2013 - JCR Evaluation Form

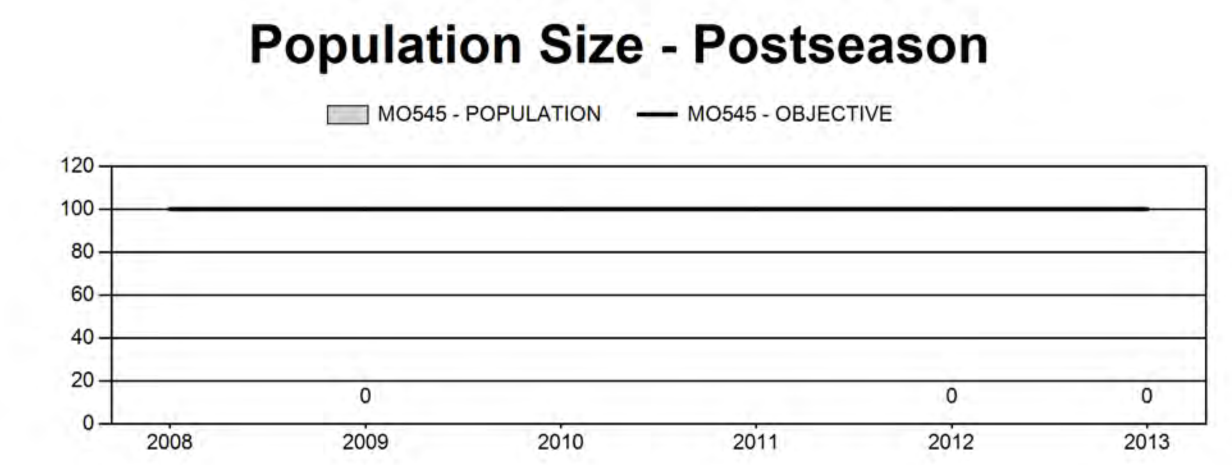
SPECIES: Moose	PERIOD: 6/1/2013 - 5/31/2014
HERD: MO545 - SNOWY RANGE	
HUNT AREAS: 38, 41	PREPARED BY: WILL SCHULTZ

	2008 - 2012 Average	2013	2014 Proposed
Population:	0	N/A	N/A
Harvest:	46	55	45
Hunters:	50	58	48
Hunter Success:	92%	95%	94 %
Active Licenses:	50	58	48
Active License Percent:	92%	95%	94 %
Recreation Days:	367	599	420
Days Per Animal:	8.0	10.9	9.3
Males per 100 Females	107	119	
Juveniles per 100 Females	47	67	

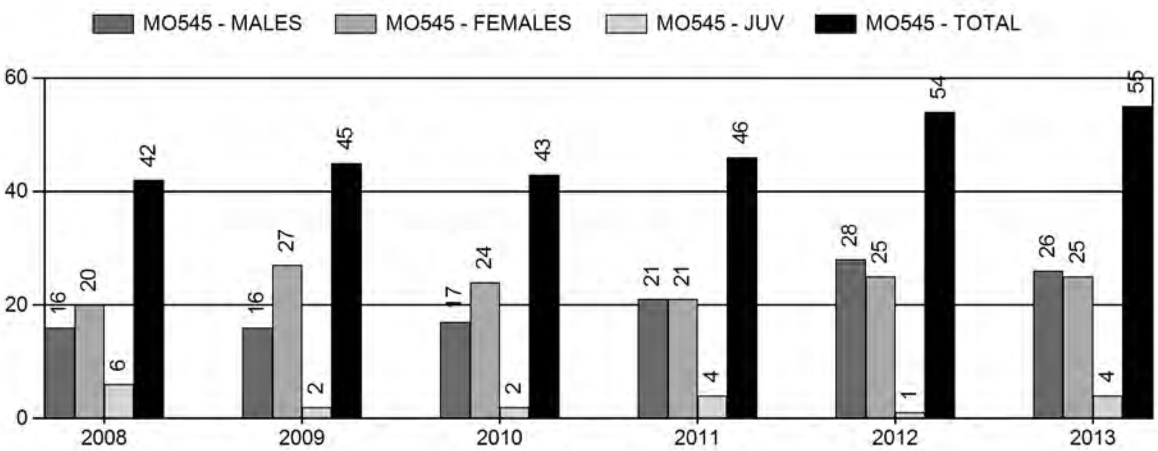
Population Objective:	100
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	N/A%
Number of years population has been + or - objective in recent trend:	0
Model Date:	None

Proposed harvest rates (percent of pre-season estimate for each sex/age group):

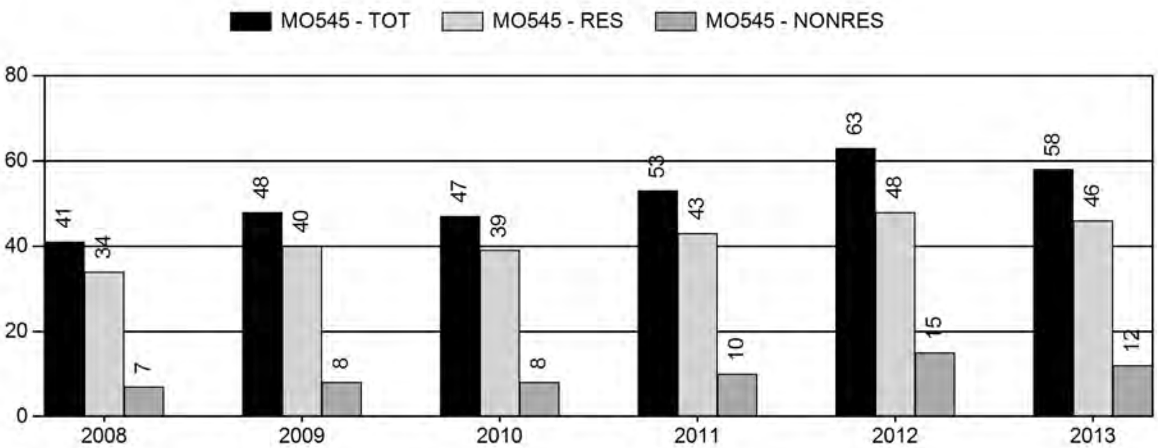
	JCR Year	Proposed
Females ≥ 1 year old:	NA%	NA%
Males ≥ 1 year old:	NA%	NA%
Juveniles (< 1 year old):	NA%	NA%
Total:	NA%	NA%
Proposed change in post-season population:	NA%	NA%



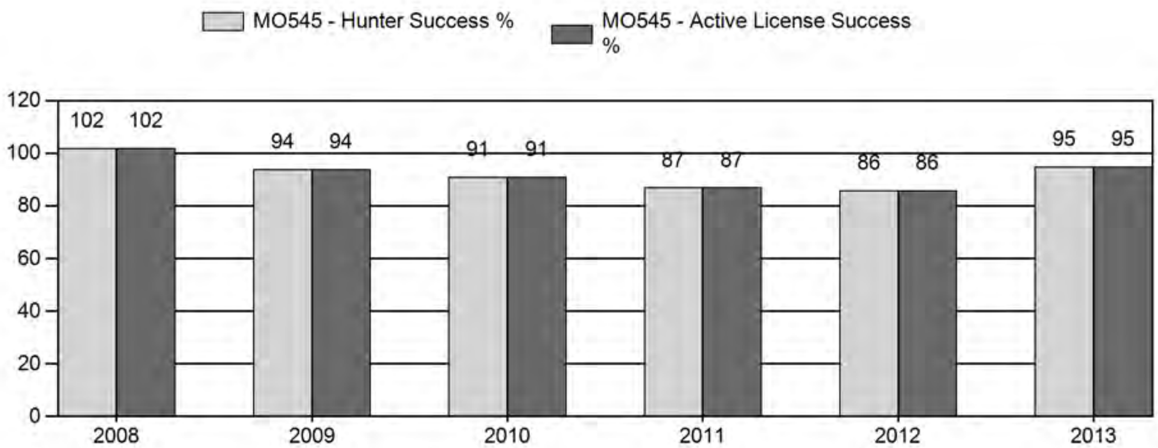
Harvest



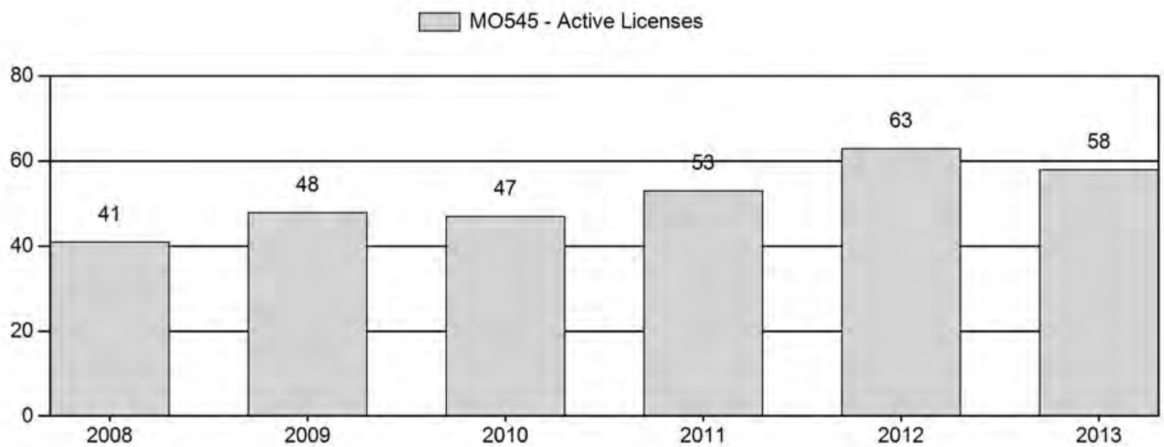
Number of Hunters



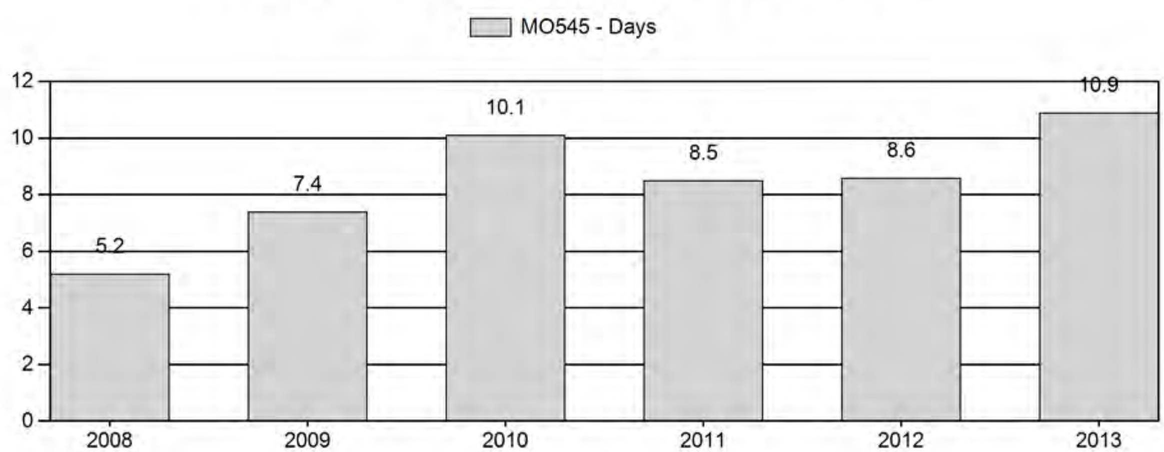
Harvest Success



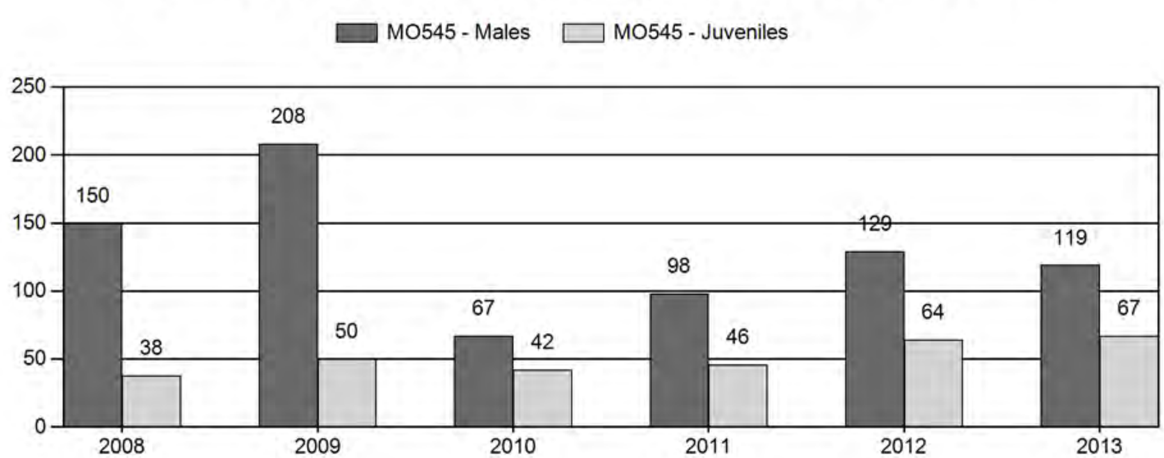
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2008 - 2013 Postseason Classification Summary

for Moose Herd MO545 - SNOWY RANGE

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2008	0	1	11	12	52%	8	35%	3	13%	23	144	12	138	150	± 0	38	± 0	15
2009	0	4	21	25	58%	12	28%	6	14%	43	0	33	175	208	± 0	50	± 0	16
2010	0	7	17	24	32%	36	48%	15	20%	75	0	19	47	67	± 0	42	± 0	25
2011	0	3	46	49	40%	50	41%	23	19%	122	0	6	92	98	± 0	46	± 0	23
2012	0	4	14	18	44%	14	34%	9	22%	41	0	29	100	129	± 0	64	± 0	28
2013	0	5	27	32	42%	27	35%	18	23%	77	0	19	100	119	± 0	67	± 0	31

Snowy Range Moose (MO545)
Hunt Areas 38, 41
2014 Hunting Seasons

Hunt Area	Type	Dates of Seasons Opens	Closes	Limited Quota	Limitations
38, 41	1	Oct. 1	Nov. 14	20	Limited quota licenses; any moose, except cow moose with calf at side
	4	Oct. 1	Nov. 14	25	Limited quota licenses; antlerless moose, except cow moose with calf at side

Hunt Area	Type	Quota change from 2013
Herd Unit Total	1	-5
	4	-10

<u>Management Evaluation</u>
Current Management Objective: 100
Management Strategy: Special
2013 Postseason Population Estimate: NA
2014 Proposed Postseason Population Estimate: NA

Moose in the Snowy Range herd unit are managed toward a numeric objective of 100. A moose population model has not been developed for this herd unit. The herd is managed under a special management strategy. The objective was last reviewed in 1997.

Herd Unit Issues

The Snowy Range herd unit stretches across southern Wyoming, along the Colorado border, from Baggs to Cheyenne. Moose are found year-round in areas on Pole Mountain, Sierra Madre Mountains, and most notably, the Snowy Range Mountains. These moose descended from moose transplanted in Colorado and were not native to this area historically. Challenges for managing moose in this herd unit include a rapidly changing forest ecosystem, high infestation rates for parasites, and human conflict/safety. Limited population monitoring for moose has been an issue in this herd unit also.

Weather

Weather in this herd unit was relatively normal during the past bio-year. This weather pattern most likely had a neutral to positive influence on moose. For specific meteorological information for the Snowy Range herd unit the reviewer is referred to the following link: http://www.ncdc.noaa.gov/cag/

Habitat

Moose habitat conditions are currently being monitored across Wyoming and in the North Park, Colorado area through a University of Wyoming project. Preliminary results published in a recent annual report for this project indicated the Snowy Range's willow habitat quality and moose fitness were relatively low when compared to the other areas (Appendix A).

Habitat conditions improved in 2013 with an increase in timely spring and fall precipitation. However, much of the transition and winter ranges were severely impacted by the drought conditions experienced in bio-year 2012. No WGFD moose habitat production/utilization data was available for this herd unit. However, annual production rates were assumed to have improved from the previous year, while utilization rates on winter ranges were assumed to have continued to be high.

Field Data

Traditionally there has been little allocation of funding in this herd unit to collect moose classification data. Moose classification data has been collected incidentally during annual mule deer and elk classification surveys. In 2011 and 2013, approximately 8 additional hours of helicopter flight time was allocated to collect moose classification data in the Snowy Range herd unit resulting in samples of 122 and 77 moose, respectively. Twenty (20) of the 77 moose observed during the 2013 survey were located in Hunt Area 41. The 2013 classification ratios were 119 bulls:100 cows and 67 calves:100 cows. Although the moose population size was unknown during the 2011 and 2013 surveys, managers thought the observed ratios were plausible.

Harvest Data

In 2013, the weighted harvest estimates indicated 63 hunters harvested 28 bulls, 25 cows and 1 calf (lab data indicated 2 calves). A total of 3 illegally harvested moose were documented in 2013. Male lab-aged tooth samples (n=24) indicated this year's median age and percentage of the bull harvest ≥ 5 years of age, were within the "prime-age bull" class (Figures 1, 2 and 3) (Thomas 2008). Age class distribution from female lab-aged tooth samples (n=19) indicated 47% of the antlerless moose harvest were ≤ 2 years old (Figure 4).

Median age for tooth samples from harvested bulls declined in 2013 and is a statistic of concern for managers. The 2013 median bull age decreased, it was at 4 years of age which was the lower parameter for the "prime-age bull" class. The Snowy Range has a reputation for producing trophy quality bulls. An objective for managers is to sustain both quantity and quality for the bull segment of this moose population. The reported ages for harvested antlerless moose were another statistic of concern for the Snowy Range moose managers. Since hunters were limited to harvesting either cows without calves at their side, or calves, managers anticipated a majority of the antlerless harvest would have consisted of antlerless moose 2 years of age or less. Perhaps in 2013, there were more cow moose of prime breeding age without a calf at side due to drought conditions experienced in 2012. This may contributed to an increased proportion of prime breeding age cow moose being harvested. As stated earlier in this report, making inferences from small or incomplete data sets has hampered the ability of managers to make management decisions of significant consequence for this herd unit.

Population

A Wyoming Spreadsheet model has not been developed for this herd unit. A population model would only be of value if better annual herd abundance/composition data and, or, survival data were consistently collected. We assume from observations and harvest data, overall moose numbers are stable to slightly decreasing in trend.

Management Summary

For the first time since we began hunting moose in this herd unit back in 2000, we decreased license numbers for the 2014 hunting season. This decrease was in part an effort to become more conservative with harvest rates, as a precaution, in case moose numbers were approaching our postseason management objective of 100 moose.

Figure 1. Median age of bulls harvested for the Snowy Range Moose herd unit, from lab aged teeth (n=24), Wyoming, 2013.

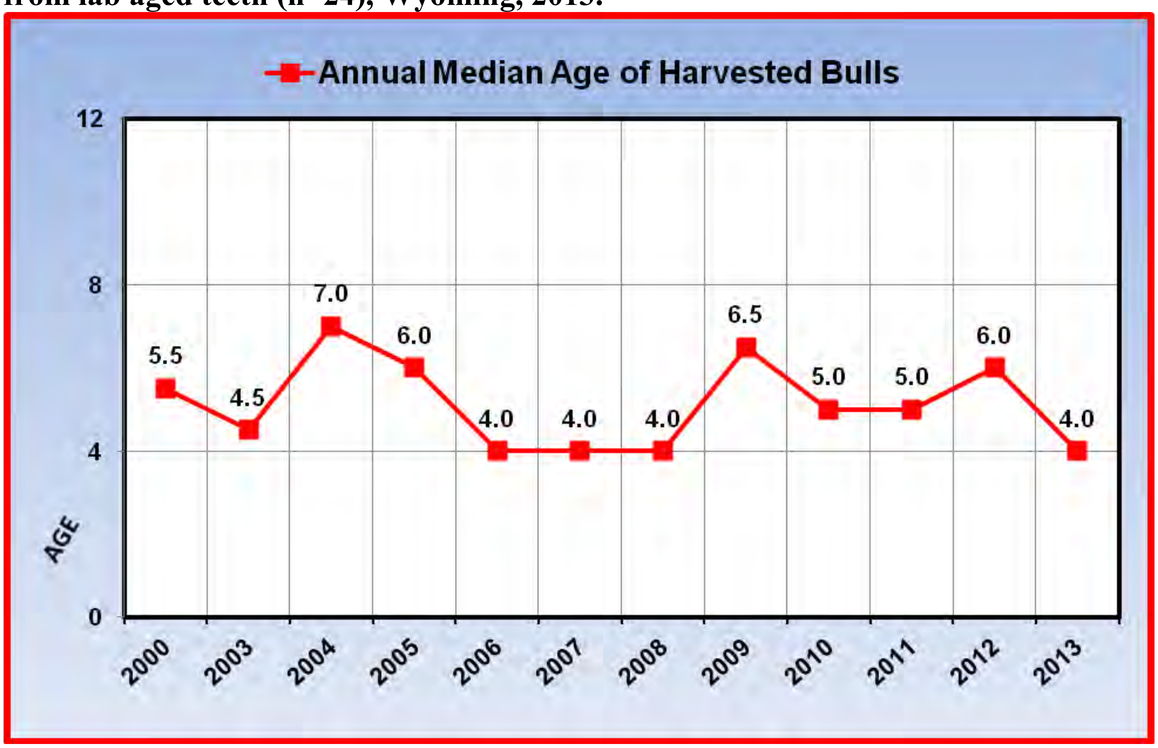


Figure 2. Average (3-year running) median age of bulls harvested for the Snowy Range Moose Herd Unit, from lab aged teeth (n=24), Wyoming, 2013.

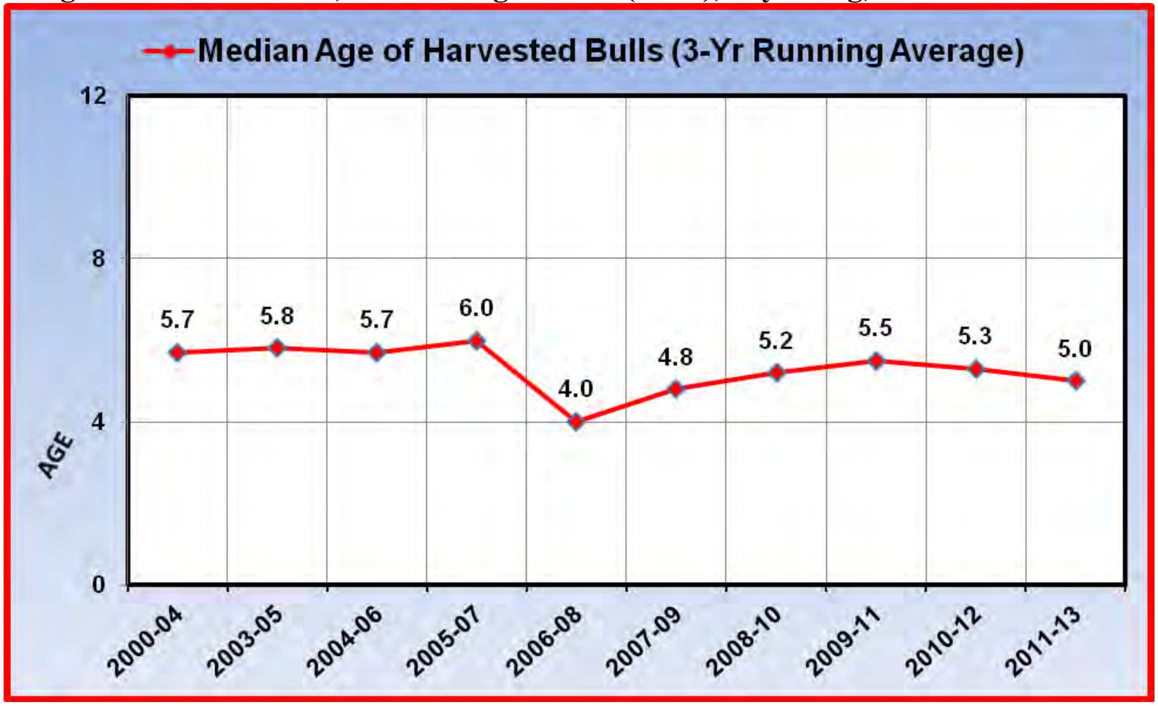


Figure 3. Annual Percentages of the bull harvest ≥ 5-years in age from Snowy Range Moose Herd Unit, from lab aged teeth (n=24), Wyoming, 2013.

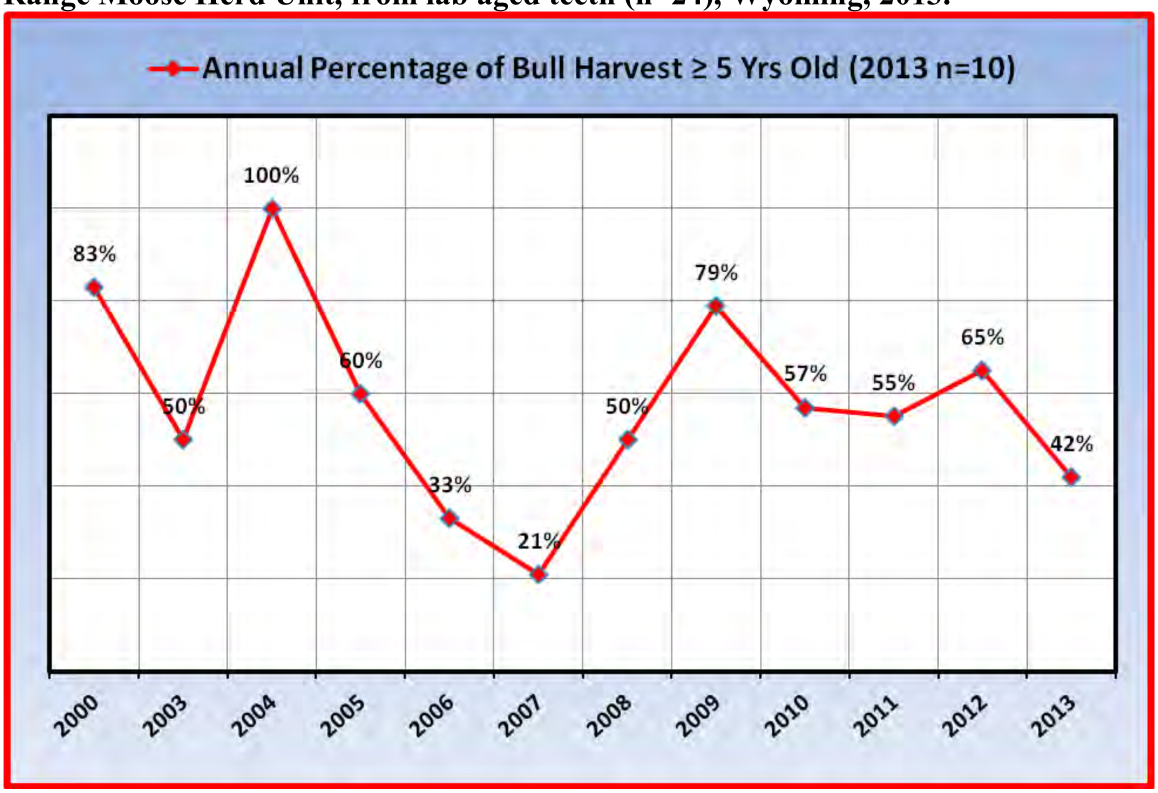
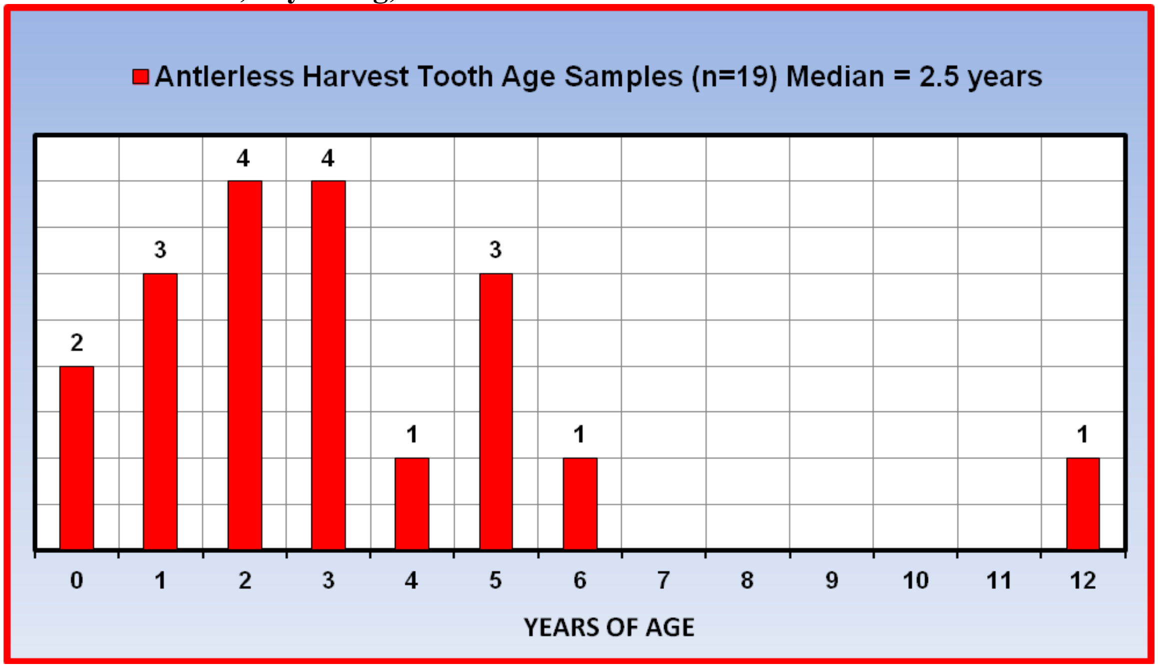


Figure 4. Age class distribution for antlerless moose harvested from Snowy Range Moose Herd Unit, Wyoming, 2013.



Literature Cited

Jesmer, B., Jacob Goheen, Matthew Kauffman, Kevin Monteith, Aly Courtemanch. 2013. Statewide Moose Habitat Project: Linking Habitat and Nutrition with Population Performance in Wyoming Moose. Annual Report 2013. Department of Zoology and Physiology, University of Wyoming, Laramie. 10 pp.

Thomas, T. P. 2008. Moose Population Management Recommendations. Wyoming Game and Fish Department, Cheyenne. 17 pp.

Bibliography of Herd Specific Studies

Baigas, P. E. 2008. Winter Habitat selection, winter diet, and seasonal distribution mapping of Shiras moose (*Alces alces shirasi*) in southeastern Wyoming. M.S. Thesis, Univ. Wyoming, Laramie, Wyoming. USA. 220 pp.

Wyoming Game and Fish Department [WGFD]. 2000. Snowy Range – Sierra Madre Moose Herd Management Plan. Wyoming Game and Fish Department, Laramie. USA. 15 pp.

Statewide Moose Habitat Project:

Linking Habitat and Nutrition with Population Performance in Wyoming Moose

Annual Report 2013

Brett Jesmer[1,2], Jacob Goheen[1], Matthew Kauffman[3], Kevin Monteith[1,2], Aly Courtemanch[4]

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Background & Objectives

The Wyoming Game & Fish Department (WGFD), Wyoming Cooperative Fish and Wildlife Research Unit, and the University of Wyoming initiated the Statewide Moose Habitat Project in June 2011. Currently, Shiras moose (*Alces alces shirasi*) herds in the state (Fig. 1) are exhibiting a wide range of population performance, with some declining and some relatively stable or even increasing despite historic declines (Fig. 2). For the declining herds, potential mechanisms that may affect carrying capacity are habitat deterioration due to current and historic overbrowsing (Boertje *et al.* 2007; McArt *et al.* 2009), and regional variation in forage quality due to climatic warming and drying (Monteith *et al.* in review) or other disturbances, such as large, intense wildfire (Vartanian 2011) or bark beetle (*Dendroctonus* spp.) outbreaks. Additionally, a new and growing predator community is present in the northwest corner of the state and may prevent higher recruitment rates from being achieved, but these predators can not account for declines elsewhere in Wyoming, Colorado, and Utah. Further, a newly emergent disease, the carotid artery worm (*Elaeophora schneideri*), appears to be prevalent in Wyoming (Henningsen *et al.* 2012). Unfortunately we do not yet understand the impacts of this disease on the nutritional condition and survival of moose.

In combination with the observed range in population performance, variability of moose habitat (see Vartanian 2011, Monteith *et al.* in review) in the state represents a timely opportunity to evaluate habitat-performance relationships (i.e. local carrying capacities). Such a statewide habitat evaluation could serve as a benchmark to understand the relationship between moose habitat and population performance and would provide the WGFD with "early warning" metrics to predict where and when declines are likely to occur, and would improve the scientific basis of moose population objectives.

This project aims to both understand the role of habitat and nutrition in recent declines in population performance as well as provide managers with tools from which they can assess a populations proximity to carrying capacity and adapt management strategies accordingly. Therefore, we have developed the following objectives:

1. Understand the relationship between resource limitation and herd productivity.
2. Establish meaningful browse condition indices for monitoring and management purposes.
3. Explore alternative 'early warning' metrics to preempt declines in herd productivity.

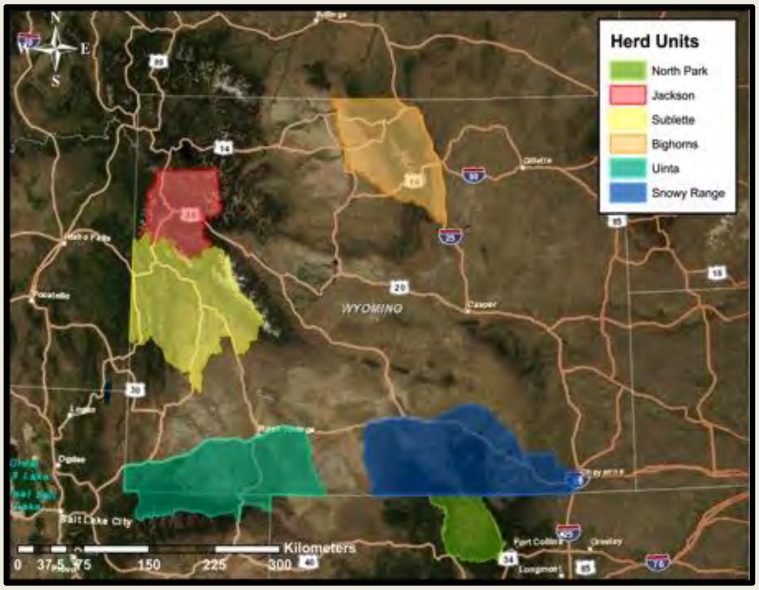


Fig. 1- Map depicting the project study areas.

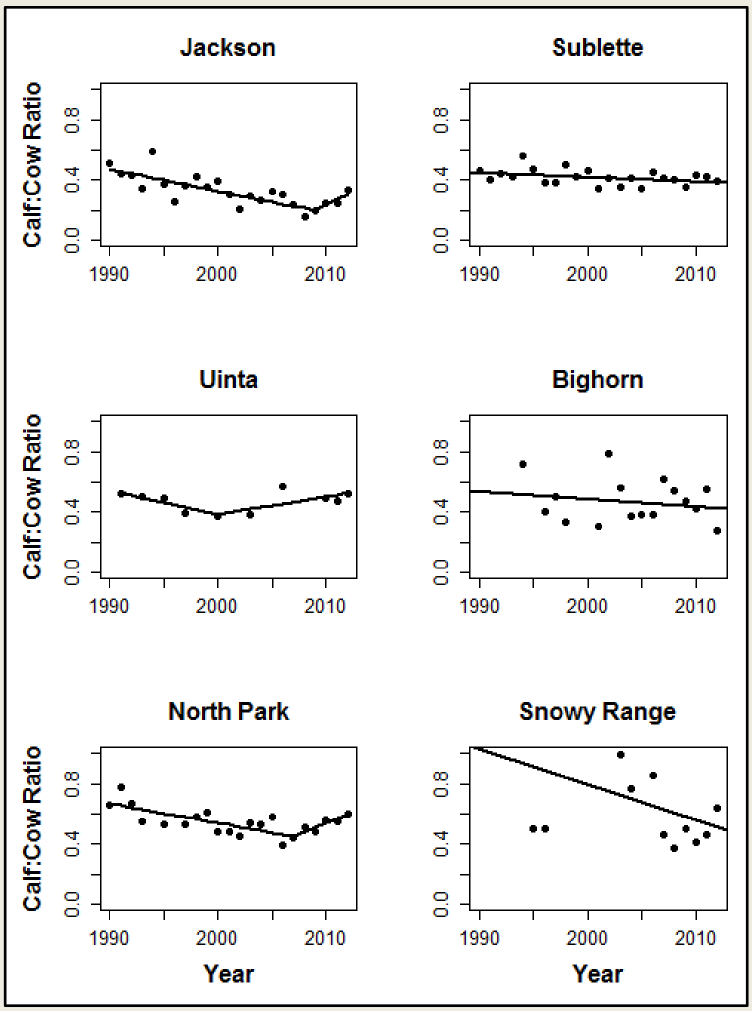


Fig. 2 – Trends in calf-cow ratios from 1990-2012 across our six areas. Trend lines established through piecewise regression. Piecewise regression quantifies multiple differing trends in a single data set. Note that the trend lines represented for the Snowy Range and Bighorn herd units are not statistically significant ($P>0.05$), meaning slopes are not different than zero.

Research Design & Methods

Vartanian (2011) concluded that **winter-range** was non-limiting to the Jackson moose population because of the underutilization of 'peripheral' winter-ranges that were previously described as heavily used by Houston (1967). Therefore, we used stratified random sampling across core (red) and peripheral (blue) winter ranges (both ranges defined as areas available to overwintering moose) to characterize the extent of willow browse utilization in each of six study areas. To quantify **winter habitat condition**, we used the WGFD Wildlife Observation System (WOS) moose location dataset and a local convex hull (LoCoH) home-range estimator to calculate core (%50 herd-range; red) and peripheral (%95 herd-range; blue) herd-ranges (Figs. 3, 4 and 5). Only WOS location data collected post-hunt from 2000 through 2012 were used in herd-range analyses.

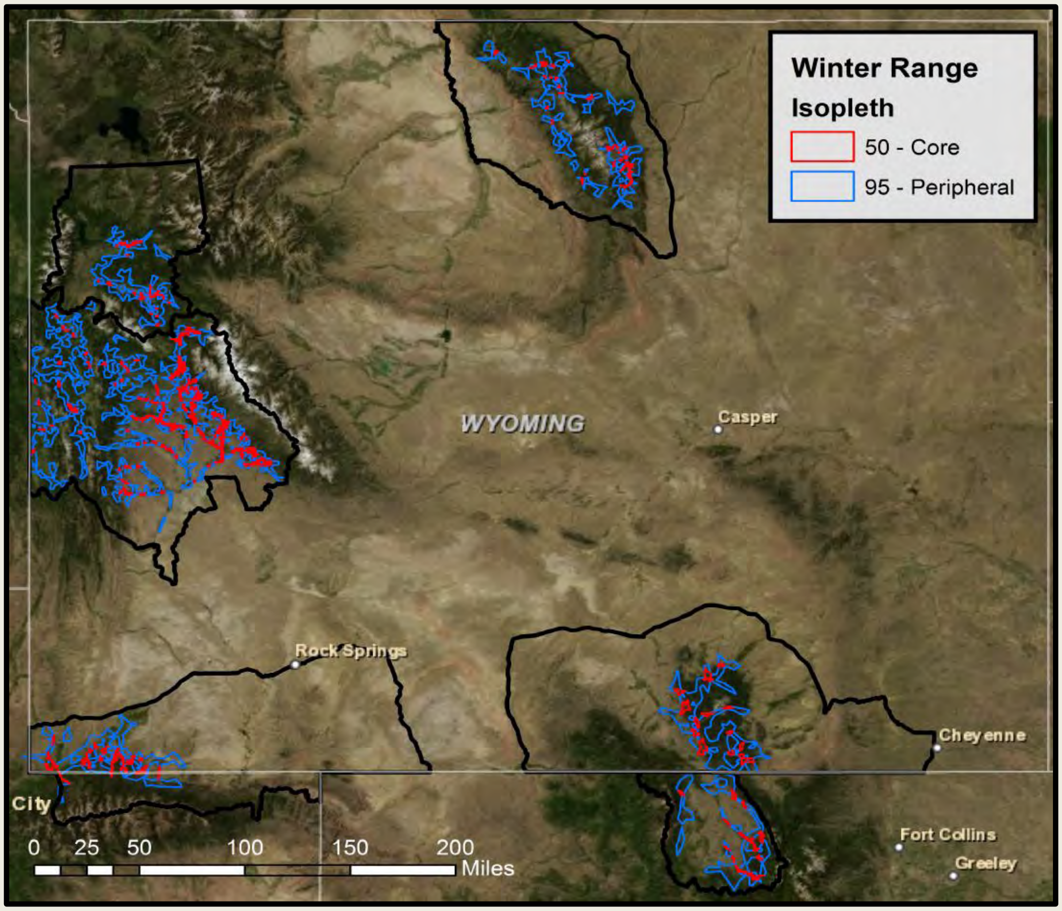


Fig. 3- Distribution of core (50%; red) and peripheral (95%; blue) moose winter ranges across the six study areas. <u>Note</u>- not all core and peripheral areas displayed here were sampled (see pg. 4 for details).

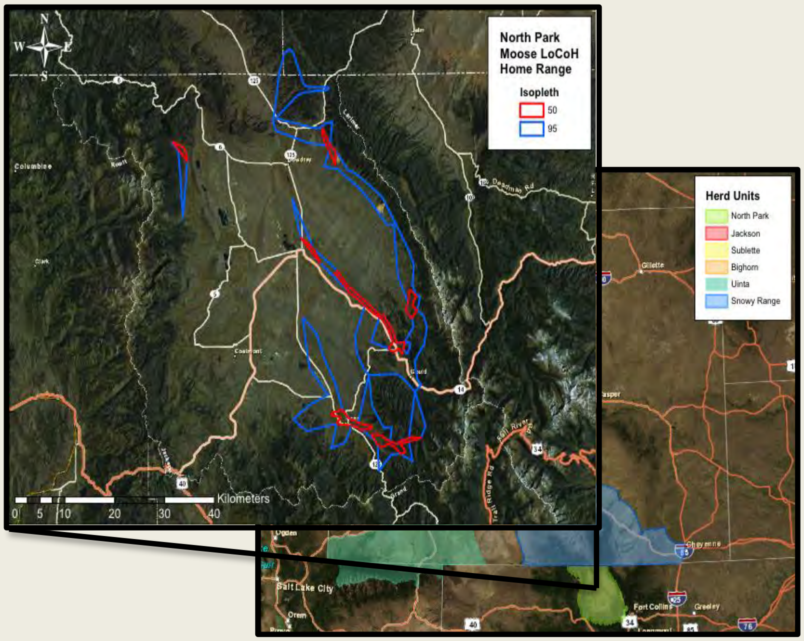


Fig. 4- In each herd unit, such as North Park (shown here), core (red) and peripheral (blue) moose habitat was identified to guide sampling of willow browse conditions and scat (see pg. 5 for details).

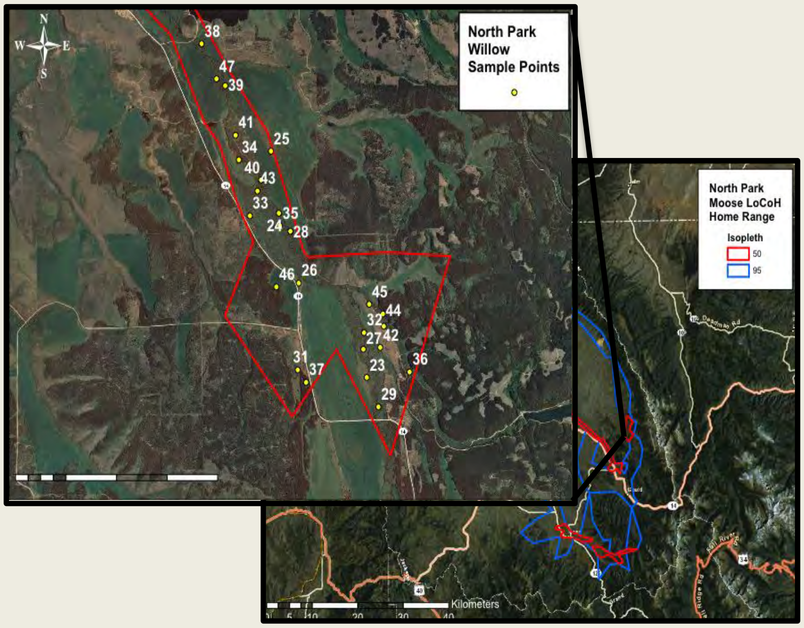


Fig. 5- Within each core and peripheral range, such as North Park's Michigan River (shown here), randomly generated points were drawn in willow habitat to prevent observer bias (see pg. 5 for details).

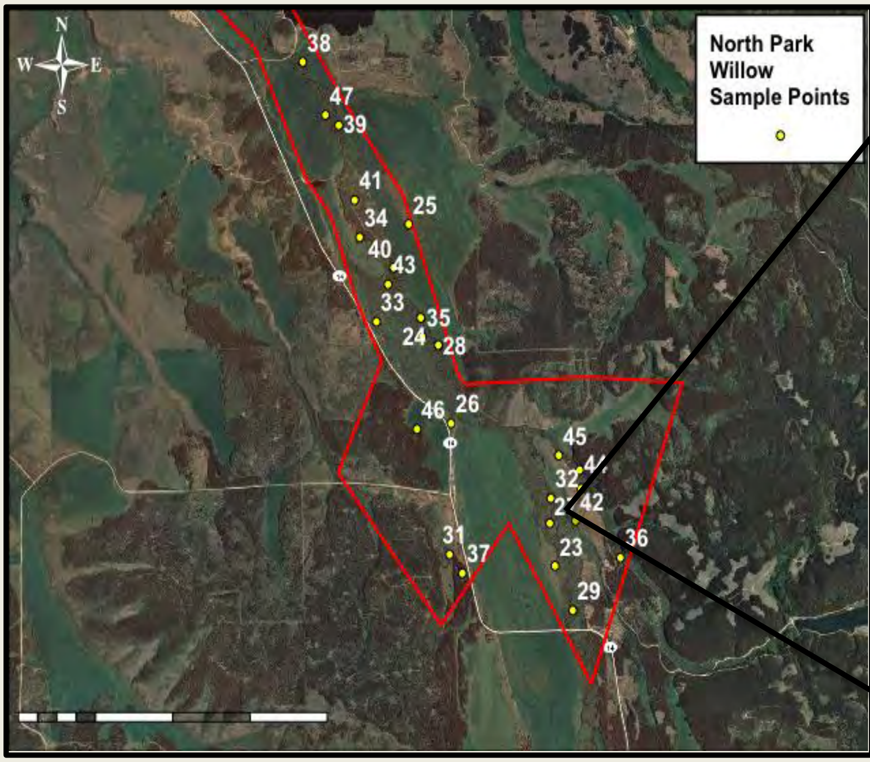


Fig. 6- Map depicting randomly generated sample sites in willow habitat along the Michigan River, Jackson County, CO.

Fig. 7- Technician**,** Allie Hunter, takes an LD reading along Spread Creek, Teton County, WY.

Within core and peripheral ranges we plotted random points with a minimum of 200m spacing between points using a generalized random tessellation stratified (GRTS; Stevens and Olsen 2004) sample generator (R; Sdraw package) to develop a spatially-balanced random sample across the two strata. Using the NLCD we calculated sampling weights by determining the proportional amount of willow habitat in each polygon (i.e. drainage) per herd unit using the tabulate area tool in ArcGIS (ESRI 2011; spatial analyst tools); meaning drainages with relatively greater amounts of willow received greater number of sampling points. In 2012 financial and logistical constraints determined that 30 live-dead (LD; measure of willow condition; Keigley and Fager 2006) transects could be accomplished per herd unit. Therefore, we multiplied the proportion of willow (i.e. sampling weight) in each of the six drainages per herd unit by 30 to calculated the final number of transects per drainage. In 2013 we increased our sample by adding 5-10 transects per herd unit as time permitted. Final sample sites were chosen in the sequential order that they were generated in GIS. However, in some cases a lack of land owner permissions or accessibility inhibited us from sampling in exact sequential order.

We completed LD transects at each randomly selected sampling point across the six study areas (Fig. 6 and 7). According to previously established protocols (see Keigley and Fager 2006; Vartanian 2011; Smith et al. 2011), 20 willow plants of the most preferred species (planeleaf willow (*Salix planifolia)* in the eastern herds, Booth's willow (*Salix boothii*) in the western herds) were measured along a random bearing every 10m starting at each sampling point. LD, leader length of the dominant apical meristem, percent browse, percent decadence, and plant height were recorded at each plant.

To assess **winter diet** (i.e. foraging behaviors) and identify important **winter forages**, we collected scat samples opportunistically and along LD transects (Fig. 8) according to a sterile protocol developed to eliminate cross contamination. We only collected scats that appeared to be fresh and were determined to have originated from an adult moose according to morphometrics (i.e. size). Using molecular techniques we will group scat piles by individual and determine sex prior to diet and **pregnancy** analyses (via progestagen analysis; Monfort et al.1993), and potentially assess nutritional state via additional hormone (triiodothyronine (T3) and glucocorticoid (GC)) assays (Wasser et al. 2000, 2010). Progestagen, T3 and GC thresholds will be validated using scats, blood samples and ultrasonography data collected during captures associated with the Sublette and Uinta moose studies.

Fig. 8- Scats found along North Horse Creek, Sublette County, WY.

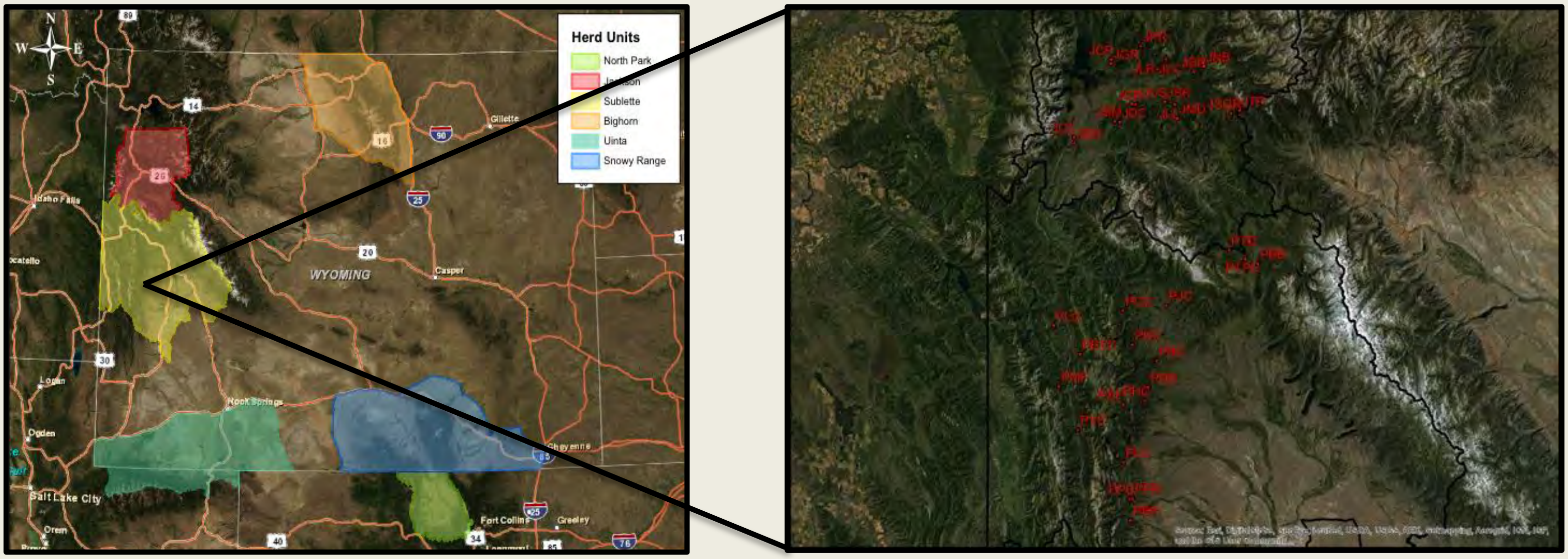


Fig. 9- Map depicting randomly generated sample sites across different habitats where summer scats were sampled in Sublette and Teton Counties, WY.

To characterize the range of **diets** (i.e. foraging behavior) and the **quality of forages** used by moose on **summer ranges**, we once again employed a stratified random sampling design. Due to the widely-reported preference for riparian and upland shrub forage amongst moose inhabiting montane regions of North America (e.g., Renecker and Schwartz 2007), we chose two strata consisting of: (1) willow habitat, and (2) all other upland habitat types (i.e. deciduous forest, coniferous forest, mixed deciduous and coniferous forest, shrub-scrub, grassland-herbaceous, and emergent herbaceous wetlands) as defined by the NLCD. We again used a generalized random tessellation stratified sample generator to develop a spatially-balanced random sample across the two strata (Fig. 9). To ensure that our scat-dog teams found as many fecal samples as possible, we restricted our search effort across strata to the top 25% quantile (summer core area) of the Baigas *et al*. (2010) summer RSF model. Logistical and financial constraints determined that 20 transects (10 willow, 10 upland) per herd unit (i.e. statewide n=120) could be completed within a single season. We chose sampling points in sequential order from which they were drawn until 10 samples from each strata were established using the following criteria: (1) < 1500m from a drivable road due to the limited distance in which a working dog can travel on any given day, (2) the willow patch must have been $\geq$ 2000m in Euclidean length, and (3) the patches were within a logistically feasible proximity (daily travel distance) to another sampling point whereby we could complete two transects per day. Each transect started at, or intersected with, the sampling point.

We collected moose scats along each transect when present (see figs. 10 and 11) using a sterile protocol. Currently, we are extracting DNA from scats (see pg. 6) to determine individuality and sex prior to diet (microhistology or qPCR) and forage quality (fecal nitrogen) analyses.

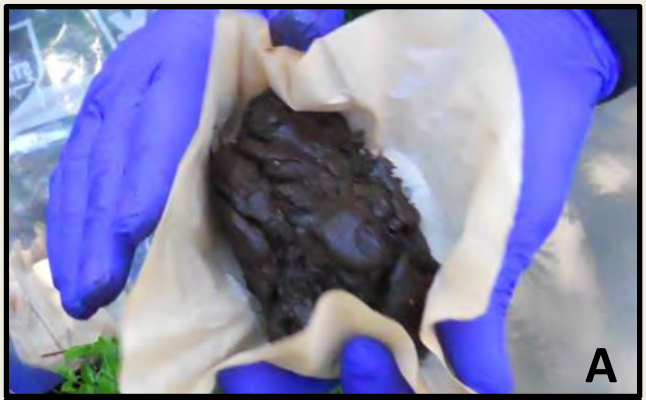
Fig. 10- Map illustrating a scat transect (5-6 km each) in willow habitat. Kilgore Creek, Sublette County, WY.

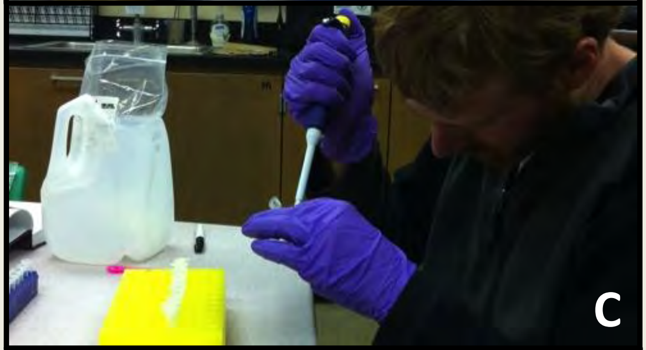
Fig. 11- Orbee the detection dog is very proud of his find (mostly he just wants his reward; a short game of fetch with a ball).

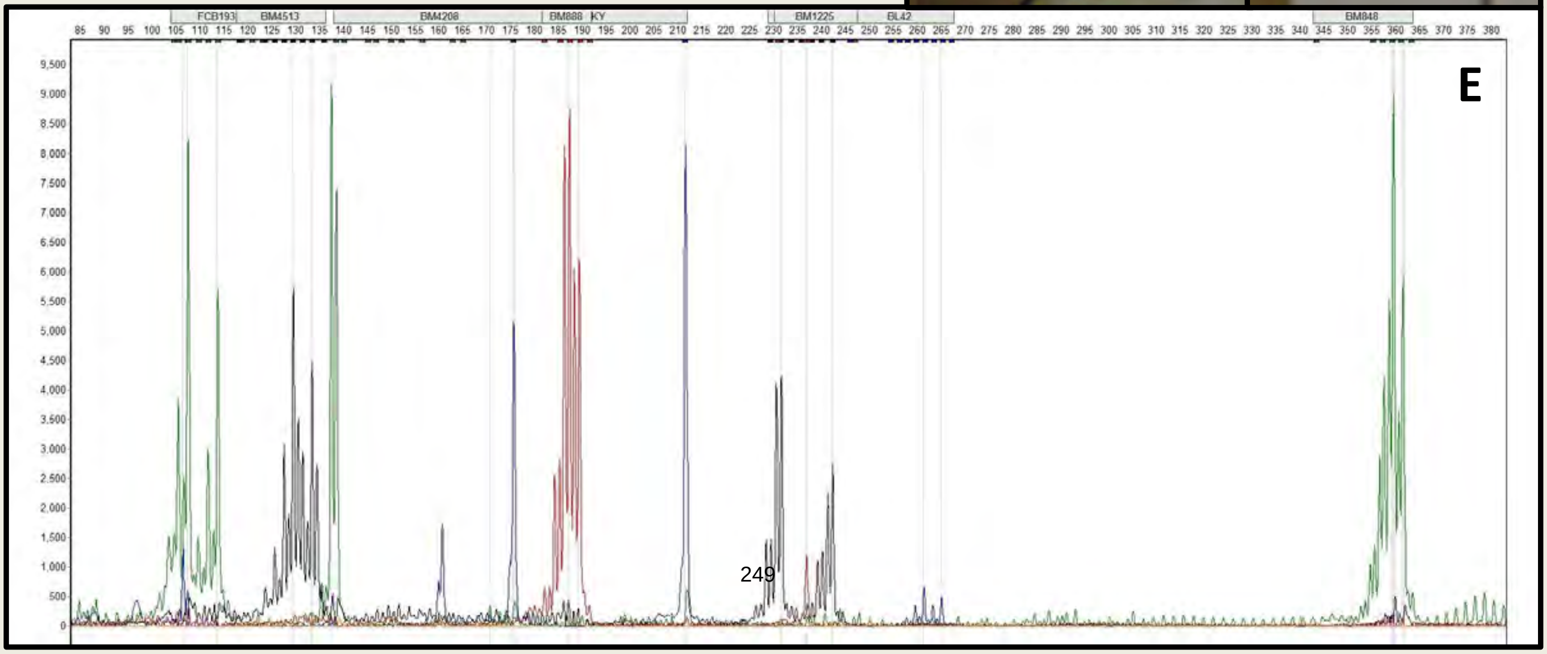
Only ‘fresh’ (i.e. typically <1 week old) scats were collected along each transect. When a fresh scat was identified, approximate age, GPS location, and habitat information was collected. The scat was then wrapped in non-bleached filter paper (coffee filters) and placed inside a plastic freezer bag on a bed of silica desiccant (photo A). The desiccant removed moisture from the scat during the day while we were in the field to help reduce bacterial action which degrades genetic material. Scats were placed in a portable battery/propane-powered freezer immediately upon returning to the campsite; followed by a cryofreezer once returning to the University of Wyoming.

Most of the DNA in moose feces is found in a ‘mucusy membrane’ on the outside of the ‘pellets’ where intestinal cells are sloughed off as the pellets move through the intestinal track. We collect portions of this ‘mucusy membrane’ (photo B) and place in vials with a substance that breaks down cell walls to release the genetic material (photo D1). We used a modified ‘ungulate’ DNA extraction protocol tailored specifically for moose scat in combination with Qiagen- QIAamp DNA stool mini kits© to obtain purified DNA products (photo D2).

Through a series of chemical reactions (photo C) we duplicate the DNA many times over and characterize nine specific portions of the genome that allow us to ‘fingerprint’ the sample so that we can identify which individual the scat came from and its sex (photo E). For example, photo E depicts nine microsatellite loci, represented by black, green, red and blue ‘peaks’, amplified from one individual moose tissue sample. The two tall blue peaks near the middle of the graph represent genetic products associated with the X and Y chromosomes; meaning this individual is a male. This process is extremely similar to that used by criminal forensic scientists and has been streamlined so that individual and sex identifications can be assessed simultaneously. We repeat this process 2-3 times for each of 1022 fecal samples we have collected and use computer software to match the samples to individual moose.







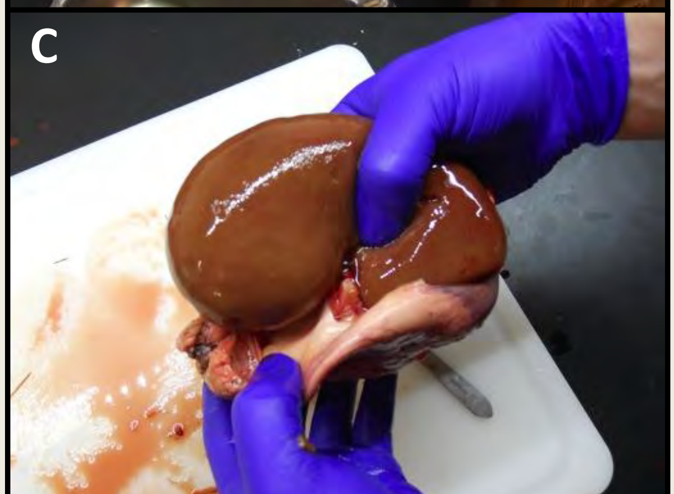
To understand how winter habitat condition and quality, and summer diet and forage quality affect the **nutritional condition** of moose, we are measuring autumn kidney fat. The amount of fat found attached to the kidney is a good predictor of total body fat in moose (Stephenson *et al*. 1998). We collaborated with the WGFD, Colorado Division of Parks and Wildlife (CDPW) and the Utah Division of Wildlife Resources (UDWR) to solicit hunters to collect kidneys from harvested moose. With each kidney, hunters and WGFD, CDPW and UDWR biologists noted sex, age, location of harvest (hunt area and drainage or GPS location), antler size (if any), and parasite information.

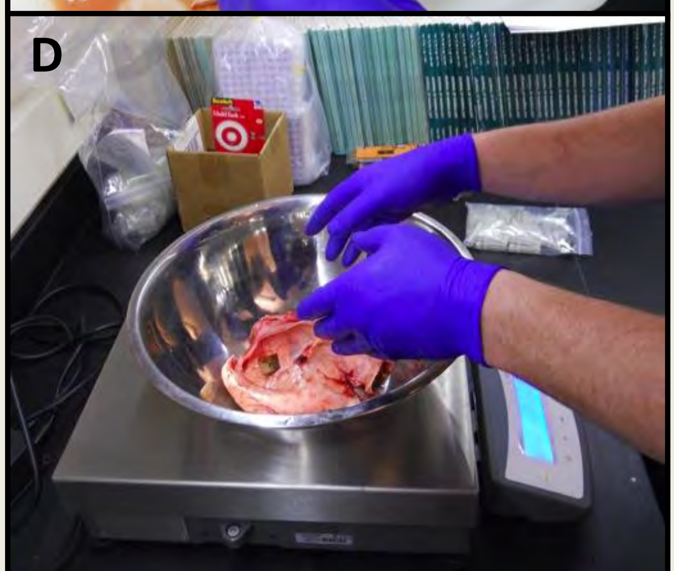
Kidneys were gathered by regional WGFD, CDPW and UDWR personnel and delivered to the University of Wyoming where we measured kidney fat levels according to the long-standing method of Riney (1955). Briefly, the kidney fat method requires an undisturbed kidney (photo A; identification of disturbed kidneys described below), trimming of excess fat to standardize the area of fat measured (photo B), removal of the fat and perirenal membrane (photo C), and a weight measurement of both the kidney and the kidney fat (photo D).

While processing each kidney, we noted whether or not the kidney and its fat appeared to be disturbed. Because some hunters are unfamiliar with moose anatomy and the exact location of the kidneys, they sometimes cut through visceral fat or the visceral cavity too quickly and end up cutting into the kidney fat (photo E) and even the kidney itself (photo F); and sometimes hunters even mistakenly removed all of the kidney fat (photo G). We omitted all samples from the final dataset that showed evidence of the fat being disturbed.


A

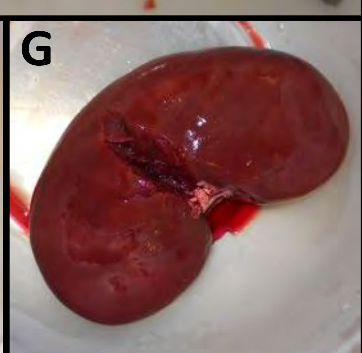

B


C


D


E


F


G

Preliminary Results

All results constitute preliminary summaries, not final statistical analyses, and should be interpreted with caution. Additionally, the data presented here only reflects autumn nutrition of moose and winter habitat condition (i.e. quantity of forage). Because winter habitat condition is only one of many factors that may influence autumn nutritional condition in moose (Parker *et al*. 2009), these trends may be strengthened or weakened once winter and summer diet and forage quality are included in the dataset. In fact, due to metabolic demands, summer forage quantity and quality is often considered to be more important to overall nutritional condition and pregnancy rates than winter forage condition or quality (Cook *et al*. 2004). It is also important to note that we only present nutritional condition data associated with male moose. The current and past (i.e. 1-2 years prior) reproductive history of all harvested female moose from which we received kidneys was unknown. The energetic demands associated with gestation, lactation, and calf rearing are important factors in determining autumn nutritional condition, and therefore likelihood of pregnancy, in ungulates (Parker *et al.* 2009). Consequently, we chose to use males as our indicator of nutritional condition at the population level because they are not influenced by as many factors as females. Even though males do not represent the reproductive portion of the population, and therefore have less influence of population performance, their nutritional condition remains an excellent indicator of habitat quality (Parker *et al*. 2009).

We completed 349 LD transects, representing 6980 individual willow plants measured, during 2012-2013. During 2011-2012 we analyzed 346 undisturbed kidneys for nutritional condition assessment. In 2013 we collected an additional 190 kidneys to supplement our sample. Nutritional condition was significantly different between the six herd units (Fig. 12; ANCOVA: P=0.02; note small sample size in Jackson). Willow condition according to the LD index was also significantly different amongst herd units (Fig. 13; ANOVA: P=<0.001). Interestingly, Baigas (2008) reported to the WGFD even poorer LD values for planeleaf willow. Also, we found that LD values for planeleaf willow and Booth's willow differed (T-test: P=<0.001). It is important to note that, although LD measures for all herd units dominated by planeleaf are statistically similar, the herd units exhibiting greater overall variation in willow condition (i.e. more patches in relatively good condition) are those herd units which are exhibiting better population performance (see figs. 14 and 15). Planeleaf is highly preferred by all large herbivores and consistently

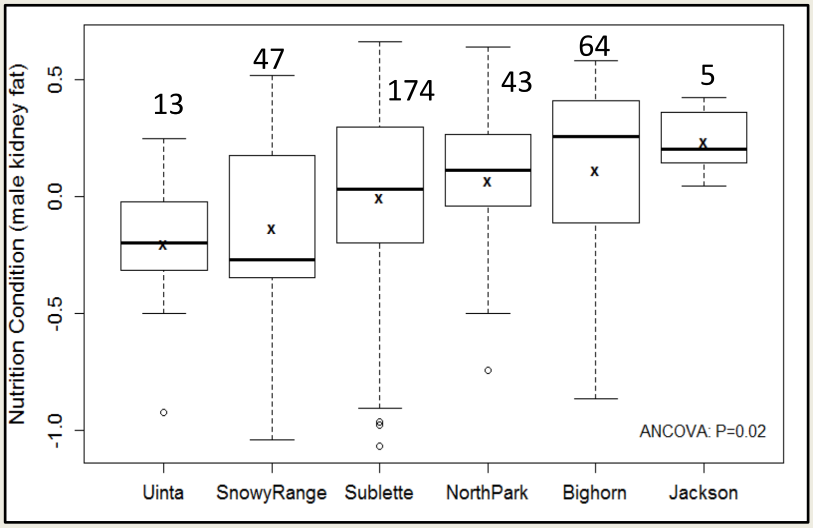


Fig. 12- Variation in male nutritional condition. X's represent means, bars represent medians, vertical lines represent the data range, circles represent outliers, and numbers represent sample sizes.

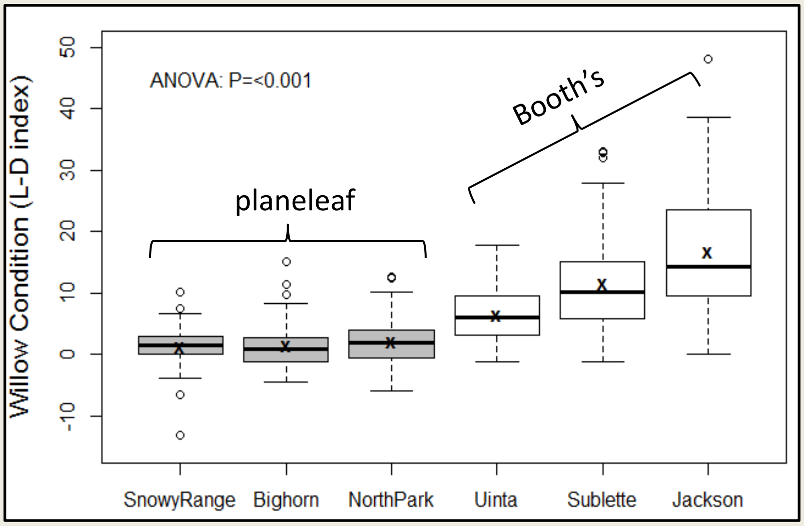
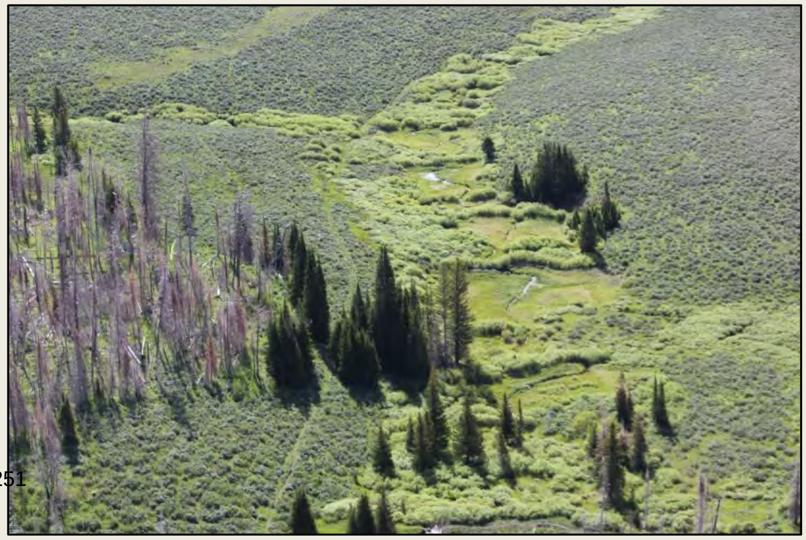


Fig. 13- Variation in willow condition. X's represent means, bars represent medians, vertical lines represent the data range, circles represent outliers, and numbers represent sample sizes.



browsed heavily. We further summarize the data using the means (x's) from figures 14 and 15 to assess the general relationships between winter forage condition, nutritional condition, and population performance (i.e. recruitment rates). Figure 14 suggests a positive relationship between winter willow condition and population performance. Figure 15 reveals that male nutritional condition in autumn is likely a good indicator of local population performance. Being able to observe relationships between winter-range willow condition and population performance, and autumn nutritional condition and population performance using simple summary statistics is an encouraging result. We suspect that we will be able to make strong linkages between habitat, nutritional condition and population performance once we assess summer and winter forage selection and quality.

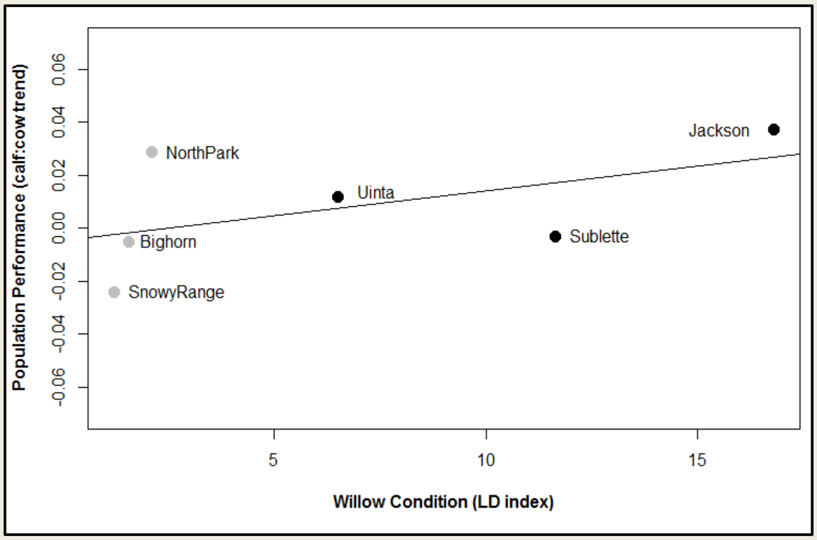


Fig. 14- General relationship between willow condition and nutritional condition of moose. Herd units dominated by the highly preferred planeleaf willow (grey circles) decline in performance as variation in willow declines, whereas herd units dominated by Booth's will decline in performance as overall willow condition declines (see fig. 13 and page 8 for details).

Current and Future Work

We continue to work towards achieving our objective of linking habitat and nutrition to population performance (Fig. 16), and suspect to complete the project during the fall of 2014. We are making daily progress with DNA extractions and genotype analysis. In 2013 we completed and a second round of winter scat collections willow condition transects. Additionally, we completed a third round of kidney collections, which represents the finalization of our field efforts. During spring 2014 we plan complete genetic analyses of 1022 fecal samples and obtain finalized diet composition, diet quality, pregnancy and spring nutritional condition data sets. Once data production is completed, we will produce comprehensive reports for state and federal agencies, provide presentations and materials for the general public, and publish our results in peer-reviewed scientific journals during summer and fall 2014.

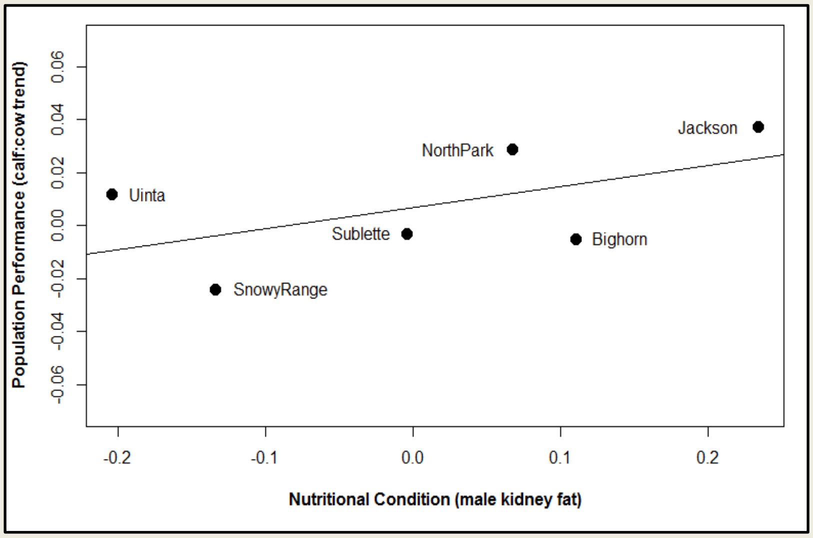


Fig. 15- General relationship between moose nutritional condition and population performance.

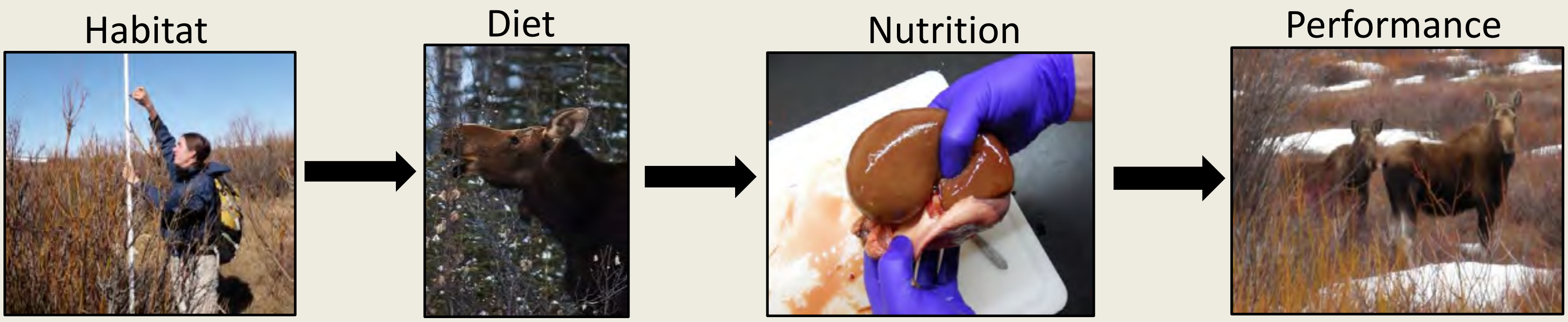


Fig. 16- General conceptual model depicting the linkages between habitat condition, diet quality and composition, and nutritional condition to population performance in Shiras moose. Once we able to quantify how these factors influence population performance, we will be able to provide managers with tools that will allow them to understand the proximity in which their population is to carrying capacity, and hence adapt management strategies accordingly.

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