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# Effect of Grazing Prairie Dog–Colonized Rangeland on Cattle Nutrition and Performance: A Progress Report

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## On the Ground

- One objective of the ongoing Renewal on Standing Rock Reservation project is to evaluate the response of grazing steers to the level of prairie dog colonization on Northern Mixed Grass Prairie.
- We fenced four pastures to create an increasing gradient of a proportion of the pasture area colonized by prairie dogs. Pastures are stocked with yearling steers during each growing season.
- Comparing steer performance, Global Positioning System (GPS) locations of grazing, diet samples, and ingestive behavior at each proportion of the prairie dog colony per pasture allows prediction of the optimal proportion of colonization, which enables selection of the most balanced diet for cattle to meet performance goals.
- Additionally, it will allow recommendation of management options for any given level of prairie dog colonization to optimize cattle nutrient intake.

**Keywords:** beef cattle, grazing, prairie dogs, diet quality, forage intake, Global Positioning System.

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Beef cattle production from rangelands occupied by prairie dogs plays an important role in local food availability. In particular, potential influences of prairie dog colonization of rangelands can have a dramatic impact on local food availability and accessibility for Native American communities in the Northern Great Plains and other regions inhabited by prairie dogs. This model is similar to those in other regions of the world, where grazing-based livestock production may be impacted by indigenous populations of non-game wildlife that fills a niche similar to that of the prairie dog. Prairie dog colonization may have either negative or positive influences on grazing livestock productivity. Steer gains declined over time as prairie dog colonies expanded in shortgrass steppe pastures in Colorado.[1] However, the decline in the rate of steer gain was less than the rate of colony expansion.[1] Because prairie dogs keep vegetation clipped short to allow visual detection of predators, forage species growing on colonies are maintained in an immature vegetative state with high nutrient concentration, albeit in limited availability. We hypothesized that this may facilitate nutrient intake by grazing livestock. Overall nutrient intake and the balance of nutrients ingested may be improved if livestock are allowed to selectively mix their diets from immature and mature forages within a pasture on and off prairie dog colonies, respectively. Alternatively, dry matter intake by livestock will be limited to the point that dietary quality is inconsequential if the prairie dog colony occupies a large proportion of the pasture and severely limits forage availability. We are investigating the influence of the proportion of the pasture occupied by prairie dogs on livestock landscape and forage utilization patterns. This information, coupled with evaluation of prairie dog and bird population responses, can improve opportunities to manage prairie dog colony size and grazing management to optimize rangeland health, prairie dog population size, habitat for birds, livestock production, and food accessibility for local human communities.

The "Renewal on Standing Rock Reservation" project was initiated in 2011 based on funding from the US Department of Agriculture's Agriculture and Food Research Initiative (grant 2011-68004-30052). The overall objective of the Standing Rock project is to improve food availability for the

**Table 1. Grazing design for treatment pastures with increasing proportion of pasture occupied by prairie dogs.**

| Prairie dog (%) | Area (acres) | Head (No.) | Stocking rate (acres/AUM)* |
|---|---|---|---|
| 0 | 503 | 75 | 1.97 |
| 18 | 477 | 55 | 2.55 |
| 40 | 510 | 45 | 3.32 |
| 75 | 513 | 17 | 8.88 |

AUM indicates Animal Unit Month.

***Stocking rate calculated based on mean steer body weight of 787 pounds and mean grazing season length of 4.33 months.**

members of the Standing Rock Sioux tribe in a culturally sensitive manner through concomitant improvement in rangeland health, wildlife habitat, beef cattle enterprise development, and beef production for local consumption. The objective of the grazing livestock research component of the project was to evaluate yearling steer responses to the impact of the spatial proportion of native rangeland pastures colonized by prairie dogs. To fulfill this objective, we measured landscape utilization patterns (particularly proportion of time spent and activities on vs off prairie dog colonies), grazing behavior, nutrient intake, and performance by grazing yearling steers in response to the proportion of the pasture occupied by prairie dogs. This article provides a report of progress, to date, toward fulfilling this objective and is intended to provide a context relative to the other articles in this special issue of *Rangelands* about the "Renewal on Standing Rock Reservation" project.

## Cattle and Rangeland Management Approach[i]

Four pastures of about 500 acres each were established, with a gradient of proportions occupied by prairie dog colonies (0–75%; Table 1). Boundaries of the area occupied by prairie dogs were mapped by using a handheld Global Positioning System (GPS) unit. The control pasture did not have any prairie dog colonization and has been maintained in that state through the project. The other pastures were fenced to contain initial proportions of 18%, 40%, and 75% of the area of each pasture colonized. Pasture boundaries were delineated to include similar proportions of relevant landscape features, such as ecologic sites, soil types, and topography.

Yearling steers have grazed the pastures from early June to late October during each year of the project. Pastures have been stocked to similar grazing pressure (animal unit month [AUM] of forage demand divided by amount of available forage) based on the proportion of pasture occupied by prairie dogs. Grazing pressure was calculated by using expected forage availability on and off prairie dog colonies, as determined from clipping studies on similar prairie dog–colonized rangelands in western South Dakota.[2,3] As the proportion of prairie dog colonization increased, the number of AUM allocated per acre decreased in direct proportion to the anticipated reduction in forage availability. We chose to stock at similar grazing pressure to evaluate responses, without differing grazing pressure influencing landscape utilization and diet selection. In future research, we intend to evaluate the same response when the stocking rate is similar across pastures, yielding increasing grazing pressure as prairie dog colonization increases.

## Where Do Steers Graze?

A subset of steers in each pasture has been fitted with collars containing GPS devices to record the locations of cattle through each grazing season. GPS locations have been loaded into a Geographic Information System (GIS) map layer along with layers that map important landscape features (boundaries of prairie dog colonies, fences, ecologic sites, water locations, etc.; Figure 1). A subset of GPS collars contains switches to indicate activity by steers, which allows us to estimate time spent by steers in grazing and other activities (e.g., traveling, resting) per day. We are evaluating the relationships between the patterns of spatial use by cattle and landscape features, particularly the proportion of grazing that occurs on prairie dog colonies.

## What Do Steers Eat?

Ruminally fistulated steers graze with resident herds and are used to collect diet samples by using the rumen evacuation technique.[4,5] Temporary enclosures are constructed by using electric fencing for collecting samples from representative areas on and off prairie dog colonies in each pasture to evaluate nutrient concentrations in cattle diets. Two locations on the colonies are sampled: 1) the core of the colony dominated by

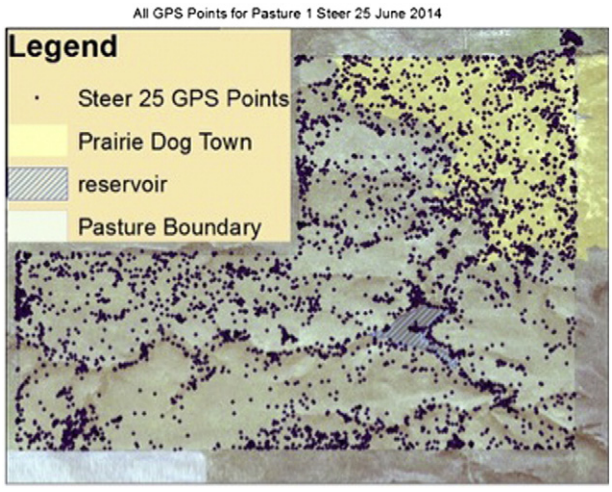


**Figure 1.** Map of Global Positioning System (GPS) locations for a steer throughout June 2014 in the pasture that had 18% of the area colonized by prairie dogs.

[i] All livestock research is being conducted with the approval of the South Dakota State University and the North Dakota State University Institutional Animal Care and Use Committees, in accordance with their guidelines.

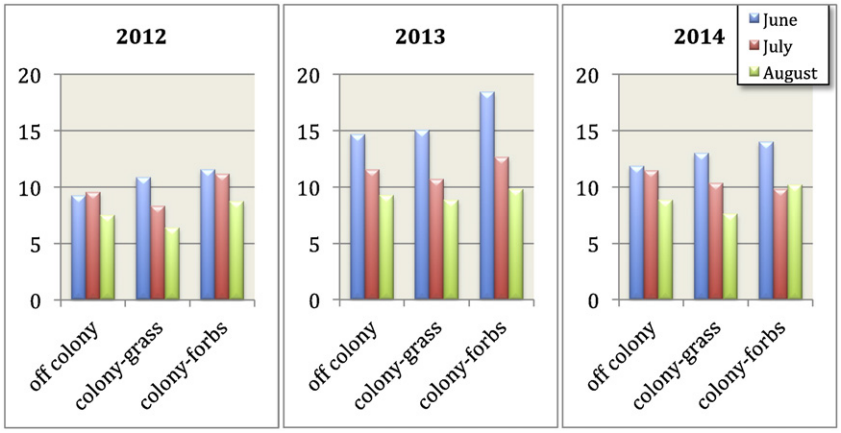


**Figure 2.** Crude protein percentage in diet samples collected by using ruminally fistulated steers at monthly sampling intervals within each year of sampling (2012 to 2014). Off-colony refers to sampling in areas not occupied by prairie dogs; colony-grass refers to sampling in areas colonized by prairie dogs with vegetation dominated by perennial grasses clipped short by prairie dogs; and colony-forbs refers to areas on prairie dog colonies with vegetation dominated by annual forb species.

annual forbs and 2) the portion of the colony dominated by perennial grass species, which are clipped short by the prairie dogs. Off-colony locations are also dominated by grass species. Sampling is conducted on a monthly interval throughout each grazing season. Diet samples are being analyzed for crude protein, detergent fiber fractions, and in vitro digestibility. Figure 2 provides an example of a preliminary assessment of the crude protein content of diet samples (diet sampling is ongoing as the project progresses). As expected, diet nutritional value declines as plants mature in all locations and years. The crude protein content of diets collected on annual forb-dominated prairie dog colony locations is consistently higher compared with that on grass-dominated locations, both on and off colony. Crude protein in steer diets was lower in 2012 than in subsequent years, likely because of the severe drought in 2012 and improved precipitation in 2013 and 2014.

## How Much Do Steers Eat?

Forage harvested by each fistulated steer is being weighed, and time spent grazing during each diet sample collection period is recorded to calculate the ingestion rate (amount of dry matter consumed per minute). Forage intake will be calculated as ingestion rate × daily grazing time = daily forage dry matter intake.[6] For this equation, grazing time will be estimated on the basis of activity switches in GPS collars. Dietary nutrient content variables will be multiplied by forage intake to calculate nutrient intakes. Forage and nutrient intakes will be calculated separately for on-colony and off-colony utilization so that total intake and proportion of forage and nutrient intakes attributable to on-colony versus off-colony grazing can be calculated. Ultimately, combining location of grazing activity based on GPS locations with diet quality and rate of intake from on-colony and off-colony locations will allow us to test our hypothesis

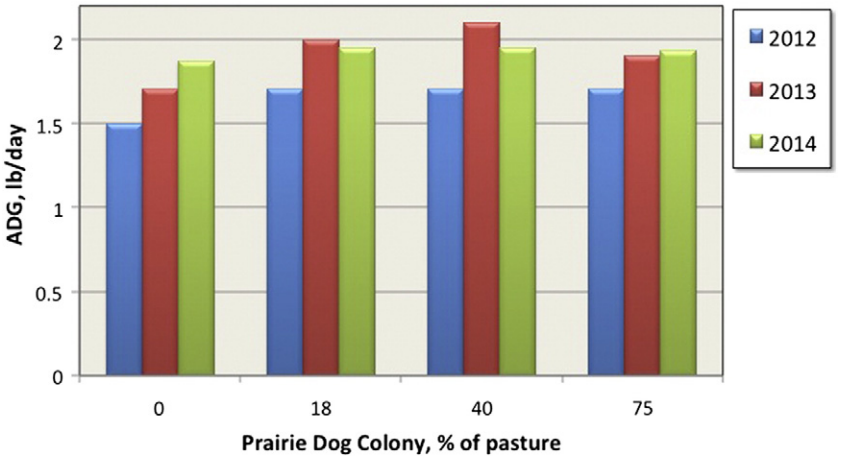


**Figure 3.** Average daily gain by steers in pastures with increasing proportions of the pasture colonized by prairie dogs during each of the 3 years of study.

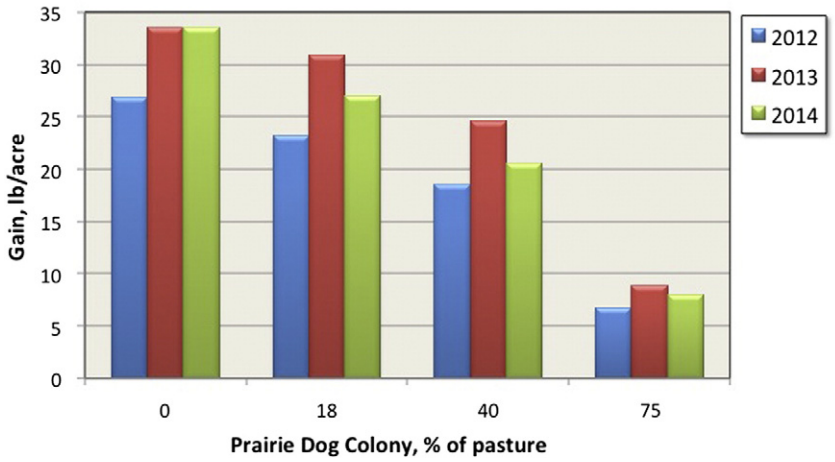


**Figure 4.** Steer production (gain per acre) in pastures with increasing proportions of the pasture colonized by prairie dogs during each of the 3 years of study.

that cattle can improve overall nutrient intake by mixing diets from different plant communities created by prairie dog colonization.

## How Do Steers Perform?

Steers are being weighed at the beginning, midpoint, and the end of each grazing season to calculate individual animal performance (ADG) and production (kg/ha). Preliminary results for ADG and production per acre are presented in Figures 3 and 4. Average daily gain has been similar across all levels of prairie dog colonization. This is reflective of our stocking goal of providing equal grazing pressure (kilogram of forage availability per AUM). Reducing stocking rate to maintain similar grazing pressure appears to allow steers the opportunity to graze selectively at a level that maintains diet quality. However, because of the reduction in stocking rate necessary to allow equal grazing pressure as prairie dog colonization increases, the level of production (steer gain per unit of land) has decreased dramatically as prairie dog colonization has increased, as should be expected. In other words, individual steer performance can be maintained as prairie dog colonization expands, but it requires appropriate reductions in stocking rate. The economic viability of a beef cattle enterprise would depend on an appropriate balance of individual performance and production per unit of land.[7] Further evaluation of our complete data set will allow us to derive the balance of colonized versus un-colonized rangeland to achieve optimal economic balance of animal performance and stocking rate.

## Expected Outcomes of Research in Progress

This article provides a report of progress on grazing cattle research associated with the "Renewal on Standing Rock Reservation" project, which is the focus of this issue of *Rangelands*. The purpose of this research on grazing cattle response is to answer the following questions:

- Is there an optimal level of prairie dog colonization that promotes cattle nutrition and performance? In other words, is there a balance between high-quality but limited amount of forage from prairie dog colonies and high forage availability of lesser quality from areas not colonized by prairie dogs?
- What are the best management practices at any given level of colonization? Although an optimal proportion of pasture colonized by prairie dogs may exist, what is the best management for pastures with differing proportions of colonized areas?
- What will happen when pastures are stocked equal, rather than proportionate to available forage? Pastures are commonly stocked the same irrespective of level of prairie dog colonization. This changes the impact of livestock grazing, in combination with prairie dog colonization, on rangeland plant community composition, productivity, and health, resulting in altered availability of forage nutrients for livestock. Evaluating the same responses described above under equal stocking rates will be an important future experiment.

The ultimate long-term impact of the project will be the development of an ecologically sustainable food production system to improve availability and access to nutritious food for Native American peoples.

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