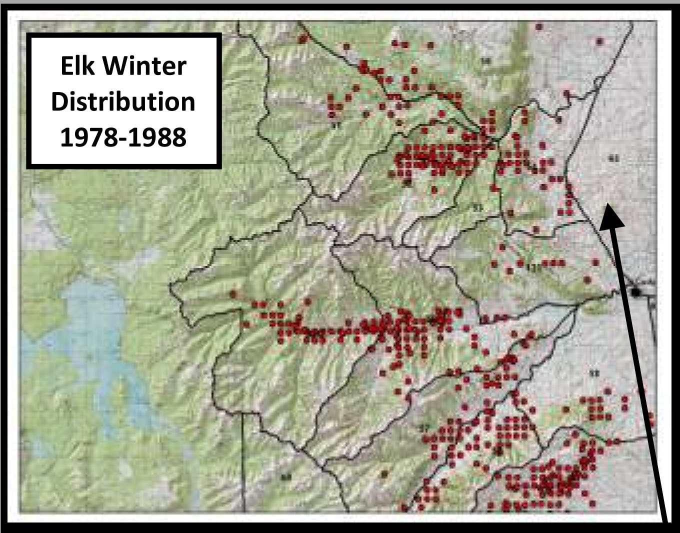
Absaroka Elk Ecology Project

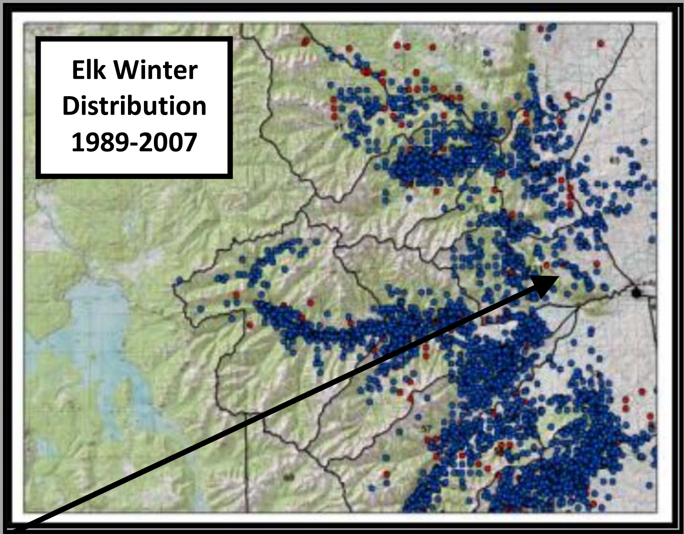
2010 Progress Update

Introduction

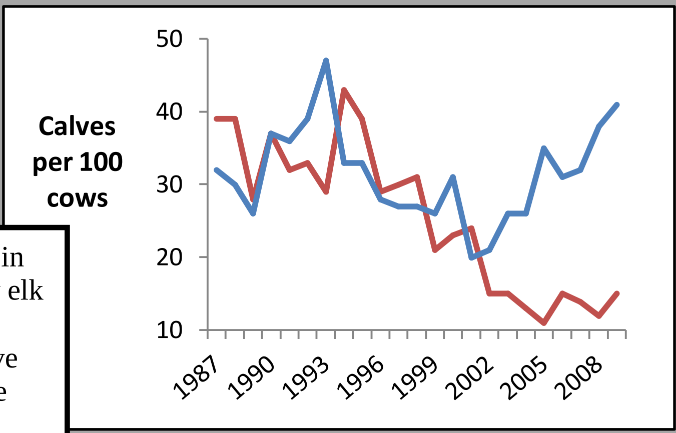
The Wyoming Game and Fish Department, the University of Wyoming, and the US Fish and Wildlife Service have been collaborating on the Absaroka Elk Ecology Project since January 2007. The original objectives were to:

- *Determine the status of migratory and non-migratory elk in the Clark's Fork Herd Unit.*
- *Determine the migration timing and routes used by migratory elk.*
- *Increase understanding of elk use of private lands.*
- *Estimate adult female survival rates.*
- *Develop habitat selection models to determine critical habitats for migratory and non-migratory elk.*
- *Evaluate the influence of wolves on elk habitat selection and movements.*

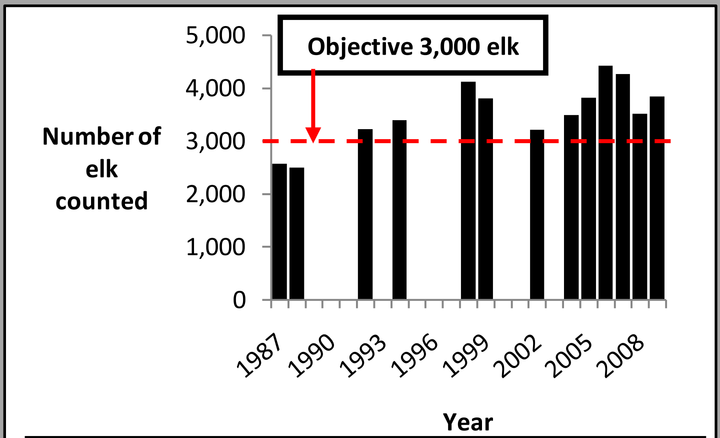




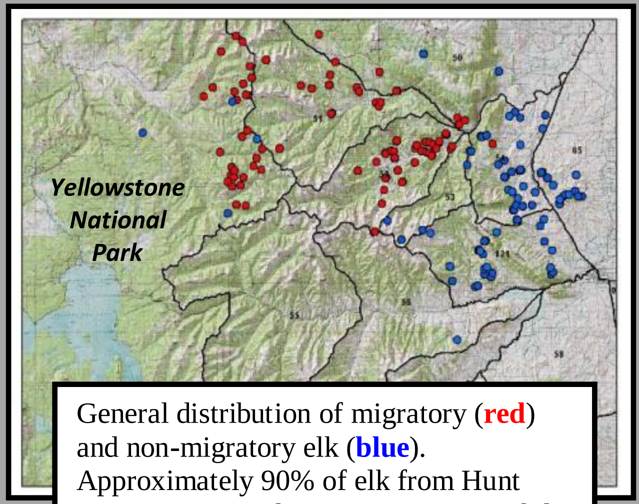
Over the past 20 years, a dramatic shift in elk distribution has occurred along the Absaroka Front, with more elk frequenting low-elevation areas in the foothills. Most of these areas are on private land.



This distribution shift is largely attributable to a growing gap in the calf production of the two subpopulations, with migratory elk (red) producing fewer calves than nonmigratory elk (blue) in recent years. These trends in distribution and productivity have raised numerous challenges for biologists and managers in the Wyoming Game and Fish Department.



Adding to these challenges, the higher productivity of non-migratory elk in recent years has obscured the migratory decline and allowed the Clark's Fork herd to grow beyond the population objective of 3,000 elk.

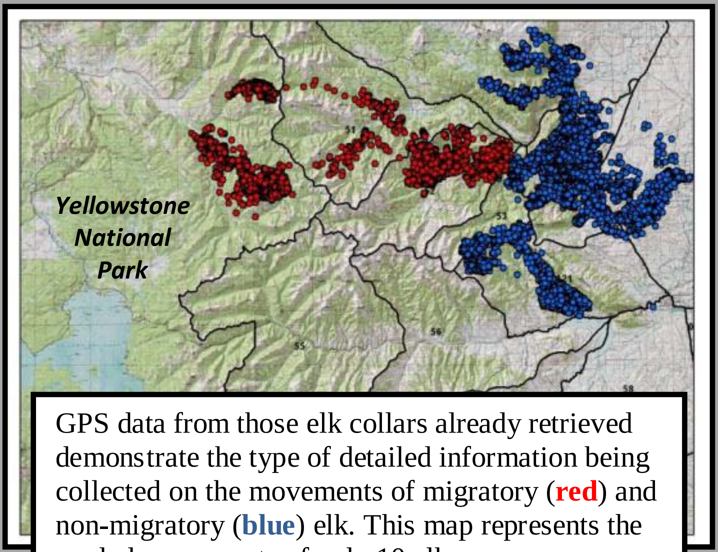


General distribution of migratory (**red**) and non-migratory elk (**blue**). Approximately 90% of elk from Hunt Areas 50, 51, and 52 are migratory, while 90% of the elk captured in Hunt Areas 54, 65, and 121 are non-migratory.

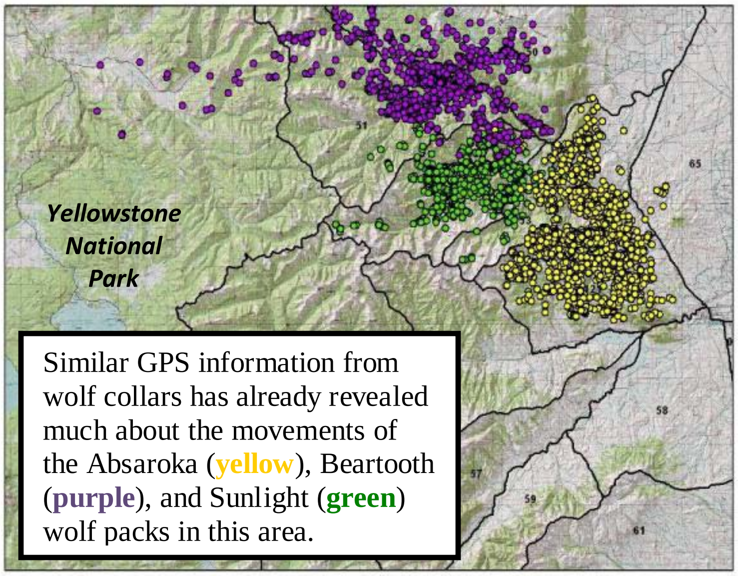
To address the objectives of the study, a total of 75 adult female elk were captured in 2007 and 2008 and fitted with GPS radio collars. An additional 20 adult females were captured and fitted with conventional VHF radio-collars.

Numerous mortalities of collared elk cows have been documented thus far. Preliminary findings suggest that factors affecting reproduction and calf survival, rather than adult female survival, will be the key to understanding recent changes in the Clarks Fork herd.

A number of wolves in packs that hunt Clarks Fork elk have been captured by USFWS, USDA Wildlife Services, and UW and fitted with GPS collars for simultaneous monitoring of elk and wolves.



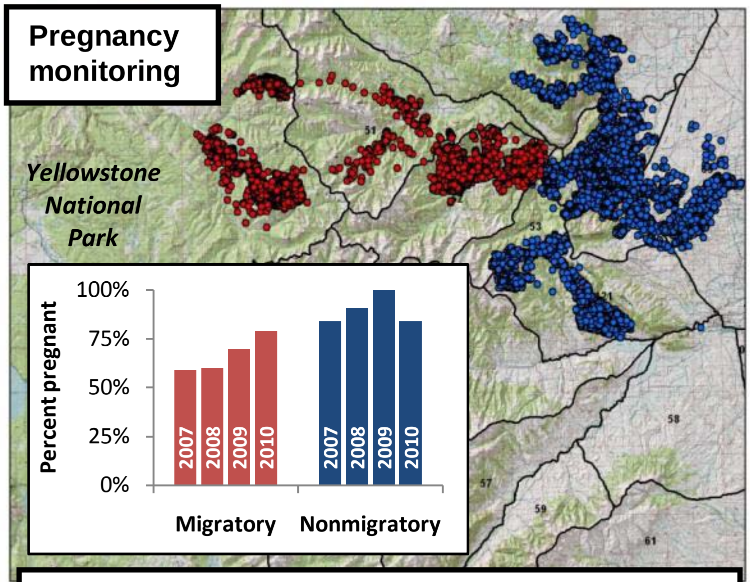
GPS data from those elk collars already retrieved demonstrate the type of detailed information being collected on the movements of migratory (**red**) and non-migratory (**blue**) elk. This map represents the pooled movements of only 10 elk.



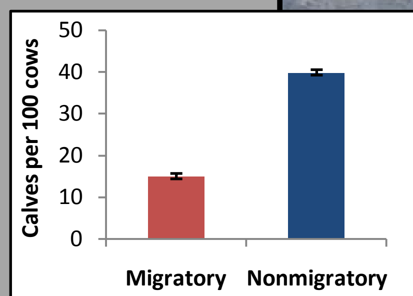
Similar GPS information from wolf collars has already revealed much about the movements of the Absaroka (yellow), Beartooth (**purple**), and Sunlight (**green**) wolf packs in this area.

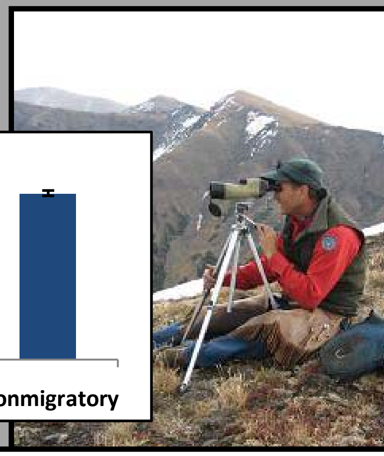
Hunter checks and blood and tooth samples from hunter-harvested elk give data on age, pregnancy status, lactation status, and body condition. Information from hunter-killed elk is an important contribution to this study.

Pregnancy monitoring



Pregnancy of migratory elk from 2007-2010 has been consistently lower than that of non-migratory elk. This pregnancy difference accounts for some of the difference in calf-cow ratios between the two herd segments.

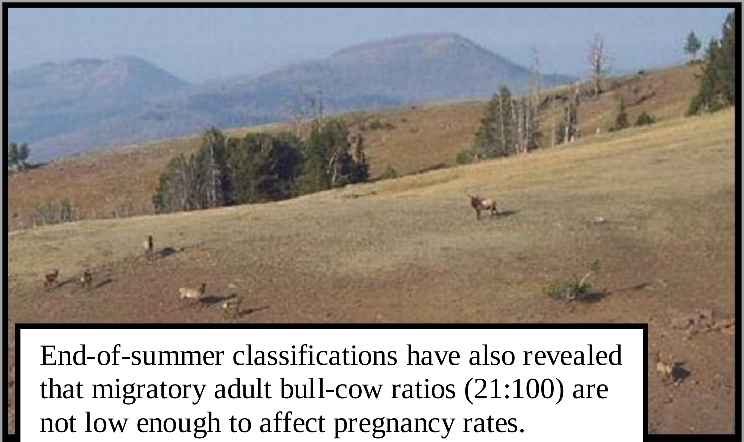




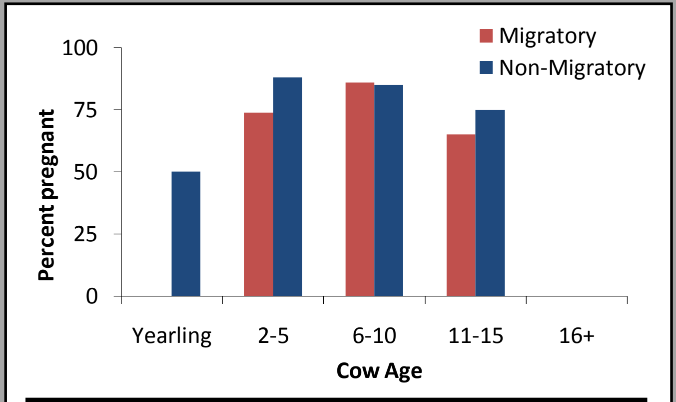
Classifications of elk at summer's end indicate that most of the annual decline in migratory recruitment occurs due to factors affecting cow pregnancy and summertime calf survival. Calf-cow ratios of migratory elk were between 14:100 and 16:100 from 2007-2009, versus non-migratory elk calf-cow ratios between 38:100 and 41:100 during that same period.

Whereas Rocky Mountain elk are typically pregnant at a rate of 90%, Clarks Fork migrants have an exceptionally low pregnancy rate of 68%. But why? To address this question, **additional project objectives** were developed and include evaluation of how pregnancy is influenced by:

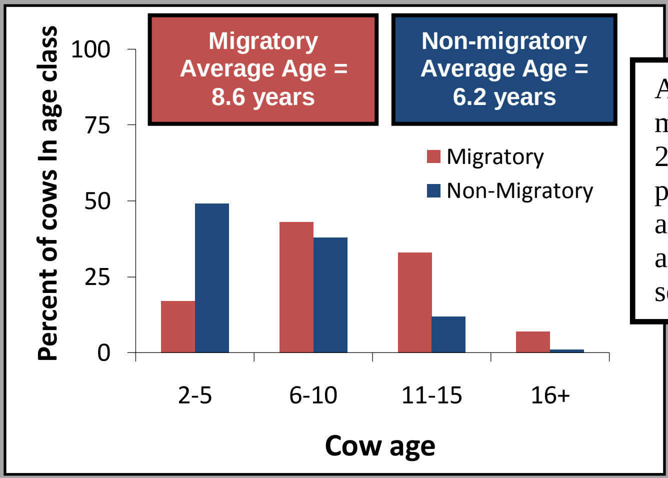
- *Bull availability during the breeding season.*
- *Female age structure.*
- *Elk habitat selection.*
- *Elk body condition.*
- *Summer forage conditions.*
- *Wolf predation risk.*



End-of-summer classifications have also revealed that migratory adult bull-cow ratios (21:100) are not low enough to affect pregnancy rates. Yearling bull-cow ratios, however, are quite low (3:100) as a result of poor calf production (versus a non-migratory yearling ratio of 11:100). In spring 2009, the Sunlight-Crandall Elk Working Group relied on this and other information to recommend harvest management changes before the Wyoming Game and Fish Commission.

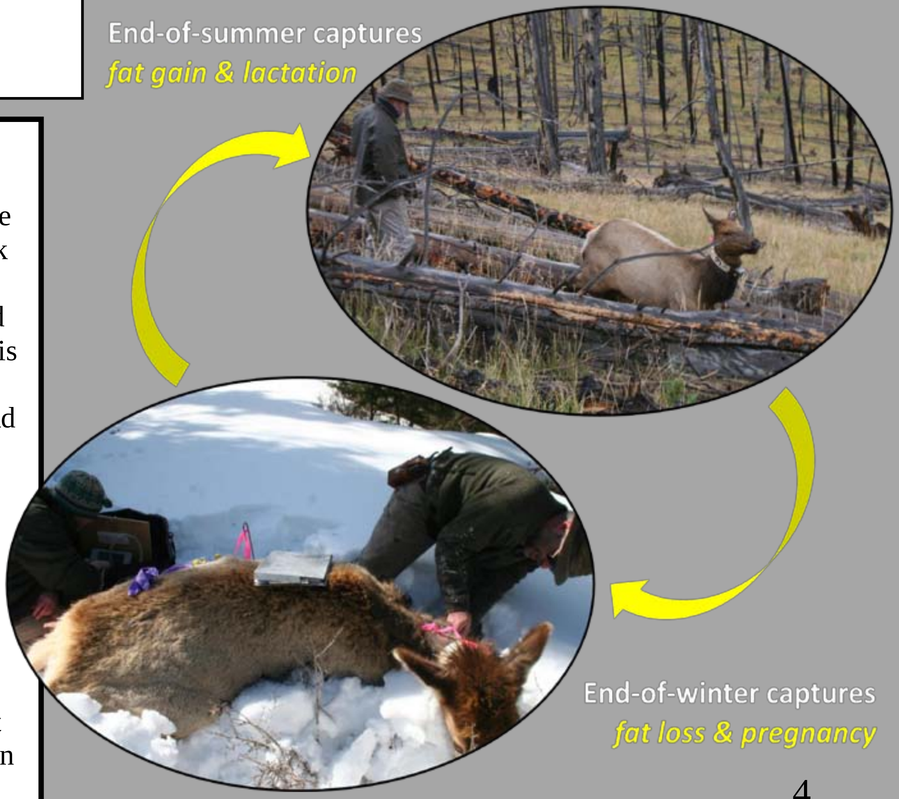


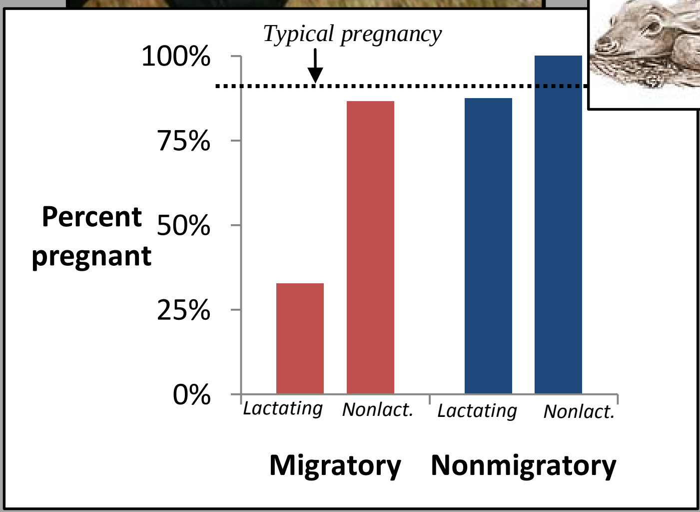
Pregnancy rates do appear to differ by age class for migratory versus non-migratory elk. Though pregnancy rates are similar for cows between 6 and 10 years old, non-migratory elk show higher pregnancy in the younger and older age classes. Higher pregnancy for younger cows suggests better nutrition for non-migratory elk, while lower pregnancy for older cows might indicate earlier reproductive senescence in migratory elk.

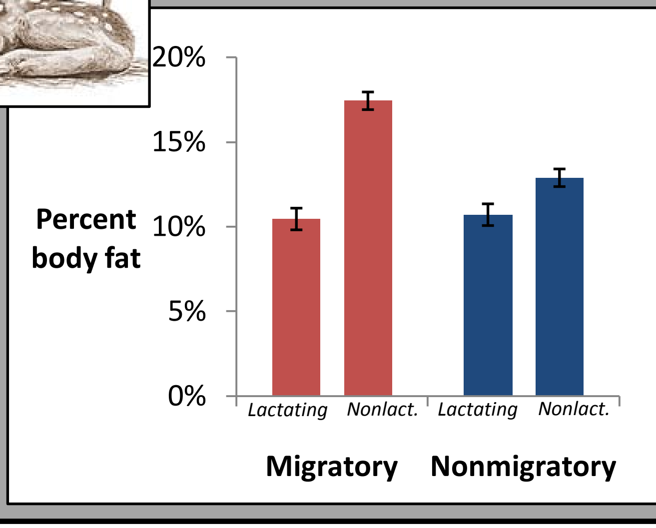


Age data from captured and hunter-killed cow elk show that non-migratory elk are younger, with a higher proportion of cows in the 2-5 year age class than migratory elk. There are similar proportions of cows in the 6-10 year class, and migratory elk have a much higher proportion of cows older than 11 years. Future analyses will explore the potential role of age and reproductive senescence in limiting the pregnancy rates of migratory elk.

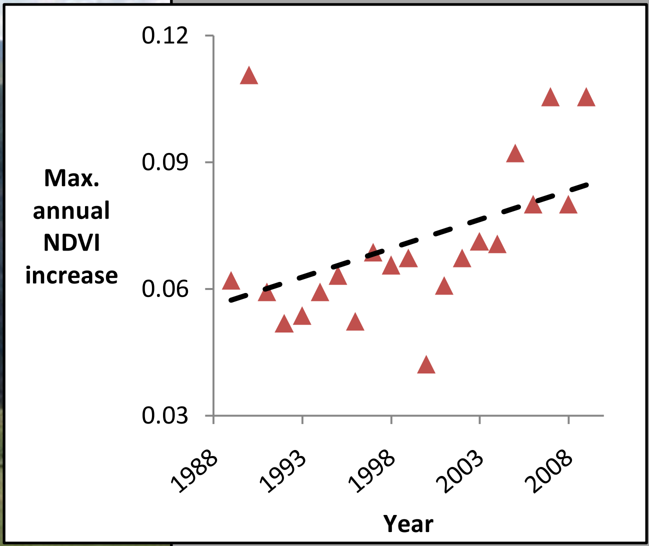
In many ungulates, including elk, pregnancy is most commonly influenced by the nutritional quality of summer range. To investigate the role of nutrition, we recaptured collared Clarks Fork elk at two critical times of the year – in late summer, after the annual period of fat gain, and in late winter, after the period of fat loss. On this dimension of the project, we have been collaborating with elk nutrition experts John and Rachel Cook. The Cooks have developed methods to directly and rapidly assess elk nutritional condition in the field using a combination of ultrasound, manual palpation, and key body measurements. They developed their approach using captive elk, and have proven them in studies of free-ranging elk and caribou throughout North America. In addition to estimating percent body fat of collared elk at both times of the year, the Cooks have also been determining whether cows are pregnant in winter and nursing a calf in summer.

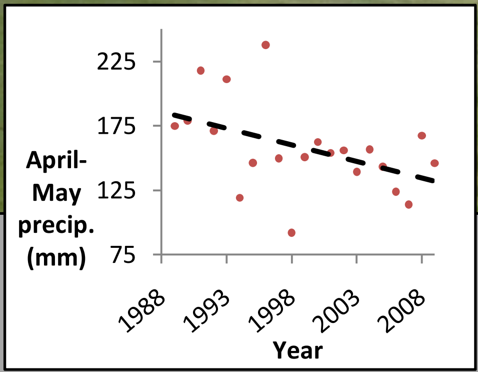


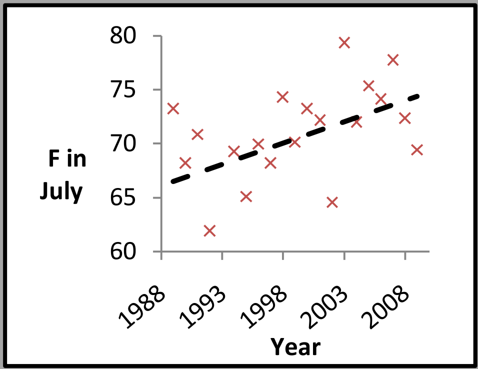


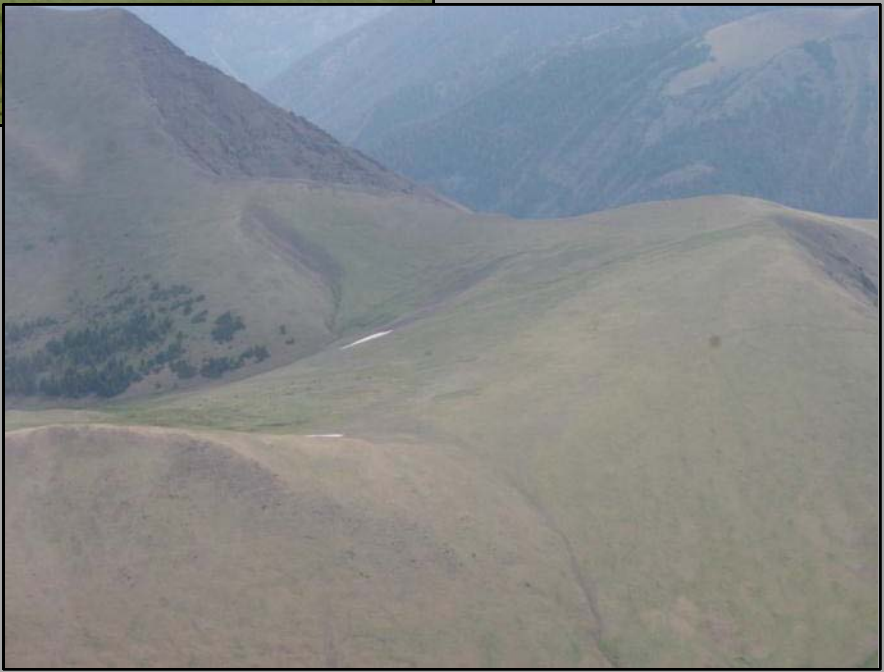


From the elk recaptures, we learned that only 33% of lactating migratory females in the Clarks Fork herd were pregnant the following winter, compared with more typical pregnancy rates for migratory nonlactators and for non-migratory elk (above left). These findings help to explain the annual depression in migratory elk pregnancy, indicating that migratory females who pay the high costs of nursing a calf are likely to skip breeding in the following year. Indeed, lactation is a costly undertaking: migratory females that nursed a calf to September had ~7% less body fat than females who did not (above right). What remains unclear is how females in the non-migratory herd segment are able to become pregnant again *regardless* of whether they nursed a calf in the prior year. It is possible that non-migratory elk gain a well-timed nutritional subsidy from irrigated fields on private lands along the Absaroka Front (below), allowing them to maintain steadier nutrition than migratory cows immediately prior to the rut, despite relatively low body fat. Future analyses of elk movements and nutrition will evaluate this possibility.



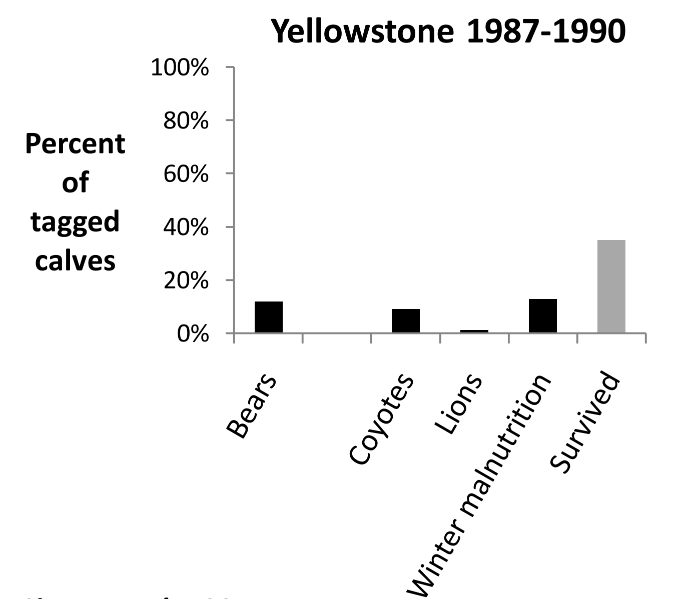




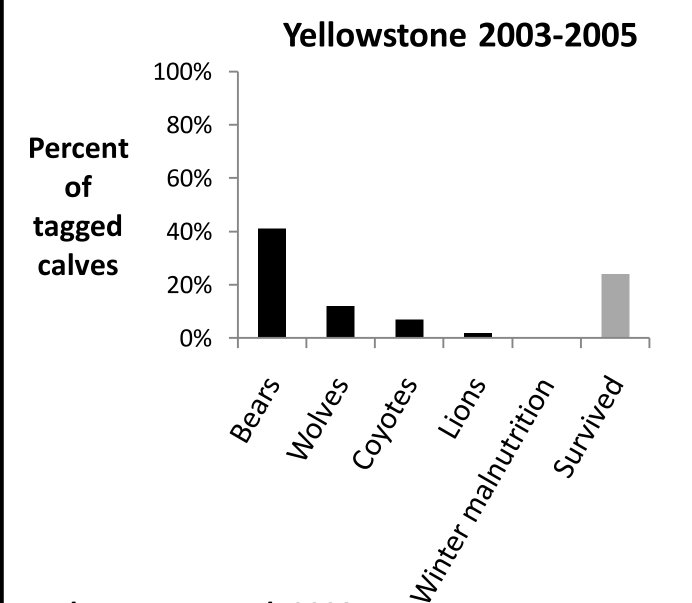


What would cause migratory elk to skip reproductive years? To address this question, we evaluated habitat conditions from 1989-2009 using greenness metrics taken by satellite (Normalized Differential Vegetation Index, or NDVI). Whereas we documented no significant changes in annual greenness patterns on the year-round range of non-migratory elk, we documented an increasingly rapid and compressed green-up (top right) on migratory elk summer range. The green period is the time during which elk can most readily gain fat to support nursing and breeding; therefore, a long-term shortening of this period is likely to compromise migratory females' ability to recover the costs of lactation, and helps explain their alternate-year reproduction. We have further learned that these changing greenness patterns are well-explained by a reduction in spring precipitation and snowpack and increasing spring and summer temperatures, particularly in July (above left). In general, the Yellowstone area has experienced a severe drought in the past decade, and it appears to have influenced high-elevation areas disproportionately. For example, the photograph at right was taken along the Yellowstone Park boundary on migratory elk summer range on July 23, 2007, in a harsh drought year. It suggests that a substantial amount of browning had already occurred by that time.

Although habitat changes help account for an unusual reduction in the pregnancy among migratory elk, a large amount of summertime calf loss remains to be explained. While we have not studied predation directly as part of the Absaroka Elk Project, we are fortunate that researchers in Yellowstone Park have twice studied elk calf mortality and survival by tagging and monitoring a large number of elk calves – once from 1987-1990 and once from 2003-2005. Both studies were conducted at sites within 5-50 km of migratory Clarks Fork elk summer range. In both study periods, bears were the leading cause of predation mortality for elk calves. However, in the more recent study period (below right), bears caused a higher proportion of calf mortality that they did previously (below left). Additionally, by the second study period, wolves had been re-introduced and became the second leading cause of calf mortality. The large increase in bear predation between these study periods appears to be consistent with monitoring that shows growth in grizzly bear numbers over recent decades. If the rates of predation indicated by the recent Yellowstone study are applicable to migratory Clarks Fork elk summering at nearby sites in the Park, they can account for the post-calving summertime decline to 15 calves per 100 cows that we have documented in recent years (p. 3).

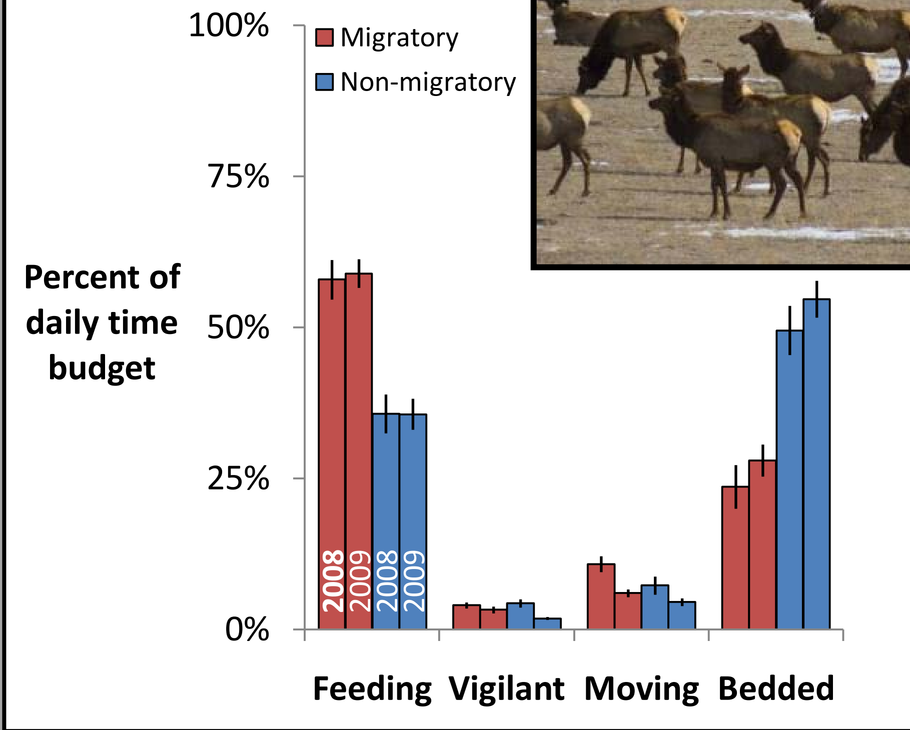


Singer et al. 1997

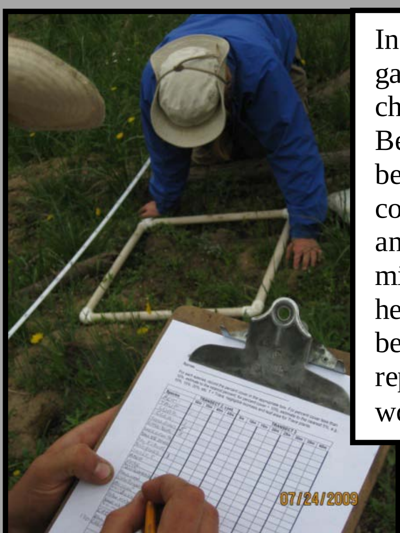


Barber-Meyer et al. 2008

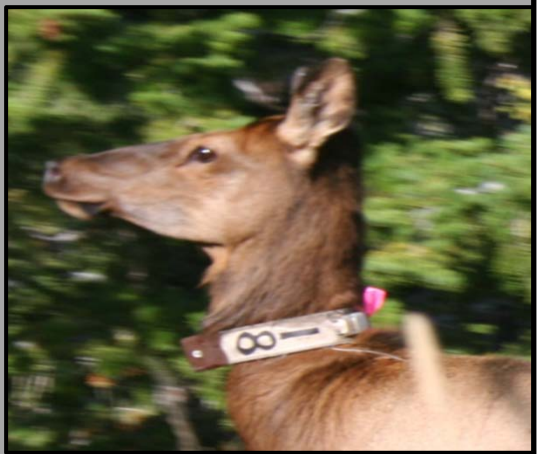
Several studies indicate that poor nutrition of elk cows, such as that we have seen among migratory Clarks Fork elk, can lead to lower calf birth weights and slower calf growth rates. This can in turn increase calves' vulnerability to predators like bears and wolves. Two regional calf survival studies have highlighted the influence of birth weight on calves' probability of survival – including the 1987-1990 Yellowstone Park study – but this factor was not found to be significant in the more recent Yellowstone study.



Much is yet to be learned on this project; we will conduct several more in-depth analyses in the coming two years. For example, field crews have been gathering information on the time budgets of collared elk cows from early January to late March each winter. This information will be used to investigate how and to what extent the risk of wolf predation influences elk behavior. Coupled with our monitoring of body fat and reproductive status (pp. 3-4), this information will help us determine whether wolves influence the nutrition and reproduction of elk – a subject warranting further study in this region. At a glance, during winters 2008 and 2009, migratory elk spent a greater proportion of time feeding but little or no additional time vigilant, despite facing higher wolf risk than non-migratory elk. Additional observations were made during winter 2010, and we will also address these questions for summertime, particularly for lactating versus nonlactating females.



In addition to the information we have gathered on large-scale, long-term habitat changes, collaborators Dan Tinker and Sara Beaver in UW's Department of Botany been conducting a finer-scale, two-year comparative study of plant composition and nutrition on migratory versus non-migratory elk ranges. This information will help us better understand relationships between elk habitat selection, nutrition, and reproduction, and the potential influence of wolves and climate upon them.



Lastly, we are very pleased to report that all our Telonics elk GPS collars dropped off, on schedule, at 6 a.m. on April 1, 2010! Most of these collars have now been successfully retrieved. They hold detailed movement information that is critical to much of our upcoming work. In the coming years, we will conduct our analyses using ~400,000 elk and ~60,000 simultaneous wolf locations, helping this project shed new light on the complicated relationships between elk, their habitat, and wolves – with the ultimate goal of improving elk population and habitat management in the Absaroka Mountains of Wyoming.

THANKS FOR ONGOING SUPPORT FROM MANY COOPERATORS AND CONTRIBUTORS!

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Wyoming Animal Damage Management Board
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Pope & Young Club
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Bowhunters of Wyoming
Cody Country Outfitter & Guides Association
University of WY – NPS Research Station

KEY AGENCIES FACILITATE THIS WORK:

Wyoming Game & Fish Department
US Fish & Wildlife Service
USDA Wildlife Services
National Park Service
Bureau of Land Management
US Forest Service

This project is a collaborative effort of the Wyoming Game and Fish Department, the University of Wyoming Cooperative Fish and Wildlife Research Unit, and the US Fish and Wildlife Service. Its lead investigators are Doug McWhirter of WGFD, Matt Kauffman and Arthur Middleton of UW, and Mike Jimenez of USFWS. For more information, contact:

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ADMB FINAL PROJECT REPORT

Project Title: NORTH FORK HUMAN/BEAR CONFLICT RESOLUTION

Brief Synopsis of Project: This project will minimize human/bear conflicts in Park County, Wyoming through (1) minimizing and properly managing bear attractants; (2) employing bear resistant waste management systems; (3) managing bears/attractive bear habitat where potentials for conflicts and risks to human safety are high; and (4) employing a public outreach program for education about preventing conflicts with bears.

FY10 Expenditures: The ADMB awarded $10,000 in FY09 to be directed toward educational initiatives for the purpose of minimizing human-bear conflicts in Park County, Wyoming. Because a portion of these funds ($4,422.00) were not spent within the 2009 fiscal year, the Board granted a time extension of the FY09 remaining funds that was effective through June 30, 2010. Expenditures for FY10 are as follows:

1. Purchased 1000 Bear Aware refrigerator magnets. The magnets were distributed to Park County residents in an educational mailing encouraging the proper storage of attractants in areas where bears are present.
2. Aired a series of public service announcements (PSA) on 3 local radio stations in the Cody area for a four week time period. The PSA's encouraged residents to store attractants properly and suggested methods to minimize human-bear conflicts.
3. Purchased promotional pencils featuring the text "Bear Wise Wyoming". Pencils will be distributed to the public at educational events and programs in the Cody area.
4. Purchased components for the "Be Bear Aware" traveling library display. The educational display will be available to public libraries across northwest Wyoming in the Greater Yellowstone area but will to be featured at the Park County public library for 6-12 months. The primary educational message and title of the display is "Reducing Human-Bear Conflicts". See Figure 1.

Figure 1. Traveling “Bear Aware” library display

Submitted by: **Tara Teaschner, Bear Wise Community Coordinator**

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Absaroka Wolf-Cattle Project

In an effort to meet the two main objectives of the study, additional data was incorporated from newly downloaded wolf and elk GPS collars in 2010. The first objective of this project is to characterize the shift in wolf habitat selection from winter to summer months, as wolves respond to seasonal changes in the distribution of their native prey and domestic livestock. The second objective is to identify landscape characteristics of cattle pastures associated with high risk of wolf depredation, and to determine summer and fall prey selection by wolves. In collaboration with the Absaroka Elk Ecology Study, wolf collars were retrieved, downloaded and replaced during capture efforts in January 2010, and over 80 elk GPS collars were retrieved and downloaded as of April 2010. We incorporated the new elk GPS data into the wolf habitat selection analysis, which enhanced our efforts to investigate the influence of landscape attributes such as elk distribution, land cover, roads, elevation and forest edge on wolf habitat use in summer and winter, for wolf packs occupying both migratory and resident elk areas.

The expected completion date for both objectives of this project is December, 2010. To date, we have added new elk and wolf data while refining the analyses for objective 1 (seasonal wolf habitat selection patterns). We also solved statistical challenges associated with low sample size and spatial autocorrelation.

Objective 1: Wolf habitat selection

Distribution of preferred prey is a known driver of wolf habitat use. If understood, prey distribution can provide a tool to predict wolf movements, and thus potential areas of conflict with livestock. However, the distribution of prey varies greatly by season and by ungulate herd: some ungulates migrate long distances while others shift their distribution locally. Considering that the seasonal variation in ungulate patterns likely changes wolf habitat use by season, quantifying this variation will enable us to predict the temporal and distributional variation in wolf habitat use, and potential for wolf-livestock encounters. To investigate this relationship, we developed an elk density layer in GIS using over 350,000 elk locations (Fig. 1A) and used over 25,000 wolf locations (Fig. 1B) downloaded from GPS collars in this analysis. Elk distribution interacts with other landscape features such as slope, elevation, roads, and vegetation cover to influence where wolves use habitat at different times of year. We included these additional variables in this analysis, but they will not be discussed here in depth, as we are currently using model selection to determine which of these variables will be included in the final model.

Migratory elk areas

In our study area, wolves living in migratory elk areas overlap with elk on winter range, but are confronted with changing conditions when elk migrate 30 miles into Yellowstone National Park for the summer months. Wolves typically establish their den-site on elk winter range, and are tied to raising pups at this static location until early fall, though they have the ability to make long-distance trips from their den-site. Preliminary results from the Sunlight pack in the migratory elk area indicate that GPS collared wolves do not shift their distribution patterns greatly summer to winter despite elk migrating away from their winter range (Fig. 1B). The Beartooth, Sunlight and Hoodoo packs all reside in territories that overlap with migratory elk, but the preliminary results discussed in this report refer only to the sunlight pack for wolves living in migratory elk areas, as the Beartooth and Hoodoo pack data are still being analyzed. Although three out of seven individual collared wolves took extraterritorial forays in a similar direction and time as the elk migration into YNP, these forays were generally short-lived and did not make up the majority of wolf locations. These results show a reverse trend summer to winter: in winter, wolves strongly select for densely aggregating elk herds (Fig. 3), whereas in summer, wolves spend the greatest proportion of their time in elk-poor habitat (Fig. 4), within their home range. Other studies on wolves and migratory caribou in Alaska show that wolves' tendencies to follow migratory caribou long distances depend on the availability of alternate prey close to the den-site (Ballard et. al 1997). The results from this analysis, from our prey selection data, and from summer aerial ungulate surveys indicate wolves in our study area can likely afford to subsist on alternate prey when elk migrate out of their winter territory. Though it is expected that wolves would select for elk-rich habitat because they have the ability to travel long distances, in this situation they do not. In summer months, constraints other than alternate prey availability that may influence wolves to stay in low-elk habitat include the risk associated with crossing neighboring pack territories, and the need to attend the den site. Though wolves generally select for habitat away from open roads and anthropogenic activity, in the migratory elk area, habitat close to open roads was selected in both summer and winter. This relationship is probably due to low traffic on the road running through the Sunlight pack territory, combined with migratory elk congregating close to the road in winter. Elk distribution in winter likely plays a role on the location of wolf den-site selection (this occurs in late march), which dictates much of wolves' distribution in summer months as well.

Resident elk areas

The same habitat selection analysis was conducted for the resident elk region, where elk shift their distribution only slightly season to season, but generally do not perform long-distance migrations. Our preliminary results for the resident elk region show wolves select for elk-dense areas in the summer months (Fig. 4), but the data show no significant selection for elk-rich habitat in winter. Our results also indicate that during both seasons wolves avoid open roads, but do so more strongly in summer. Why do wolves show no selection for elk rich areas in the winter months? From summer to winter, elk appear to move from higher elevation on remote ranchlands, forest and wilderness areas, down to low elevation areas that are close to roads, human activity and agricultural fields. Our results show wolves avoid roads in winter months, likely due to human presence and traffic, but still are attracted to these elk groups. Wolves utilize the periphery of the cow-calf elk groups that forage in close proximity to areas of human use, but they also may seek prey away from roads (Fig. 2B), which could include bull elk groups and deer.

Overall, prior studies predict wolves to select for elk-rich habitat, however, we found there are exceptions to this relationship. As expected, our results show when elk occur in areas with low to no human activity, wolves will strongly select for elk-rich habitat. However, if elk occur near or overlapping with human activity, it is likely that wolves will not select for the most elk - rich areas, but more likely use the periphery of these elk groups to avoid human contact. Additionally, though there is individual variation in response to elk migration, wolves in the Sunlight pack will not select for elk- rich habitat when elk migrate a long distance from the wolf den-site (probably dependant on alternate prey availability). In this report, we discuss preliminary findings for two out of the four study packs, and only report on the two most influential habitat characteristics (elk distribution and open roads). In the final report we will include results from all four packs as well as other variables that influence wolf habitat selection such as cover type, distance to forest, elevation and slope. Several of our findings can assist in predicting wolf-cattle encounters during the grazing season. Cattle that graze in pastures with high elk density are likely to encounter more wolves than pastures with low elk density, or pastures close to human activity and roads. Wolves will spend much of their time near their den site attending young in the summer months, which may be problematic if wolves den in a heavily used cattle pasture. Generally wolves avoid networks of open roads, which may provide refuge for both cattle and elk. We do not have GPS data on bull elk group locations throughout the year, but based off of bull distribution from WGFD classification counts, it is possible that wolves utilize areas with bull groups to a greater extent in the winter when cow-calf groups are closer to roads. This situation may provide an opportunity for further study.

Objective 2: High- risk areas for cattle depredations and wolf –prey selection

Throughout the 2007 and 2008 field seasons, field crews searched a total of 589 clusters of wolf GPS locations, locating a total of 120 carcasses from clusters and reports. These clusters and carcasses were derived from GPS information from 4 wolf collars, with a total of 204 wolf tracking days. The carcasses found through wolf GPS cluster searching were augmented by reports of dead livestock from ranchers, USDA Wildlife Services, the US Fish and Wildlife Service, (USFWS), and the Wyoming Game and Fish Department (WGDF). The total number of wolf-killed cattle found within the study period including reports from ranchers and cattle found at GPS clusters was 23 cattle. Research crews found a greater proportion of elk in wolves' diet in the resident elk area (Absaroka pack, 2007), and an approximately equal amount of wolf-killed deer and elk in the migratory area (Figs. 7 and 8). In addition, three wolves were documented taking large extra-territorial forrays into Yellowstone National Park. Analyses of habitat characteristics associated with wolf depredation sites will continue through the summer and fall of 2010. Expected project completion date is December 2010.

The Absaroka Wolf-Cattle Project has been made possible due to a strong collaboration between the USFWS, the WGFD, USDA Wildlife Services, and the US Forest Service. The project's successful completion of fieldwork was largely dependant on the support of private land owners and ranch managers in Cody, Sunlight and Crandall. Primary funding and support has been provided by the Wyoming Game and Fish Department and the Wyoming Animal Damage Management Board.

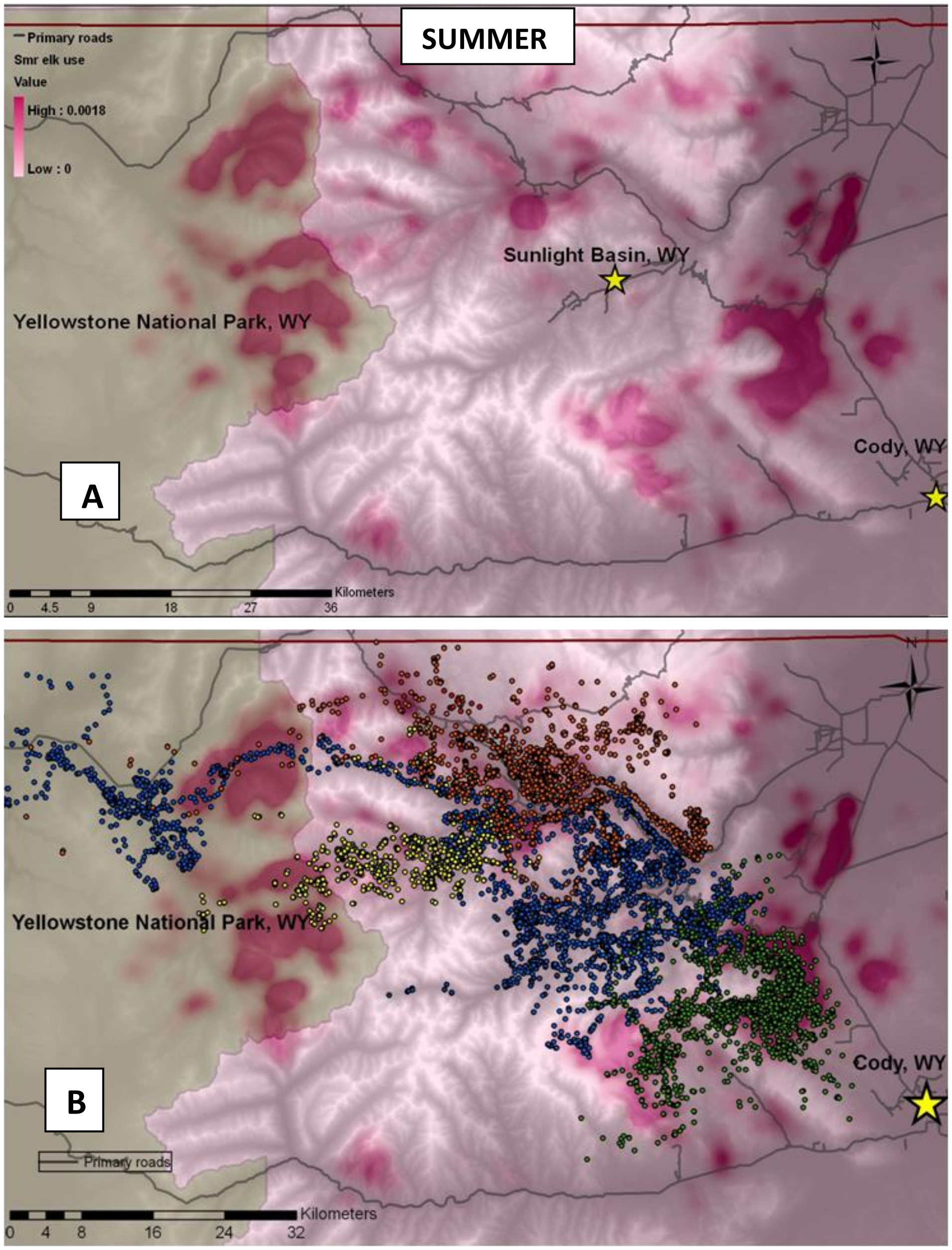

Figure 1. (A) Elk density in summer months (dark pink represents highly used areas by elk). (B) Summer GPS locations for wolf packs living in migratory elk areas in red (Beartooth), blue (Sunlight) and yellow (Hoodoo), and for resident elk area in green (Absaroka).

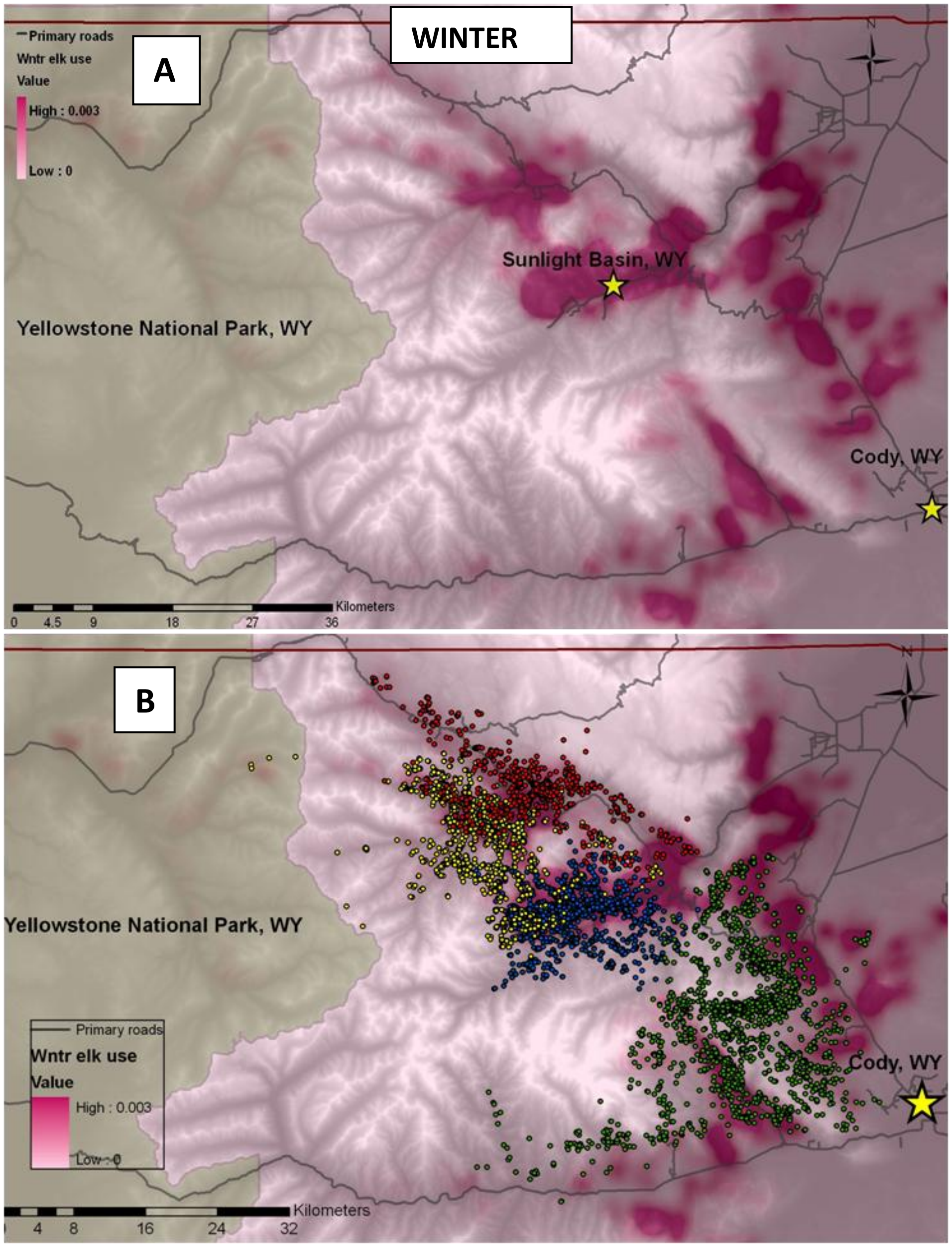

Figure 2. (A) Elk density in winter months (dark pink represents highly used areas by elk). (B) Winter GPS information for wolf packs living in migratory elk areas in red (Beartooth), blue (Sunlight) and yellow (Hoodoo), and for resident elk area in green (Absaroka).

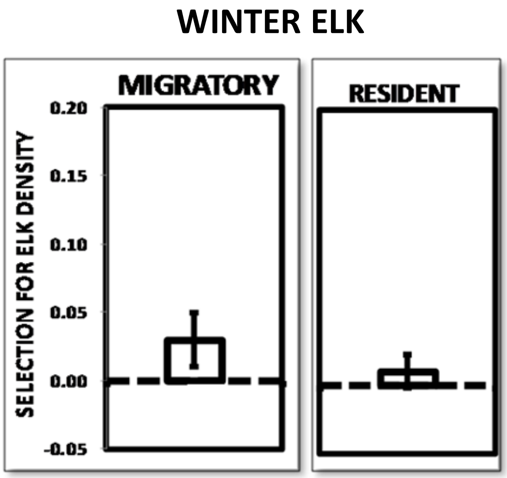

Figure 3. In winter, wolves in migratory elk areas select for elk-rich habitat, whereas wolves in resident elk areas show no significant selection for elk rich areas, a relationship likely driven by human avoidance.

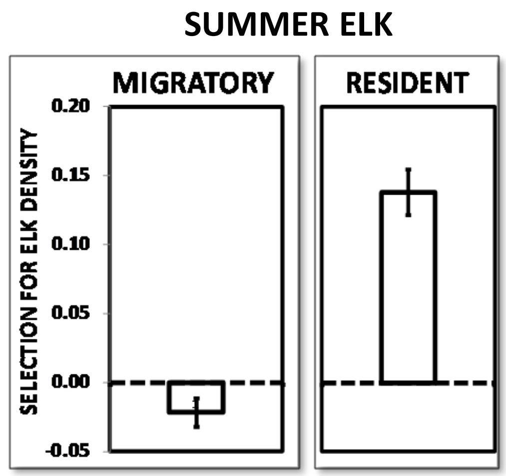

Figure 4. In summer, wolves in migratory elk areas select for elk-poor habitat, whereas wolves in resident elk areas strongly select for areas of high elk density.

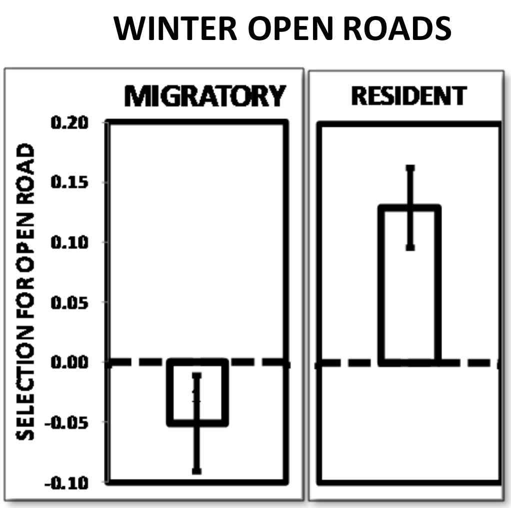

Figure 5. In winter, wolves in migratory elk areas select for habitat close to open roads and in resident areas strongly avoid open roads. Differences in daily traffic between the two areas may contribute to the divergent wolf response.

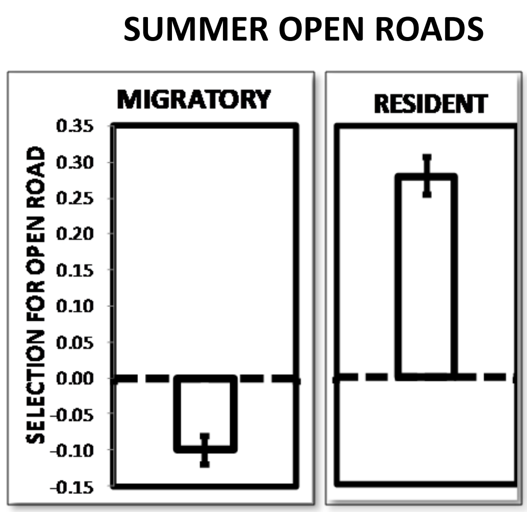

Figure 6. In summer, wolves in migratory elk areas select for habitat close to open roads and in resident areas strongly avoid open roads.

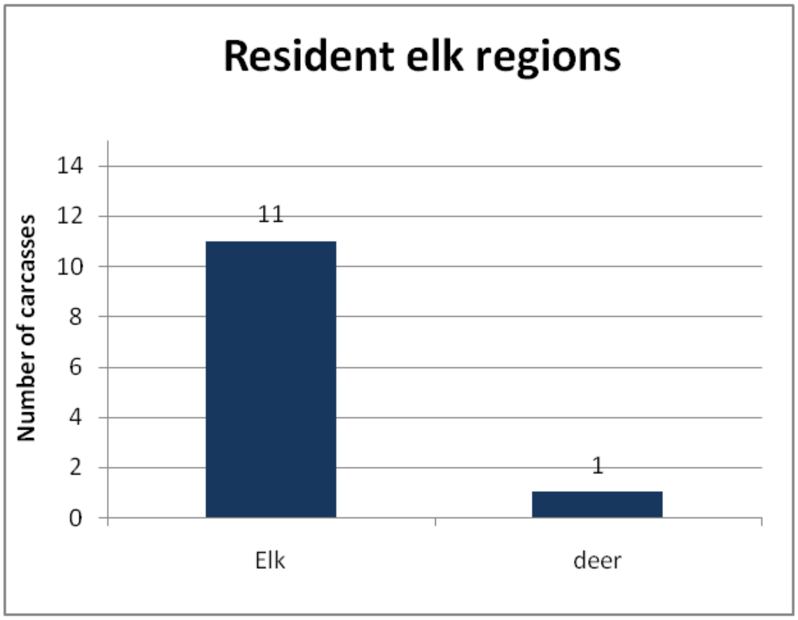

Figure 7. Wolf kills found at cluster sites in resident elk areas (2007) were predominantly elk.

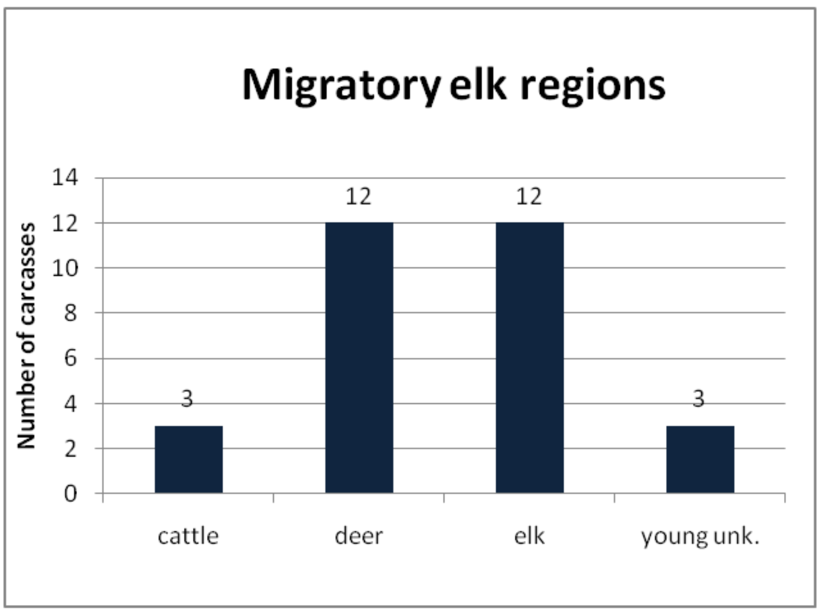

Figure 8. Wolf kills found at cluster sites in migratory elk areas show a greater breadth of prey species.