Effects of Prairie Dogs and Cattle on Vegetation Disappearance on Prairie Dog Towns in Mixed-Grass Prairie

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Abstract

Quantitative data is lacking on competition between prairie dogs and cattle for forage on mixed-grass prairie pastures. The objective of this study was to determine the disappearance of vegetation attributable to cattle and prairie dogs on pastures with prairie dog towns. During the summers of 2002 and 2003, biomass estimates were made periodically on three mixed-grass prairie pastures in south central South Dakota that had varying degrees of prairie dog town coverage (percent of pasture area). Two types of grazing exclosures were established. Cattle exclosures allowed grazing by prairie dogs only. Cattle/prairie dog exclosures excluded both herbivores. Permanent plots outside cages were established that allowed grazing by both species. Biomass estimates on individual vegetation species were obtained both inside the exclosures and on permanent plots outside the exclosures two times in 2002 and 2003. Forage removed was estimated and compared for cattle alone, prairie dogs alone, and cattle and prairie dogs together in each year. Forage removed by prairie dogs on the on-town sites was nearly three times as great as forage removed by cattle on the on-town sites for the June and July sampling periods. Cattle removed two times more forage on off-town sites than on on-town sites. Total forage removed on on-town sites (cattle + prairie dogs) was almost two times greater than on off-town sites. Livestock forage was significantly reduced on prairie dog towns compared to unoccupied sites. Classic carrying capacity calculations overestimate forage availability when prairie dog towns are present. Stocking rates on pastures with prairie dog towns should be adjusted to account for forage disappearance due to prairie dogs.

Introduction

The black-tailed prairie dog (*Cynomys ludovicianus* Ord) is a native rodent found throughout the shortgrass and mixed-grass prairies of North America. Presence of prairie dog towns and their effect on forage availability for large ungulates, such as cattle, has been very controversial. Ranchers contend that prairie dogs severely reduce forage available to their livestock, increase weeds, and increase erosion, while other groups claim that a variety of studies suggest that prairie dogs have a beneficial or neutral effect on livestock (e.g. National Wildlife Federation, 1998). It is known that prairie dogs clip vegetation in addition to what they eat in order to see predators. Laboratory studies have revealed how much prairie dogs eat, yet little work has been done to quantify total disappearance of vegetation attributed to prairie dogs. Level of competition between cattle and prairie dogs is another area of concern. Cattle and prairie dogs have similar diets, which consist of approximately 87% graminoids (Uresk, 1984; Uresk, 1986) suggesting considerable overlap and competition between the two herbivores. Competition between cattle and prairie dogs may create a problem when stocking cattle on pastures supporting prairie dog towns. The objective of this study was to determine the difference in disappearance of vegetation due to cattle and prairie dogs on pastures with prairie dog towns.

Materials and Methods

Research was conducted in south central South Dakota on mixed-grass prairie rangelands approximately 25 miles west of Mission. Climate of the region is continental and semiarid with hot summers and cold winters. Annual precipitation averages approximately 19 inches near Mission, SD (NOAA, 2000), and over half of the yearly

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precipitation falls during the growing season. Soils in the study area are predominantly silts and loams (USDA SCS, 1974). Vegetation is typical of the mixed-grass prairie, with a variety of warm- and cool-season species. Common grass species in the area include western wheatgrass (*Pascopyrum smithii* [Rydb.] A. Love), little bluestem (*Schizachyrium scoparium* (Michx.) Nash), needleandthread (*Stipa comata* Trin. & Rupr.), prairie sandreed (*Calamovilfa longifolia* [Hook.] Scribn.), blue grama (*Bouteloua gracilis* (H.B.K.) Lag. Ex Griffiths) and buffalograss (*Buchloe dactyloides* [Nutt.] Engelm.).

Three mixed-grass prairie pastures grazed by cattle with varying degrees of prairie dog town coverage (percent of pasture area) were used. Data collection took place on the three pastures during the summers of 2002 and 2003. Vegetation samples were collected during two sampling periods in each year: late spring (June) and mid-summer (July) in an effort to adequately sample both the cool- and warm-season species common to the region. Two sites were selected on each study pasture. One site was the prairie dog town (on-town site). The second site (off-town site) was near the prairie dog town but had no prairie dog activity. Off-town sites were chosen based on similarity of soils with their paired on-town site. Soils on all on-town and off-town sites were evaluated by a Natural Resources Conservation Service soil scientist prior to final selection.

It was important to this study that the soils were matched within each pair of on- and off-town sites, because sites with the same soils have potential for production of similar quantity and composition of vegetation. Differences in species and/or production can then be more closely tied to differences in use. On-town sites in this study were dominated by annual grasses and forbs as well as by the shorter perennial grasses including blue grama, buffalograss, and sedge (*Carex)* species (grouped as shortgrasses), and red threeawn (*Aristida pupurea* Nutt). Off-town sites were dominated by perennial forbs and grasses including the shortgrasses, needleandthread and prairie sandreed.

Three types of plots were used in this study: 1) uncaged plots open to grazing by both prairie dogs and cattle (NONE EXCL), 2) plots fenced/caged so as to exclude cattle but allow use by prairie dogs (CATTLE EXCL), and 3) plots covered by cages which excluded both prairie dogs and cattle (ALL EXCL). All plots were 0.30 yd^2.

Forty NONE EXCL plots were established on each prairie dog town and 20 on each off-town site. These plots were “permanent”, that is, the same plots were used for all sampling periods in both years. To avoid marking these plots with stakes or flags which would attract herbivores to them, we obtained a GPS location for each, marked the corners of each plot with metal stakes driven into the ground, and then used those coordinates and stakes to relocate each plot at each sample date.

Ten CATTLE EXCL plots were established on each prairie dog town. These were fenced by creating an exclosure with barbed wire and fence posts to ensure availability to prairie dogs (we were concerned prairie dogs might not go into exclusion cages, even though the wire mesh would have permitted their entry). Another 10 CATTLE EXCL plots were established on each off-town site. These were covered with an exclusion cage constructed with a large mesh wire over a metal frame.

Ten ALL EXCL plots were established on each prairie dog town; none were established on the off-town sites since these sites were not utilized by prairie dogs. The ALL EXCL plots were covered with an exclusion cage constructed of chicken wire mesh over a metal frame to prevent access by prairie dogs and cattle.

At the end of each 3-week sampling period (one in June of each year and one in July of each year), biomass was estimated by species on all plots. Estimates for aboveground biomass by species were obtained using two methods. For all plots in 2002, all NONE EXCL plots in 2003, and the on-town CATTLE EXCL plots in 2003, double sampling methods appropriate for each species were used, including the use of cover, reference units (Andrew et al, 1979, 1981), and plant volume (Johnson et al., 1988) as estimators. In 2003, all plots underneath movable cages (off-town CATTLE EXCL plots and ALL EXCL plots) were clipped and sorted by species. Biomass estimations were made for individual species with the exception of two groups which were lumped together: blue grama, buffalograss, and sedge species were grouped together as shortgrasses and downy

brome and Japanese brome were grouped as annual brome.

Differences between ALL EXCL plots and the CATTLE EXCL plots on towns provide an estimate of forage disappearance (destruction + consumption) due to prairie dogs. Differences between ALL EXCL plots and NONE EXCL plots provide an estimate of total disappearance by all herbivores. By subtracting disappearance due to prairie dogs from total disappearance, disappearance due to large herbivores was estimated for on-town sites. For off-town sites, differences between CATTLE EXCL plots and NONE EXCL plots provide an estimate of forage disappearance due to cattle in areas not grazed by prairie dogs.

The experimental design for this study was a randomized complete block design (pastures were blocks) with three factors: year, season, and grazing treatment (prairie dogs on-town, cattle on-town, and cattle off-town). The dependent variable was forage disappearance. Analysis of variance was used to test the effects of grazing treatment, year, and year $\times$ grazing treatment on forage disappearance. Year and year $\times$ grazing treatment effects were analyzed with repeated measures using PROC MIXED with AR(1) covariance model structure. Treatment mean differences were separated using the LSMEANS statement with the PDIFF option in PROC MIXED.

Results and Discussion

Our study clearly demonstrates that prairie dogs are highly competitive with cattle, reducing the amount of forage available for livestock consumption throughout the growing season. Forage removed by prairie dogs on the on-town sites was nearly three times as great as forage removed by cattle on the on-town sites during the June sampling period (Table 1). Surprisingly, the apparently greater amount of forage removed by cattle on the off-town sites, compared with forage removed by cattle on the on-town sites in June was not different, likely due to large variation during that sampling period. Additionally, prairie dogs on the on-town sites removed a similar amount of forage as cattle did on the off-town sites.

During the July sampling period, forage removed by prairie dogs on the on-town sites was approximately three times greater than forage removed by cattle on the on-town sites (Table 1). Forage removed by cattle on the off-town sites was more than two times greater than forage removed by cattle on the on-town sites. This may indicate that the forage on a prairie dog town is less accessible and/or desirable to cattle than forage on similar off-town sites. Prairie dogs also removed a similar amount of forage on on-town sites compared to cattle on off-town sites.

For the combined periods of June and July, prairie dogs removed nearly three times more forage than cattle did on prairie dog towns, indicating a significant level of competition for forage between cattle and prairie dogs (Table 1). Forage removed by cattle on the off-town sites was more than two times greater than forage they removed on the on-town sites. The greater forage disappearance during these two grazing periods due to prairie dogs versus forage disappearance due to cattle on on-town sites demonstrates that prairie dogs can significantly reduce the quantity of forage that is available to cattle.

Total forage removed in the combined sampling periods on on-town sites (cattle + prairie dogs) was nearly twice as great as forage removed on the off-town sites (Table 2). This level of forage removal on prairie dog towns greatly decreases the likelihood that the on-town plant community will shift species composition toward a more desirable plant community for livestock production.

Less forage was removed by cattle on on-town sites than on off-town sites in this study. One explanation is that long-term prairie dog activity has shifted the species composition of on-town sites. Undesirable livestock forage species represented approximately 69% of the forage biomass (Table 3). Red threeawn and annual brome made up 50% of the vegetation on prairie dog towns, and are not desirable livestock forage species due to their short duration of growth and early maturity. However, on off-town sites, species desirable for livestock forage made up 84% of the forage biomass. A second explanation is that defensive clipping activity by prairie dogs during the growing season reduces the height of all vegetation thereby limiting accessibility by cattle. For these reasons, livestock are able to utilize less forage on on-town sites and the total amount of forage available in the pasture is reduced.

Implications

Our study clearly indicates that prairie dog towns reduce forage available to cattle. In this study, prairie dog town sites provided only half the forage to livestock as did similar sites without prairie dogs. Both a shift in composition toward less desirable plant species and a reduction in accessibility due to clipping likely contribute to reduced forage availability.

Traditional carrying capacity calculations are based on vegetation seral stage, which is primarily quantified using species composition. While such calculations would indicate a reduction in carrying capacity for prairie dog town areas, the result would still be an overestimate. Further adjustments must be made to account for the forage being removed by prairie dogs. Prairie dogs on cattle pastures should be treated in a similar fashion to other herbivores such as elk or insects that compete with cattle for forage. Without this adjustment, the risk of overgrazing the pasture, both on- and off-town, exists.

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Tables

Table 1. Least square means forage disappearance (lbs/acre) by grazing treatment for June, July, and combined sampling periods from the summers of 2002 and 2003 in south central South Dakota

Sampling Period	Grazing Treatment			SEM[4]
	Prairie Dog	Cattle On-town	Cattle Off-town	
June[1]	460[a]	160[b]	330[ab]	116
July[2]	320[a]	110[b]	260[a]	43
Combined[3]	760[a]	230[b]	520[a]	121

[1] Means followed by different letter within the June period are different $P < 0.10$.
[2] Means followed by different letter within the July period are different $P < 0.05$.
[3] Means followed by different letter within the combined periods are different $P < 0.10$.
[4] Standard error of the mean.

Table 2. Least square means forage disappearance (lbs/acre) by prairie dogs and cattle on-town versus cattle off-town for June, July, and combined sampling periods from the summers of 2002 and 2003 in south central South Dakota

Sampling period	On-town	Off-town	SEM[1]	P-value
June	620	330	167	0.28
July	430	260	20	0.02
Combined	990	520	156	0.10

[1] Standard error of the mean.

Table 3. Species composition (%) by estimated dry weight found on study sites in the summers of 2002 and 2003 in south central South Dakota

Livestock Preference	Scientific name	Common name	On-town	Off-town
Desirable	*Pascopyrum smithii*	Western wheatgrass	7	5
	Bouteloua gracilis *Buchloe dactyloides* *Carex* spp.	Blue grama Buffalograss Sedge species	17	48
	Stipa comata	Needleandthread	1	12
	Calamovilfa longifolia	Prairie sandreed	<1	9
	Poa pratensis	Kentucky bluegrass	<1	6
	Schizachyrium scoparium	Little bluestem	2	1
	Other species		4	3
Undesirable	*Aristida purpurea*	Red threeawn	27	0
	Bromus tectorum	Annual brome	23	4
	Dichanthelium oligosanthes	Scribner panicgrass	2	2
	Verbena bracteata	Prostrate vervain	2	<1
	Lappula occidentalis	Stickseed	2	<1
	Other species		13	10