:30	People	Pen	5 people in pen to capture and collar. - calves #3, 4

*Codes for Event: Aircraft – Visitors – People – Trucks – Sleds – Quads – Big wind storm – Tree falling, etc...

*Codes for Location: Camp – Pen – Road – Alpine – Cutblock – etc...

PEN PERIMETER WALK-AROUND

Fence Section	Time	Electric Fence	Geo-textile	Bottom Wire	Vege-tation	Predator Tracks	Comments

Codes: ✓ = Checked & in good standard; X = Need attention and then, in "Comments", describe the problem(s) and indicate if it is ***"Fixed"*** or not and if not when it will be fixed → Description/Comments can be as follow: Hole; Wire short; Broken wire; Vegetation touching the wire; Tree on the fence; ...

Comments: _____

PREDATOR CONTROL

Time	Species	Sign (tracks, scat, visual)	Location (pen, camp, road, cut block)	Action
5:40pm	Black Bear	Visual	Road 8Km	Seen bear on pred patrol. did not have time to react.

Comments: _____

APPENDIX B. COMMERCIAL CARIBOU PELLET INGREDIENTS

15% CARIBOU PELLETS
(For Caribou)

INGREDIENTS:

Barley, Wheat, Corn
Faba beans, Soybean meal
Molasses
Canola oil
Limestone, Salt, Dical
HP Mineral Mix(Wheat, Millrun, Canola oil, Copper Sulfate, Zinc Oxide, Calcium Carbonate, Iodine, Manganeous Oxide, Selenium, Cobalt)
HP Fortifier(Wheat, Millrun, Canola oil, Copper Sulfate, Zinc Oxide, Calcium Carbonate, Iodine, Manganeous Oxide, Iron Sulfate, Calcium Pentothenate, Selenium, Santoquin, Biotin, B-Traxim, Niacin, Folic Acid, Vitamin A, Vitamin B1, Vitamin B2, Vitamin B6, Vitamin B12, Vitamin D, Vitamin E, Vitamin K3)
Vitamin A, D, E, Vitamin E
Choline chloride
MAG OX, Dyna-Mate

INGREDIENTS: A list of ingredients used in this feed may be obtained by the manufacturer or registrant.

This feed contains added selenium at 0.4 mg/kg.

GUARANTEED ANALYSIS: Crude Protein (min) 15.0%; Crude Fat (min) 2.0%; Crude Fibre (max) 6.0%; Calcium (act) 1.00%; Phosphorus (act) 0.90%; Sodium (act) 0.25%; Potassium (act) 0.83%; Magnesium (act) 0.20%; Sulfur (act) 0.20%; Iron (act) 400 mg/kg; Iodine (act) 1.3 mg/kg; Copper (act) 25 mg/kg; Manganese (act) 100 mg/kg; Zinc (act) 191 mg/kg; Cobalt (act) 0.40 mg/kg; Vitamin A (min) 15,000 I.U./kg; Vitamin D (min) 2,000 I.U./kg; Vitamin E (min) 100 I.U./kg; Thiamin (min) 5.3 mg/kg; Riboflavin (min) 8.2 mg/kg; Niacin (min) 72 mg/kg; Vitamin B_6 (min) 14 mg/kg; Biotin (min) 0.28 mg/kg; Pantothenate (min) 28 mg/kg; Choline (min) 1,500 mg/kg; Folate (min) 4 mg/kg; Vitamin B_{12} (min) 0.02 mg/kg.

FEEDING INSTRUCTIONS: Feed Caribou Pellets to Caribou when they are on tundra. Provide Hi-Pro Mineral and salt free choice and provide fresh water.

CAUTION:
1. Directions for use must be carefully followed.
2. Do not feed in association with another feed containing supplemental selenium.

Individual results from the use of this product may vary due to management, environment, genetics, health and sanitation differences. Therefore, Hi-Pro Feeds does not warrant or guarantee individual results.

Net Weight 20 KG

APPENDIX C. LAB REPORTS FROM DEAD CALF NECROPSIES

BRITISH COLUMBIA
The Best Place on Earth
Ministry of Agriculture

Animal Health Centre

AAVLD - Accredited Laboratory

1767 Angus Campbell Road
Abbotsford BC V3G 2M3
Telephone: (604) 556-3003
Facsimile: (604) 556-3010
Toll-Free: 1-800-661-9003

Final Report AHC Case: 15-2813

Last Updated: 06/22/15 2:13 PM
Pathologist: Ann Britton, DVM, MSc, PhD
Received Date: 06/11/15
Collected Date: 06/11/15
Client Ref No: 15-6602

Veterinarian: **Dr. Helen Schwantje**
Clinic: **Ministry of Environment**
Phone: (250) 953-4285
Fax: (250) 356-9145

Submitter: **Helen Schwantje**
Phone:
Fax:
Owner: **Ministry of Environment**
Phone:
Fax:(250) 356-9145

Animal Data
Species: Caribou
Breed:
Sex: M
Age:
Premise ID:

Case History

Submitted one Caribou calf for post mortem. Please not that the "bad smell" is coming from our specimen freezer.

Found May 29, 2015 Moberley Penning Project, 538235E, 6170414N, calf, male, Calf has ear tag #3 (Red), found evening of May 28, 2015, at calving site within treeline. Snow/rain zero - 2 C on the 28th, 29th. Finder: Brian Pate

Final Diagnosis

Final Diagnosis:

Mild meconium aspiration

Comment:

No significant lesions were identified during the necropsy. Ancillary tests did not reveal any evidence of an infectious etiology. The mild amount of meconium in the lung could represent fetal distress and meconium aspiration during parturition. Is there any possibility of a dystocia?

Necropsy

GROSS DESCRIPTION:

A neonatal male caribou was presented for post-mortem examination. The carcass was well muscled and had abundant subcutaneous and visceral adipose stores (BCS 5/9). There were abundant milk clots in the abomasum. The feces were very soft. There were no other significant findings on gross examination.

MORPHOLOGIC DIAGNOSES:

1. Open

TENTATIVE DIAGNOSIS:

COMMENTS:

There were no gross abnormalities observed that would have caused the death of this animal.

Samples from a variety of organs have been fixed in formalin for histopathologic examination, which will allow for further interpretation. Lung, liver, spleen and small intestine were submitted for routine bacterial culture. Feces were submitted for parasitology. Portions of lung, liver, spleen, kidney and brain are being held frozen in the event that further testing is warranted.

** Gross necropsy was conducted by Dr. Tony Redford under the supervision of Dr. Ann Britton. Gross comments prepared by Dr. Redford.

Histopathology

Lung: There is a mild amount of meconium scattered in alveolar spaces.

Liver, spleen, rumen, urinary bladder, gastrointestintal tract, tongue, thymus, kidney, thyroid gland, heart, skeletal muscle, brain: No significant lesions.

Parasitology

Fecal Flotation Resulted by: Kristen Younie Verified by: Ann Britton on 06/18/15 @ 12:45 PM

Specimen	ID	Isolate	Result	Level
Feces			Negative	

Bacteriology

Aerobic Culture - Prod Resulted by: Jaime Osei-Appiah Verified by: Erin Zabek on 06/18/15 @ 12:20 PM

Specimen	ID	Isolate	Result	Level
Liver			No Bacteria Isolated	
Lung		E.coli (haemolytic)	Positive	1+
Spleen			No Bacteria Isolated	
Ileum		E.coli (haemolytic)	Positive	3+
Ileum		Enterococcus sp.	Positive	3+

Culture - Salmonella Resulted by: Jaime Osei-Appiah Verified by: Erin Zabek on 06/19/15 @ 11:53 AM

Specimen	ID	Isolate	Result	Level
Ileum			No Salmonella sp. Isolated	

Molecular Diagnostics

Apicomplexa Resulted by: Julie Bidulka Verified by: Tomy Joseph on 06/18/15 @ 4:37 PM

Specimen	ID	Test	Result

Brain		Apicomplexa	Negative

Test validation in progress.

Ann Britton, DVM, MSc, PhD
Ann.P.Britton@gov.bc.ca

These results relate only to the animals or items tested.
This report shall not be reproduced except in full, without the written approval of the laboratory.
The above material is intended only for the use of the individual to whom it is addressed, as it may contain confidential or personal information that is subject to provisions of the Freedom of Information and Protection of Privacy Act. This material must not be distributed, copied or disclosed to other unauthorized persons. If you have received the transmission in error, please contact the sender immediately by telephone.

END OF REPORT

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Agriculture

Animal Health Centre

AAVLD - Accredited Laboratory

1767 Angus Campbell Road
Abbotsford BC V3G 2M3
Telephone (604) 556-3003
Facsimile (604) 556-3010
Toll-Free 1-800-661-9903

Final Report AHC Case: 15-2812

Last Updated: 06/23/15 10:10 AM
Pathologist: Ann Britton, DVM, MSc, PhD
Received Date: 06/11/15
Collected Date: 06/11/15
Client Ref No: 15-6576

Veterinarian: **Dr. Helen Schwantje**
Clinic: **Ministry of Environment**
Phone: (250) 953-4285
Fax: (250) 356-9145

Submitter: **Helen Schwantje**
Phone:
Fax:
Owner: **Ministry of Environment**
Phone:
Fax:(250) 356-9145

Animal Data
Species: Caribou
Breed:
Sex: M
Age:
Premise ID:

Case History

Submitted one Caribou calf for post mortem. Please note that the "bad smell" is coming from our specimen freezer.

Found May 15, 2015 North East corner of Maternal Pen 538235E 6170414N, calf, male, one dead - no ear tag. Found evening of May 14, 2015. Eye eaten by bird and small section of after birth on underside of calf. At calving site within tree line. Climate +14 C on 15th. Finder: Ken McEwan (250)997-5700.

Final Diagnosis

Final Diagnosis:

Multifocal multiphasic moderate degenerative myopathy

Comment:

The calf exhibited changes in the skeletal muscle (but not the heart) typical of multiphasic myofibre degeneration and regeneration. The most common cause of this muscle lesion is nutritional myopathy associated with deficiency of Vitamin E and/or selenium. Because this is such a young animal, the pathology likely occurred in utero and may have been due to deficiency in the diet of the mother. Death of animals affected by nutritional myopathy typically occurs due to lesions in the heart muscle. There were no changes observed in the heart in this case. However, there could be pathologic changes in sections of the heart other than the one sampled and examined.

Please advise if you would like to send liver to PDS for selenium analysis. The second calf (15-2813) did not exhibit changes suggestive of myopathy. This liver could be sent for analysis as an age matched control. Please note that Vitamin E testing requires serum for analysis and thus this test cannot be conducted on the liver samples.

Necropsy

GROSS DESCRIPTION:

A neonatal male caribou was presented for post-mortem examination. The carcass was well muscled and had abundant

tissues, thorax and abdomen. The lungs were not inflated and sank when put in formalin. The eyes were absent and there were multiple fractures of the frontal and parietal bones with no associated hemorrhage (scavenging). There were no other significant findings on gross examination.

MORPHOLOGIC DIAGNOSES:

1. Open

TENTATIVE DIAGNOSIS:

Open (Pending histopathology)

COMMENTS:

The fluid in multiple areas and sinking of lung in formalin suggest that the calf died in utero or prior to birth and never breathed. There were no gross abnormalities observed that would have caused the death of this animal.

Samples from a variety of organs have been fixed in formalin for histopathologic examination, which will allow for further interpretation. Lung, liver, spleen and small intestine were submitted for routine bacterial culture. Feces were submitted for parasitology. Portions of lung, liver, spleen, kidney and brain are being held frozen in the event that further testing is warranted.

** Gross necropsy was conducted by Dr. Tony Redford under the supervision of Dr. Ann Britton. Gross comments prepared by Dr. Redford.

Histopathology

There are diffuse changes in several of the tissues relating to autolysis of varying degrees, characterized by generalized loss of cell detail, hypereosinophilia, pallor, and fading nuclei. There is also freeze-thaw artifact.

Skeletal Muscle: There are multifocal areas that feature a large variation in myofiber diameter, increased optically vacant space between myofibers, infiltrates of lymphocytes, plasma cells and macrophages, and myocytes with one or more of the following changes: loss of striations, loss of nuclei, hypereosinophilic sarcoplasm, and nuclear rowing (myocyte degeneration, necrosis and regeneration).

There are no significant findings in the tongue, rumen, kidney, liver, urinary bladder, thyroid, jejunum, ileum, spiral colon, lung, heart, diaphragm, duodenum, pancreas, adrenal gland, thymus, spleen, cerebellum and cerebrum.

MORPHOLOGIC DIAGNOSES:

1. Skeletal Muscle: Myocyte degeneration and necrosis, multifocal, polyphasic, chronic, severe, with regeneration.

Parasitology

Fecal Flotation Resulted by: Kristen Younie Verified by: Ann Britton on 06/18/15 @ 12:45 PM

Specimen	ID	Isolate	Result	Level
Feces			Negative	

Bacteriology

Aerobic Culture - Prod Resulted by: Jaime Osei-Appiah Verified by: Erin Zabek on 06/18/15 @ 12:19 PM

Specimen	ID	Isolate	Result	Level
Lung		Streptococcus sp. (alpha)	Positive	1+
Lung		Enterococcus sp.	Positive	2+
Liver			No Bacteria Isolated	
Spleen			No Bacteria Isolated	
Ileum		Streptococcus sp. (alpha)	Positive	1+
Ileum		Enterococcus sp.	Positive	1+
Ileum		E.coli (non-haemolytic)	Positive	1+

Culture - Salmonella Resulted by: Jaime Osei-Appiah Verified by: Erin Zabek on 06/19/15 @ 11:54 AM

Specimen	ID	Isolate	Result	Level
Ileum			No Salmonella sp. Isolated	

Molecular Diagnostics

Apicomplexa Resulted by: Julie Bidulka Verified by: Tomy Joseph on 06/18/15 @ 4:36 PM

Specimen	ID	Test	Result
Tissue	lv,ht,tong,diaph,musc	Apicomplexa	Negative
Brain		Apicomplexa	Negative

Test validation in progress.

A. Britton

Ann Britton, DVM, MSc, PhD
Ann.P.Britton@gov.bc.ca

These results relate only to the animals or items tested.
This report shall not be reproduced except in full, without the written approval of the laboratory.
The above material is intended only for the use of the individual to whom it is addressed, as it may contain confidential or personal information that is subject to provisions of the Freedom of Information and Protection of Privacy Act. This material must not be distributed, copied or disclosed to other unauthorized persons. If you have received the transmission in error, please contact the sender immediately by telephone.

END OF REPORT

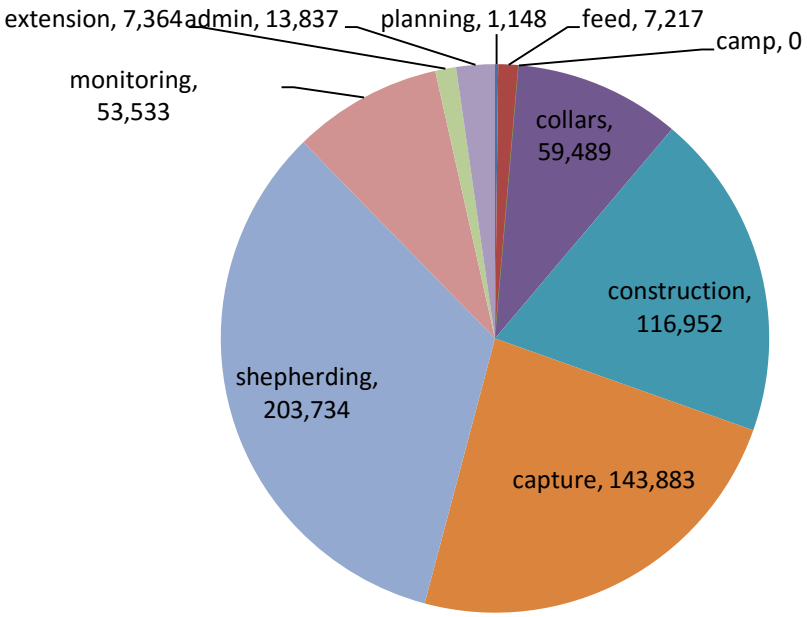
APPENDIX D: CARIBOU CAPTURE PARTICIPANTS LIST

- Emergency Response Coordinator
  - Brian Pate
- The capture crew will be operating out of a Bell 206 Jet Ranger from Qwest Helicopters;
  - Pilot Zvonko Dancevic
  - Net gunner Brad Culling
  - Handler Jeff Gollner
- Transport crew 1 will be operating out of an A-Star from Qwest Helicopters;
  - Pilot Tom Henderson
  - Veterinarian Bryan Macbeth
  - Handler Dale Seip
- Transport crew 2 will be operating out of an A-Star from Qwest Helicopters;
  - Pilot Scott Dwyer
  - Veterinarian Dana Bergen
  - Handler Mac Culling
- Filming crew will be operating out of a Jet Ranger from Bailey Helicopters;
  - Yellow Head Helicopters, Tim Seabrook
  - Isabelle Groc
  - Discovery Channel Crew Sean McShane
  - Discovery Channel Crew TBD
  - David Moskowitz Photography
  - Wilderness Awareness Marcus Reynerson
  - Wilderness Awareness Colin Arisman
- Snowmobile crew;
- Crew 1
  - Harley Davis
  - Naomi Owens
  - Les Davis
- Crew 2
  - Ryan Desjarlais
  - Handler Steve Desjarlais
  - Sean West
- Pen crew;
- Crew 1
  - Veterinarian Owen Slater
  - Handler Diane Culling
  - Handler Line Giguere
  - Recorder Carmen Marshal
- Crew 2
  - Veterinarian Helen Schwantje
  - Handler Doug Heard
  - Handler Jeff Richert

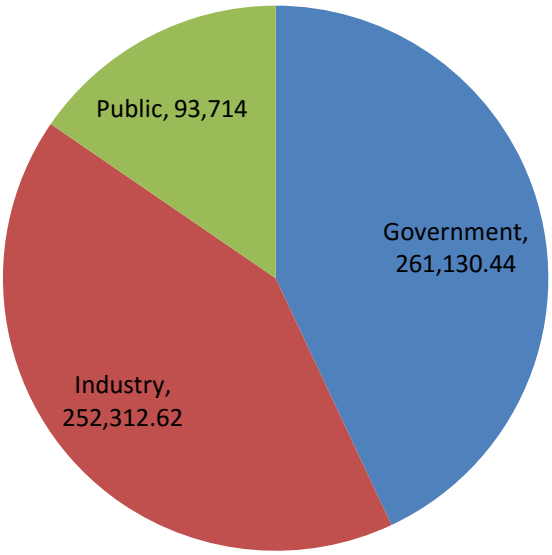
    - Recorder Kayla McNay
- Scales
    - Nik McEwan
- Visitor
    - Meghan Anderson

APPENDIX E. PROJECT COSTS AND SPONSORSHIPS

The total cost of the maternity pen project in 2015-16 was $607,157. The diagrams below provide details on phase costs (A) and sponsor contributions (B).



(A)



(B)