

CORONA RANGE AND LIVESTOCK RESEARCH CENTER RESEARCH PROTOCOL 2006 – 2007

Title: Habitat use, individual performance, and population performance of wild ungulates relative to population structure and domestic ungulate habitat use

Investigators: Jon Boren, Lou Bender, Shad Cox

Location: Deer study includes the entire CRLRC and the pronghorn study includes Johnson pastures

Livestock: The mature cow herd at the Corona Range and Livestock Center will be used to provide the prescribed livestock grazing treatments.

Duration:

Background:

The mission of the Corona Range and Livestock Research Center (CRLRC) Big Game Program is to produce and maintain viable mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana*) populations that economically contribute toward the support of the CRLRC. The mule deer and pronghorn resources are managed in a manner consistent with providing quality research, teaching and demonstration opportunities for the faculty, staff and students of New Mexico State University. The results of these efforts are used in extension programs designed to aid New Mexico citizens in their ability to manage natural resources while improving their quality of life.

Mule deer and pronghorn on the CRLRC were subjected to a fee-hunting operation prior to New Mexico State University's acquisition of the area. The fee-hunting program continues to be operated with approximately 33 mule deer and 6 pronghorn harvested annually. Data have been collected from hunter-harvested males to assess trophy quality and body condition. Data also has been collected to estimate mule deer numbers, sex, and age ratios, home range size, and changes of vegetation on CRLRC. These data have been used to make management decisions regarding the fee-hunting program and the overall health of the mule deer herd.

In effect, the CRLRC acts as a demonstration area for economically profitable and ecologically sound holistic management of rangeland resources in New Mexico. Because data on big game management on CRLRC are used to provide recommendations on co-managing mule deer and livestock on ranches in New Mexico, CRLRC must enhance the rigor of data collection and interpretation regarding wildlife resources.

Severe declines in productivity of mule deer and pronghorn populations throughout the West suggest suboptimal foraging habitats. On both public and private lands, wild and domestic livestock are co-managed, and both can strongly affect the habitat of the other. Managers typically use mechanical, herbicide, and prescribed fire to manipulate habitat for free-ranging herbivores. However, these treatments can be expensive and may have undesirable consequences such as increased erosion and chemical residues. Conversely, domestic livestock grazing can also influence plant community composition, structure, and nutrient availability, and can be used to facilitate wild herbivore use by removing coarser, more fibrous vegetation. However, livestock rarely graze uniformly, and areas preferred by livestock are often not the sites where grazing is needed for wildlife habitat management. Because livestock and wild ungulates are often co-managed on private lands, information on how the presence of each affects the distribution and individual performance of the other is necessary to identify informed habitat management prescriptions for either herbivore. Moreover, identification of methods whereby 1

ungulate guild may facilitate use and performance of the other would allow maximal use of co-habited habitats. Heretofore, most management actions have utilized a “trade-off” approach, where management for 1 guild typically results in losses for the other.

Performance of wild ungulate populations can also be affected by their own population demographics, including density, age structure, and viability of individual cohorts. High density populations are less productive because they allow fewer resources per individual and thus limit individual performance (i.e., individual productivity, antler development). These effects can also be carried throughout the lifetime of individuals; stressed cohorts usually do not “catch up” with unstressed and thus show lowered individual and cohort performance throughout their lifetime. Such effects are usually tied to nutrition as well, and make calibration of nutrition-condition-performance relationships a key factor in maximizing products from hunted populations. Last, population age structure can have a severe limiting effect on population performance, because wild herbivores show reproductive senescence at ages $> \frac{1}{2}$ their potential lifespan. Monitoring of and managing population age structure, whether of females (to maximize productivity) or of males (to maximize survival into older, trophy age classes) are further critical components to maximizing benefits associated with wild ungulate population managed for multiple uses.

We propose to evaluate the effects of various habitat management and distribution-affecting (i.e., herding) techniques on distribution and performance of mule deer and pronghorn. We will utilize measures of both individual (i.e., body fat, muscle reserves) and population (young/juvenile ratios, rates of population change) to determine positive and negative effects of habitat treatments. Condition of both wild and domestic ungulates has been shown to be fundamental to production and survival of young, survival of adults, individual development, and susceptibility to predation; condition, in turn, is primarily a result of nutrition as mediated by security (disturbance) effects. Because individual performance is fundamental to population performance, measures of individual condition provide the only unbiased assessment of responses to habitat changes and thus need to be conducted to identify any real effects of management. Previous work on mule deer in both north-central New Mexico and the San Andres Mountains has shown that accretion of body reserves is related to only a few attributes of the habitat available to deer, and thus provides a powerful tool to identify critical habitats and effective management strategies. Similar relations likely exist for pronghorn, although our work at Corona will be the first project to ever assess these effects directly. Last, intensive monitoring of population trajectories and demographics in combination with the above condition assessments will allow much greater resolution in development of the hunt programs at Corona, and consequently maximization of the revenues associated with wild ungulates on private lands. As a primary purpose of CRLRC is to demonstrate proper and profitable management of all rangeland resources for managers of both private and public lands, our program will fundamentally address to wild ungulate aspect of that equation in association with existing domestic livestock and habitat manipulations being conducted by all investigators at CRLRC.

Last, our work will simultaneously facilitate current research activities by D. Bailey on using cattle distribution to affect pronghorn distribution and A. Cibils on micromovements and microsite use of cattle.

Objectives:

Our goals are to determine the effects of various habitat, distribution, and population management practices on condition and productivity of mule deer and pronghorn on the CRLRC.

Objectives of this project include:

- 1) Determine effects of current land management (i.e., pinyon-juniper control, deciduous shrub rehabilitation, etc) practices on condition and productivity of wild ungulates.

- 2) Determine effects of fine (hourly, daily) and coarse (seasonal, annual) scale livestock use patterns on distribution of mule deer and pronghorn at both fine and coarse temporal scales.
- 3) Determine productivity, survival, and cause-specific mortality patterns of mule deer and pronghorn and how these are affected by individual condition and animal distribution.
- 4) Determine population composition and population size of mule deer and pronghorn and relate these to individual animal performance.
- 5) Evaluate current and alternative population management programs for mule deer and pronghorn to assess effects on population performance and economic returns.
- 6) Define effective habitat and livestock management schemes for maximizing individual deer and pronghorn performance and consequently population production.
- 7) Continue administering the fee-hunting program and provide extension programs to livestock producers and natural resource management agencies.

Methods:

Hunters are required to check their harvested mule deer and pronghorn out before leaving CRLRC. Numerous antler (Boone and Crockett Club scoring criteria) and body measurements (field weight, dressed weight, and body length) will continue to be taken to assess trophy quality. Examination of a cross-sectional view of the first incisor will be used to age the harvested animals. Body condition also will be assessed using a subset of the Kistner Score Index, indexing fat accretion around the heart, pericardium, and kidneys. This data is being concurrently collected throughout New Mexico and thus provides a spatial and temporal index of body condition of mule deer. Diet quality also will be examined using rumen and fecal samples. Further, monthly fecal samples from mule deer throughout CRLRC will be collected and analyzed for fecal DAPA levels. DAPA would be converted into estimates of dietary digestible energy and dietary digestible energy intake.

Cattle grazing patterns will be recorded using GPS tracking collars and forage use measurements in cooperation with Andres Cibils and Derek Bailey. Approximately 16 randomly selected cows will be tracked using GPS collars during the study. Forage utilization measurements using stubble heights and height-weight relationships will be recorded.

Harvested forage samples will be dried and analyzed to determine forage quality before and after grazing treatments. Forage samples will be analyzed for crude protein, NDF, ADF, and mineral concentrations. Grass cover and density of forbs will be measured before and after herding in target and control areas using permanent transects. In addition, standing crop of grasses and forbs (current year's production and residual standing dead material) will be measured before and after grazing treatments.

Mule deer and pronghorn performance and use will be monitored as follows:

1. Repeated annual capture of 20-30 mule deer does and ~40 pronghorn each December at or near the peak of fat accretion. Ungulates will be captured by aerial darting and immobilization or net-gunning.
2. All captured ungulates will be assessed for condition using ultrasonography (to measure subcutaneous fat and muscle depth at the rump and loin) and body condition scores (rump [rBCS] and withers [wBCS]). Individuals will be checked for pregnancy (if possible) and lactation status, a blood sample collected via jugular puncture for future diseases screening), and released.
3. All captured ungulates will be radio-collared with either VHF (pronghorn, 1/2 of deer) or GPS (1/2 of deer) radio-collars. Individuals will be located a minimum of twice per week with periods of seasonal emphasis (i.e., multiple locations/day during herding experiments). GPS collars will be programmed for hourly locations.
4. Deer and pronghorn use areas will be defined using 95% and 50% adaptive kernel home ranges. Characteristics of home ranges (cover type, proportion of area in various

- treatments, amounts of preferred forages, intensity of livestock use, etc.) will be used as variables to model deer/pronghorn condition in a multiple regression analysis.
5. Determine seasonal and annual survival rates using the staggered-entry Kaplan-Meier estimator and cause-specific mortality rates using the method of Heisey and Fuller. Individual animal survival will also be modeled using logistic regression with predictor variables including IFBF, loin depth, rBCS, wBCS, seasonal precipitation, body size metrics, etc.
 6. Diets (from microhistological analyses) and diet quality (FN, DAPA, NDF) indices will be determined to identify food habitats and diet quality of deer/pronghorn associated with treatments versus deer/pronghorn not associated with various treatments.

Treatments:

The mature cow herd at the Corona Range and Livestock Center will be used to provide the prescribed livestock grazing treatment. Cattle grazing will be focused in areas that traditionally have received little grazing use because of long distances from water and decadent vegetation. Timing of grazing is designed to remove decadent mature before the monsoon rains typically occur so that forbs have additional areas to grow. Warm season grasses dominate these rangelands so that any current year's production that is grazed should have an opportunity to regrow. Early defoliation should help keep the grasses in vegetative state for a longer period and correspondingly improve forage quality. The target level of defoliation for treated areas is a 35 to 45% reduction of the grass standing crop.

Further, existing land management practices (i.e., pinyon-juniper control treatments, deciduous brush management practices, etc.) will provide the vegetation treatments. Later, specific treatments may be defined and implemented.

Time table:

December 2006	Complete composition survey of mule deer and pronghorn antelope. Capture approximately 20 deer and 40 pronghorn antelope, measure condition, and attach collars.
April 2006	Complete aerial sightability survey of mule deer and pronghorn
December 2006-7	Monitor deer/pronghorn movements a minimum of 2X/week.
June-August 2007	Monitor deer/pronghorn movement patterns minimum of 2X/day.
June-August 2007	Measure availability and relative use of preferred mule deer and pronghorn forages (tentative)

Results to Date:

1. Population estimation and structure

An aerial survey for mule deer and pronghorn was conducted on the CRLRC in April 2005 and 2006 (Table 1). The mule deer sightability model corrects deer observed for group size (G) and 2 levels of activity (Moving or Not Moving [i.e., bedded, standing]). This model is still being evaluated for performance and sensitivity; therefore consider these results preliminary. Mule deer on the Corona Research Center were at higher densities (12–13 deer/mile²) in April 2005 compared to other populations in New Mexico where comparable data is available (5-7 deer/mile² in the higher density areas of Colfax County). However, survey data suggests that mule deer population declined approximately 26% from April 2005 to April 2006, and survival data from

2006 (Table 4) indicates a further decline in deer numbers can be expected for April 2007 (Table 2).

Table 1: Results from the April 2005 and 2006 aerial surveys of mule deer and pronghorn on the CRLRC.

Species	Year	Total	Doe	Fawn	Buck	B/D/F Ratio ¹	N ²
Deer	2005	369	240	108	21	9:100:45	539
	2006	169	124	36	6	9:100:29	397
Pronghorn	2005	136	78	N/A	75	75:100	N/A
	2006	126	76	N/A	50	66:100	N/A

¹Ratios from uncorrected composition; pronghorn = bucks:does + fawns.

²Corrected total from deer sightability model developed for mule deer in Colfax County, NM.

Table 2. Projected population trends of mule deer and pronghorn on CRLRC based on observed survival (December 2005–present) and anticipated productivity rates (based on data seen in April 2006).

	S _F	J/F	λ	What may happen?
Deer	0.47	0.22	0.64	Decline ≥ 42%
Pronghorn	0.64	0.18	0.73	Decline ≥ 27%

Further, anecdotal evidence indicates that age structure of the doe population is old; of 15 mule deer does captured during a December 2005 collaring event, 4 were aged by tooth wear as >10 years old despite efforts to avoid deer that appeared aged (i.e., substantial grey/white in pelage, emaciated). Consequently, in order to improve productivity of mule deer on the CRLRC, we proposed to the New Mexico Department of Game and Fish to harvest a maximum of 30 adult females through CRLRC's hunting program with revenues generated from hunts used to partially fund the research project. Following the extremely low adult survival seen to date in 2006, however, this effort has been delayed until we can further assess the effects of the early drought on deer population size and productivity on CRLRC.

Pronghorn populations appear to be more stable than mule deer (Tables 1 and 2). However, pronghorn population estimates are minimum counts, no sightability-adjusted estimator is available for pronghorn. Regardless, the low survival seen in 2006 predicts a significant population decline for pronghorn. The true extent of this decline will not be known until productivity surveys are able to determine the level of fawn recruitment seen in 2006.

2. Condition and productivity

Adult mule deer females were in poor condition on Corona (Table 3). Lactating does averaged only 5.1% IFBF (all does combined = 6.9%) and only 5/15 had measurable subcutaneous fat. Bucks were able to accrue significantly more subcutaneous fat than were does (Table 3) but specific equations for converting these levels to IFBF are not yet available for buck mule deer. Based on rBCS scores, fat levels in bucks averaged 8.8% IFBF. However, this is based on equations developed for desert mule deer.

Mule deer are capable of accruing > 20% IFBF; thus condition of deer on CRLRC is poor. In other areas of New Mexico, nonlactating doe Rocky Mountain mule deer in north-central New Mexico ranged from 6.8–9.1% IFBF during a period when preweaning fawn survival ranged from 0.0–0.50 and the population showed maximum annual rates of increase of 0.64, 0.94, and 1.05. Both survival of does and production and survival of fawns were most strongly related to doe

condition in this population (Bender et al. 2007, Lomas and Bender 2007). In the San Andres Mountains, doe desert mule deer were able to achieve slightly higher levels of IFBF (lactators = 5.8–6.8%; nonlactators = 7.1–10.4%) and bucks much higher (12–17% IFBF) than seen in CRLRC. The SAM data has been collected for 3 y and this project is currently ongoing.

Table 3. Condition and size metrics of mule deer and pronghorn captured on CRLRC, December 2005.

	<i>Deer</i>		<i>Pronghorn</i>	
	Doe	Buck	Doe	Buck
Fat (cm)	0.18	0.56**	0.86	1.07
% IFBF	6.93	---	---	---
rBCS	2.13	2.80**	2.86	3.16**
wBCS	3.28	3.70	3.80	3.88
Loin (cm)	3.68	4.10**	3.40	3.77**
Girth (cm)	87	100**	92	92

**Values between sexes within a species differ ($P < 0.05$)

Pronghorns showed significantly less sexual dimorphism in any condition or size measures than did mule deer (Table 3). In general, buck pronghorn were in slightly better condition than does. However, comparative data on pronghorn condition are not available to place condition levels at CRLRC in perspective. Collection of similar data on pronghorn on White Sands Missile Range, an ungrazed Chihuahuan desert habitat, may allow assessment of whether condition of pronghorn in CRLRC is currently poor or good.

3. Survival and cause-specific mortality

Survival of both mule deer and pronghorn has been extremely low (Table 4). Little or no precipitation during mid-late gestation resulted in high early mortality due to malnutrition for mule deer, a pattern seen previously in north-central New Mexico (Bender et al. 2007a). Pronghorn died primarily from disease, likely enterotoxemia associated with the June green-up and later likely toxic effects of certain forages (analysis pending).

Table 4. Causes of mortality and overall survival rates of radio-collared mule deer and pronghorn on CRLRC, December 2005–present.

Cause	<i>Deer</i>		<i>Pronghorn</i>	
	Doe	Buck	Doe	Buck
Malnutrition	0.46	0.25	0.00	0.11
Predation	0.07	0.00	0.00	0.00
Disease	0.00	0.00	0.36	0.00
Illegal kill	0.00	0.00	0.00	0.00
Accident	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00
Total	0.53	0.25	0.36	0.11
Survival	0.47	0.75	0.64	0.89

During the worst year of the STAMP project, adult doe survival was 0.64, fawn recruitment < 0.02, and the population declined a minimum of 35% in a single year (Bender et al. 2007). To date, survival of adult doe mule deer on CRLRC suggest that the deer population will decline

even more than seen in STAMP; survival rates observed to date indicate that populations of both mule deer and pronghorn will decline approximately 30–50% during 2006 (Table 2).

4. Habitat relationships

No analysis of home range, distribution, or other habitat data has been performed to date.

Deliverables to Date:

In order to disseminate research results to extension clientele as well as federal and state natural resource agencies, workshops and field tours will be conducted throughout the project. Three poster presentations were presented at the 2005 CRLRC Field Day and one poster presentation at the 2006 Joe Skeen Institute for Rangeland Restoration Conference. Presentations also will be given at local and professional scientific meetings. New Mexico State University Cooperative Extension Service publications also will be developed for a variety of audiences.

Literature cited:

- Bender, L. C., L. A. Lomas, and J. Browning. 2007. Condition, survival, and cause-specific mortality of mule deer in northcentral New Mexico. *Journal of Wildlife Management: In press.*
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