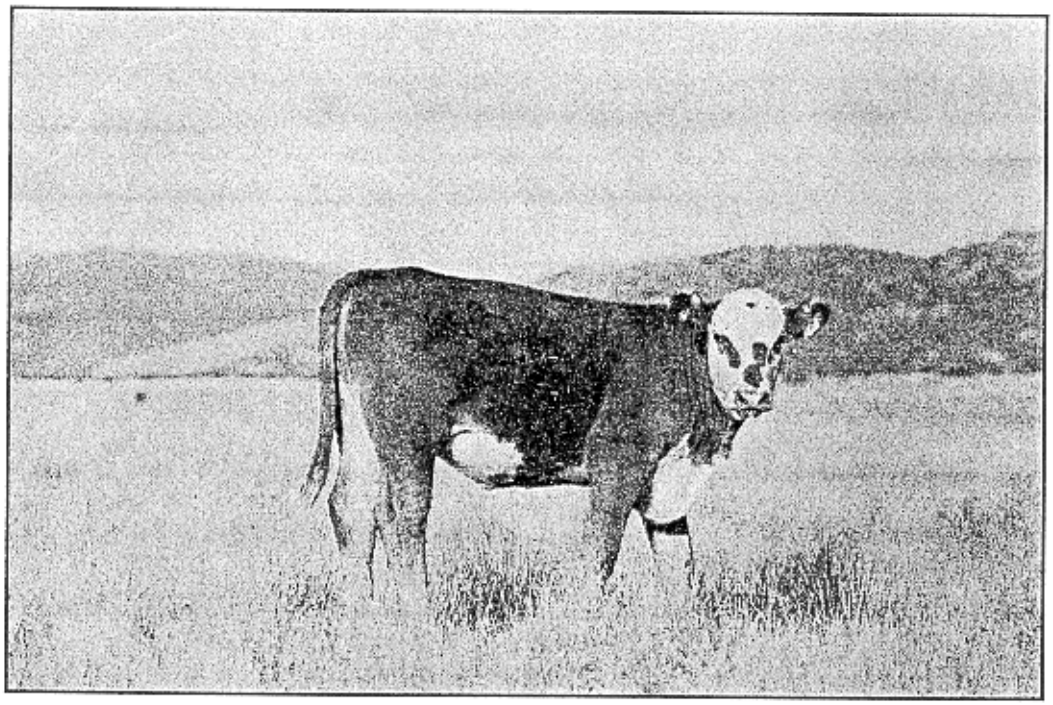
Livestock Research Briefs and Cattle Growers' Short Course Proceedings



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New Mexico Cattle Growers' Association

control, with shortgrasses dominating early successional areas and midgrasses dominating mid-successional areas. Effects of chemical brush control on vegetation composition persist at least 20 years, and probably much longer. Soil properties were measured at the canopy center, canopy edge, and interspace. Soil samples were taken by dead and live creosotebush in treated areas. In untreated areas, soil samples were only taken by live creosotebush. Organic matter, nitrogen, phosphorus, potassium, aggregate stability, and sand content increased with creosotebush proximity. Magnesium, calcium, pH, cation exchange capacity, clay content, and silt content increased with distance from creosotebush. Most soil properties were not significantly different among successional stages. A portable rainfall simulator was used to examine hydrologic processes. Infiltration rates and sediment concentration were greater and the wetting front deeper in the canopy zone than interspace. Infiltration rates were highest in early successional areas and lowest in mid-successional areas. Sedimentation was significantly influenced by creosotebush proximity and successional stage.

RANGELAND RESEARCH ON THE JORNADA EXPERIMENTAL RANGE

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Key Words: Livestock Management, Rangeland Ecology

Introduction: The mission of the research program at the Jornada Experimental Range is to develop new technologies for management and remediation of desert rangelands. This program leverages the 88 year research history at the 193,000 acre Jornada Experimental Range under the stewardship of the USDA to address four general objectives. These are to: 1) quantify key ecological processes that characterize functions of arid rangelands, 2) identify, evaluate and describe methods for monitoring and assessing desert rangeland conditions, 3) design and test techniques for remediating degraded rangelands and 4) develop agricultural practices appropriate for livestock production in desert environments. The following are a few of the current projects at the Jornada related to these four objectives. For more information about these or the many other studies in progress, or to obtain publication lists or specific publications, please contact our office (bgamboa@nmsu.edu) or visit our website (usda-ars.nmsu.edu).

Livestock Foraging Behaviors in Desert Landscapes: An understanding of the spatial and temporal dynamics of free-ranging grazing animals is essential for range livestock management, whether the goal is to promote more uniform use of rangelands or to create heterogeneous vegetation patterns in order to enhance plant and animal diversity. Cattle are typically supplemented with small amounts of high protein feedstuffs during periods of abundant, low quality forage to improve animal production. A study was conducted to determine the effect of protein supplementation and timing of supplementation on grazing distribution of free-ranging cows. Lactating cows received either no supplementation or 1.7 lbs of a 32% crude protein range cube at either 7:30 AM or 1:00 PM daily. Animals were rotated between three pastures every five days. Animals in the study pasture were fitted with GPS collars equipped with activity sensors that record head position and location every five minutes (Lotek model 2200). All animals were rotated through the study pasture three times during the 45-day trial. Preliminary data indicate that both protein supplementation and timing of supplementation altered beef cow distribution patterns. Non-supplemented animals were more dispersed than supplemented cows, and those supplemented at 7:30 were the least dispersed. These animals tended to stay in areas of

the pasture near supplementation areas. Figure 1 illustrates the grazing distribution of one heifer with and without morning supplementation. If substantiated by complete data analyses, these results may have important implications for livestock managers wishing to better utilize their forage resource while preventing localized overgrazing.

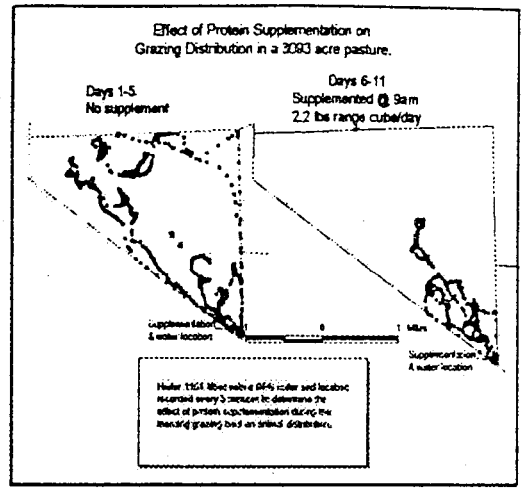


Figure 1. Effect of protein supplementation on grazing distribution.

Bilateral Virtual Fencing: Control of animal distribution is a crucial aspect of range livestock management, with economic and ecological implications. Conventional fence is expensive to build and maintain, limits flexibility in livestock management, has negative impacts on wildlife movement, and is aesthetically undesirable in some cases. Virtual fencing is a novel approach for the control of animal location in real time with virtual boundaries. A device worn by the animal contains a central processing unit that uses radio frequency signals captured from GPS satellites to determine the animal's location. A geographically referenced virtual boundary programmed into the unit's Geographic Information System is combined with GPS data to determine when a virtual boundary has been penetrated and the angle of penetration. Algorithms in the CPU then determine which side of the animal to apply a cue, from a programmable set of cues with a range of intensities. The cues encourage the animal to move away from the virtual boundary using the least intense cues and shortest possible route. The virtual boundary can be programmed to enclose an area, to surround an animal, or to move an individual to cause dispersal or allow animals to be gathered. The concept has been field-tested with one cow wearing a neck saddle prototype (Figure 2). Heart rate measurements collected when cues were applied suggest the system does not cause undue stress. A field test with more units is in progress. Ultimately, this system will provide a mechanism for management of individual animals using low stress animal handling techniques and satellite-based technology. Although bilateral virtual fencing should not be used in situations in which human or animal safety is compromised (e.g., perimeter fences near roads), this method allows pro-active resource management and site-specific prescription animal management that should improve the nutritional status of livestock and reduce supplementation costs, and be used to exclude livestock from ecologically sensitive areas or those containing poisonous plants.

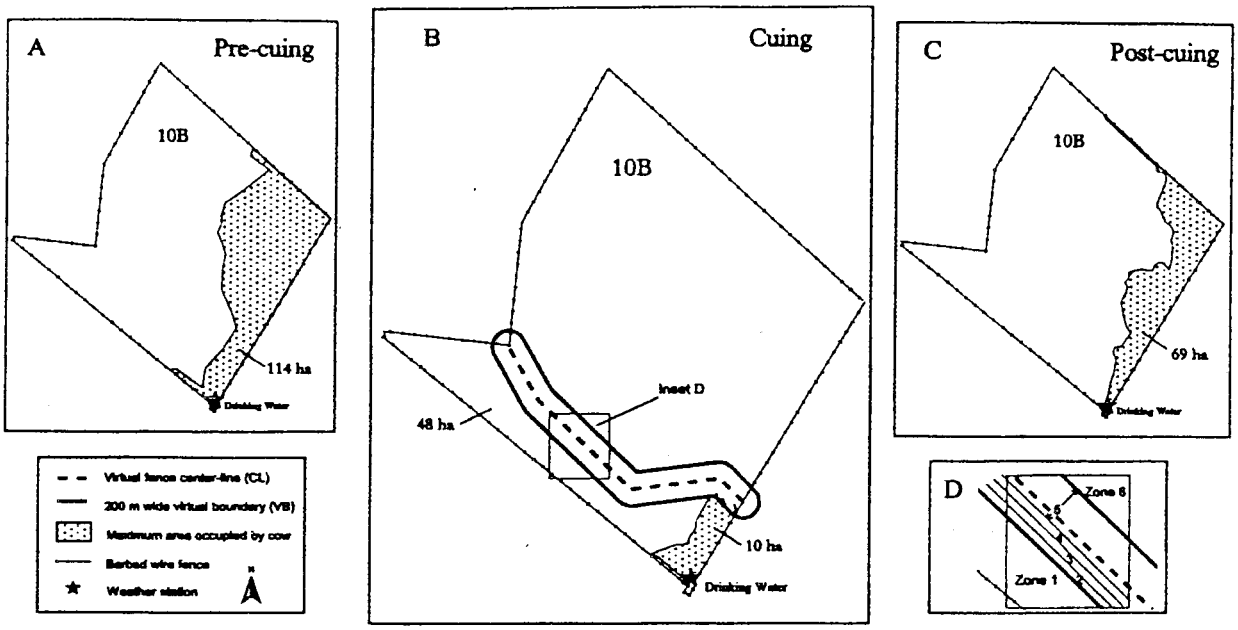


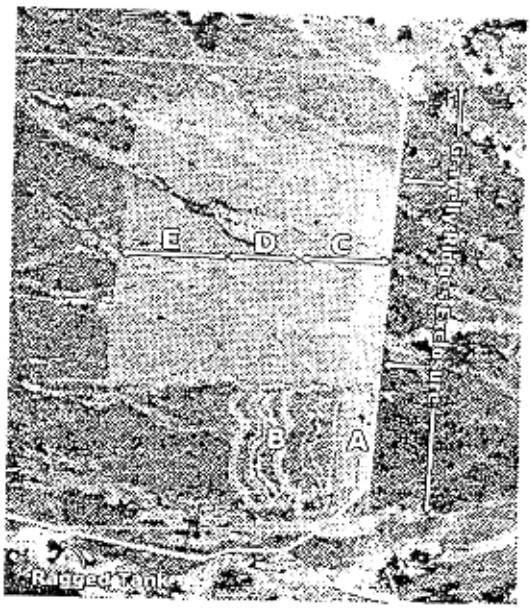
Figure 2. Evaluation of a solar powered virtual fencing device with bilateral cuing for controlling animal movement in a 1152 acre pasture. One cow used a maximum area of 282 acres (A) in the absence of cues, a maximum of 25 acres (B) during activation of autonomously applied cues and a maximum of 171 acres (C) after cues had been eliminated for three days. Animal location was recorded using GPS for 46 hr (A), 127 hr (B), and 72 hr (C). Algorithms in the central processor used GPS data to determine at what location and to which side of the animal the sound and electric shock cues were to be applied. Cues were only applied when the animal penetrated into one of four zones inside the VB (D). Intensity of cues increased as the cow approached the center line from Zone 1. The cow always moved out of the VB and back into Zone 1 before encountering the maximum cuing intensity (Zone 5) surrounding the center line (B).

Role of Phytochemistry in Diet Selection by Livestock on Arid Rangelands: Desertified rangelands generally translate to reduced forage for livestock, even though woody species are often high in protein and other nutrients. Shrubs are often defended by secondary compounds that cause them to be unpalatable. Using tarbush as a shrub model, we found that livestock exhibited differential use when forced to consume tarbush, and preferred plants contained less epicuticular wax. Removal of surface compounds with organic solvents increased tarbush intake by lambs, and crude extracts isolated from tarbush with three organic solvents all dramatically decreased intake when applied to alfalfa pellets. We conducted a series of experiments to determine which specific chemicals control intake. Each chemical was applied to alfalfa pellets at five treatment concentrations (0, .5, 1, 2 and 10X, with X being the concentration of that chemical on the leaf surface of tarbush). Intake of treated pellets by lambs during a 20 minute interval was monitored daily (9 lambs per treatment, 5 days per experiment). Four of the 15 volatile compounds examined to date reduced intake when tested individually (camphor, alpha-pinene, caryophyllene oxide, and camphene). This information will be used to design experiments searching for mechanisms to alter intake and selectivity of foraging ruminants.

Carbon Sequestration in a Desert Grassland: The chemistry of the earth's atmosphere is changing and increased levels of CO_2 in the atmosphere impact the earth's climate. As scientists

and policy-makers struggle to understand the complex global carbon system, it has become apparent that a better understanding of regional-scale carbon dynamics is much needed. Fundamental questions regarding carbon storage and cycling in arid ecosystems remain unanswered and the size of existing carbon pools and the potential for future storage are unknown. A project has been initiated to measure carbon storage in plants and soils of arid grasslands and shrublands in New Mexico. Building on a history of biogeochemistry research conducted in the Jornada basin, the project will identify and quantify how carbon storage might change naturally over time, or be enhanced by informed management practices. The research approach combines direct field measurement of CO_2 fluxes using Bowen Ratio systems, improved analytical approaches to soil carbon assessment, development of new models for soil inorganic carbon (caliche), and landscape-level computer simulation modeling. Initial results support the hypothesis that improved rangeland management increases the amount of carbon stored in grassland soils. Additionally, rangelands may serve as a significant long-term repository for carbon when shrubs store large amounts of carbon belowground in their extensive woody root systems.

Using Aerial Photography to Reconstruct the Remediation Treatment History of Rangeland: Many remediation treatments have been implemented on rangelands during the last 100 years in an effort to slow shrub invasion of desert grasslands. Over time, land management agencies have been disbanded or reorganized and paper records have been lost resulting in poor documentation of type and extent of treatment, methods used, and evaluations of success. Nationwide aerial photography begun by USDA in the early 1930's and continued by USDA and other agencies (USGS, BLM, NASA) is a valuable source of information for establishing past management histories and vegetation response to treatments on rangelands. Combining aerial photography and remaining conventional records with present day field measurements greatly increases the total information content of the rangeland management history with significant ramifications for deciding on the most effective remediation approaches to use today. A number of treatments imposed on the Jornada during early research projects are still evident in aerial photographs today. A few examples of these treatments imposed years ago that appear in photos in the Jornada Basin Aerial Photo Data Base are shown in Figure 3.



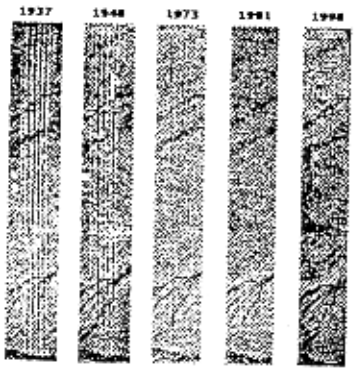


Figure 3a. Surface disturbance pattern of an arid land seeder on the JER, as shown on a 1998 aerial photograph. Area A was rootplowed prior to 1972, areas B and C between 1975 and 1977, and areas D and E between 1977 and 1980.

Figure 3b. Water ponding dikes in a 1994 aerial photograph on the JER, revealing a positive response to a treatment applied in 1975.

Figure 3c. Sequential aerial photographs (1937 through 1998) of a shrub removal treatment imposed in 1936 on the CDRRC. Shrubs (predominantly creosotebush) were manually removed in alternating grubbed and nongrubbed strips.