Vegetation Changes Induced by Prairie Dogs on Shortgrass Range

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Highlight: *This study documented some effects of prairie dogs on a shortgrass type of the Central Plains Experimental Range approximately 35 miles northeast of Fort Collins, Colo., and an adjacent area. Prairie dogs changed the plant species composition of the two sites studied, but these changes were not all detrimental. Species diversity was greater and some plant species used by livestock were more abundant inside than outside the prairie dog towns.*

The black-tailed prairie dog (*Cynomys ludovicianus*) is characteristically an inhabitant of the mixed-grass prairie region of the United States. It originally inhabited an area extending from southern Canada to Mexico, bounded on the west by the Rocky Mountains and on the east by the tall-grass prairie. The prairie dog population on the western prairies during the 1870's was estimated to be five billion. Their barking and comic antics were a curiosity to early western travelers. However, as the prairies were settled and domestic livestock populations increased, prairie dogs became a destructive rangeland pest rather than an interesting curiosity. Widespread extermination campaigns were conducted because of both real and imagined damage to rangelands. These campaigns were so successful that prairie dogs apparently now number only a small fraction of what they did a century ago.

Koford (1958) found that during the winter prairie dogs fed mostly on available green plants, roots, and basal parts of buffalograss (*Buchloe dactyloides*). Green grasses and forbs, particularly Russian thistle (*Salsola kali*), scarlet globemallow (*Sphaeralcea coccinea*), and fireweed summercypress (*Kochia scoparia*), were favored for consumption during the spring and summer. Scarlet globemallow, bases of grasses, and seeds were preferred in the fall. Koford (1958) considered western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), buffalograss, and Russian thistle to be the most important prairie dog foods. Kelso (1939) found that prairie dog stomach material contained western wheatgrass, sixweeks fescue (*Vulpia octoflora*), Russian thistle, plains pricklypear (*Opuntia polyacantha*), and saltbush (*Atriplex* spp.).

Koford (1958) reported that prairie dogs affected the forage crop directly by removing part of it each year and indirectly through long-term influence on certain plant species. The seed crop of plants such as Russian thistle, western wheatgrass, and blue grama, was decreased through early spring clipping by the animals. However, such clipping apparently did not have a significant detrimental effect on plants that were capable of reproducing by rhizomes and stolons. Hence, the grazing and clipping action of prairie dogs resulted in a selective favoring of plants such as buffalograss. Prairie dog clipping was observed to decrease the proportions of annual grasses and forbs and to increase perennial grasses. Furthermore, it was noted that tall perennial plants were affected more than were shorter ones, because a greater proportion of photosynthetic tissue was lost through clipping. Therefore, prairie dog grazing pressure appeared to favor an increase in blue grama and buffalograss and a decrease in western wheatgrass. Koford (1958) then suggested that western wheatgrass was the first major grass to disappear from a prairie dog town in a mixed-grass prairie, but that the increase in forbs could have been caused by factors other than prairie dogs.

Two questions must be asked concerning prairie dogs and rangelands. First, are prairie dogs really destructive rangeland pests? Second, if so, then to what extent do they alter botanical composition? In an attempt to answer these questions, the vegetation of two areas where prairie dogs were present was compared to the vegetation of adjacent areas not occupied by prairie dogs. Both areas have been grazed by cattle for many years. The vegetation of the area is a native shortgrass type dominated by blue grama. Buffalograss, western wheatgrass, Indian ricegrass (*Oryzopsis hymenoides*), and needleandthread (*Stipa comata*) are major grass associates and the most common forbs are scarlet globemallow, tansyleaf aster (*Aster tanacetifolius*), stickseed (*Lappula* spp.), and woolly plantain (*Plantago patagonica*).

The dominant vegetation of the two study sites was typical of that of the general area. Blue grama, buffalograss, needleleaf sedge (*Carex eleocharis*), and scarlet globemallow are the most common species on both sites. The most abundant forbs are tansyleaf aster, little stickseed (*Cryptantha minima*), bluebur stickseed (*Lappula redowskii*), woolly plantain, prairie pepperweed (*Lepidium densiflorum*), and bigbract verbena (*Verbena bracteata*).

Methods

Vegetation characteristics were studied in two prairie dog towns and in adjacent areas outside each town. One site was located 2 miles north of Nunn, Colo., and the other site was located on the Central Plains Experimental Range (CPER) 2 miles north of the Nunn site. Data were collected on vegetation, soil, and prairie dog diet characteristics during the summer of 1973.

Line transects located 10 m apart crossed each town and extended into adjacent areas. Quadrats, 20 × 50 cm, placed at 5-m intervals along these transects, were used to obtain the total ground cover for each species. Fifteen transects were used at the Nunn site and ten at the CPER site. A total of 583 quadrats were sampled at each of four dates for the Nunn site;

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402 quadrats were sampled at the CPER site. Vegetation cover estimates were obtained in early May, late June, mid-August, and mid-September of 1973. Cover estimates for individual species were made according to Daubenmire's cover classes (Daubenmire, 1970) as follows: 1 = 1 to 5%; 2 = 6 to 25%; 3 = 26 to 50%; 4 = 51 to 75%; 5 = 76 to 95%; and 6 = 96 to 100% for each quadrat. Each quadrat estimate for each species was converted to its mid-class value for statistical analyses. A test for statistical significance was based on a probability value of 0.05.

Fresh fecal samples from prairie dogs were collected from around burrow openings at each vegetation sampling date. A microscopic technique (Dusi, 1949; Storr, 1968; Todd and Hansen, 1971; Hansen et al., 1973) was used to identify plant fragments found in the fecal samples. This information was used to interpret vegetation characteristics.

Soil texture varied within the towns. Sandy loam soils were common, with an occasional loamy sand occurring at the edges of the towns. A sandy clay loam was the most common texture found in the center of the towns, where runoff water from adjacent slopes accumulated.

Results and Discussion

Frequent snows during the winter of 1973 provided soil water conditions favorable for plant growth in early May. However, precipitation during May and June was below normal and the vegetation was in a state of drought-induced dormancy by the end of June. This dry, hot period was followed by a cool, wet period during July and August.

Several annual plant species were in the soft seed stage, and the warm-season perennial grasses initiated growth during May. Some perennial grass species were in drought-induced dormancy in June, and some of the annual species had set seed. The favorable weather conditions during July and August induced germination and growth of annual species, while perennial grasses broke dormancy and completed their reproductive cycle.

Number of Plant Species

Significantly fewer annual than perennial species occurred on both sites (Table 1), and there were more annuals on the Nunn site (21) than there were on the CPER site (5). The number of perennials occurring on the Nunn site (43) was significantly greater than the number occurring on the CPER site (23). The total number of species occurring within the prairie dog towns was greater than in the adjacent areas. Since sampling alone caused variations in number of perennial species enumerated on sampling dates, no attempt was made to determine significant differences in number of annual or perennial species occurring between sampling dates.

Perennial species were more numerous inside the CPER town than outside it. It appears that activities of prairie dogs not only promote an increase in the total number of species

Table 1. Number of annual, perennial, and total number of species present in prairie dog towns (In) and adjacent areas (Out), 1973.

Plant groups	Nunn site										CPER site									
	May		June		Aug.		Sept.		Total		May		June		Aug.		Sept.		Total	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Annual species	14	13	17	16	20	13	20	13	25	21	9	2	4	0	7	2	5	2	19	5
Perennial species	21	21	29	28	26	24	27	27	44	43	22	15	15	11	21	16	21	15	29	23
Total species	35	34	46	44	45	37	47	40	69	64	31	17	19	11	28	18	26	17	48	28

Table 2. Average percent cover provided by the major species on Nunn prairie dog site, 1973.[1] The dash indicates < .01 percent cover.

Species	May		June		August		September	
	In	Out	In	Out	In	Out	In	Out
Grass or grass-like								
Blue grama	9.6	18.0	9.5	15.6	13.2	21.1	16.3	21.9
Buffalograss	3.1	1.4	3.5	1.3	6.5	1.8	7.7	1.3
Needleleaf sedge	0.9	1.0	0.8	1.0	0.8	0.8	0.8	0.7
Red threeawn	0.3	0.2	0.2	0.2	0.6	0.6	0.8	0.5
Sand dropseed	0.0	0.0	0.1	0.1	0.2	0.2	0.5	0.2
Sixweeks fescue	5.6	1.4	1.7	0.3	0.1	0.1	0.1	0.1
Forbs								
Bigbract verbena	0.1	0.0	0.2	0.0	0.5	–	0.5	–
Bluebur stickseed	0.4	0.1	0.3	0.1	0.0	0.0	0.0	0.0
Little stickseed	0.8	0.3	0.7	0.2	–	–	0.1	0.0
Mountain springparsley	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Prairie eveningprimrose	0.8	0.3	0.2	–	0.0	0.0	–	0.0
Prairie fameflower	0.0	0.0	0.2	0.1	0.6	0.3	0.3	0.1
Prairie pepperweed	0.3	0.3	0.3	0.3	0.1	1.0	–	0.0
Ridgeseed spurge	0.0	–	0.0	0.0	0.7	0.3	0.5	0.3
Scarlet globemallow	0.8	0.8	1.1	0.8	1.1	0.7	1.2	0.7
Starlily	0.6	0.6	–	–	0.0	0.0	0.0	0.0
Stemless springparsley	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Tansyleaf aster	0.9	0.3	0.9	0.3	1.6	0.3	1.0	0.3
Woolly plantain	2.4	2.2	2.0	1.3	0.5	0.3	0.6	0.4
Shrubs								
Broom snakeweed	0.1	0.9	0.3	0.7	0.3	0.9	0.2	1.0
Spreading wildbuckwheat	0.1	0.1	0.2	0.2	0.2	0.4	0.2	0.3

[1] In = in prairie dog town; Out = in adjacent area.

Table 3. Average percent cover provided by the major species on CPER prairie dog site, 1973.[1]

Species	May		June		August		September	
	In	Out	In	Out	In	Out	In	Out
Grass or grass-like								
Blue grama	13.4	20.1	16.5	22.3	16.4	24.0	15.8	24.0
Common buffalograss	9.5	6.7	8.5	6.2	10.5	6.0	10.1	5.1
Needleleaf sedge	3.4	3.3	2.4	1.9	2.3	1.8	1.8	1.6
Forbs								
Scarlet globemallow	1.3	1.3	1.3	1.4	1.2	1.3	1.4	1.6

[1] In = in prairie dog town; Out = in adjacent area.

found within the town, but also that they increase the number of both perennial and annual species. This observation supports a general conclusion of Koford (1958) that prairie dog grazing favors a heterogeneous vegetation mixture in the general vicinity of the town.

Ground Cover of Species

Species cover data are reported only for major species occurring on the two study sites (Tables 2 and 3). Blue grama had the highest cover value of all species and was significantly greater outside than it was inside the towns (Figs. 1 and 2). Blue grama cover did not decline inside the towns as the growing season progressed. However, this species was grazed by prairie dogs as indicated by the dietary data. The removal rate did not exceed the growth rate of blue grama, which suggests that prairie dogs do not exert a selective grazing pressure against it.

The cover of buffalograss was consistently greater inside the towns than outside them for all dates for both study sites (Figs. 1 and 2). Its cover inside the town at the Nunn site increased significantly from 3% in May to 8% in September. On the other hand, the change in cover of this species outside this town was not significant during the growing season. The decrease in cover of buffalograss inside the CPER town from the May sampling period throughout the remainder of the season was not significant. Moreover, the difference in cover of this species between the inside and the outside of the latter town was significant during June only (Fig. 2).

Soil differences within the Nunn site undoubtedly accounted for some of the differences in buffalograss cover on that site. That is, buffalograss probably would have a greater cover value in the center of the town without the presence of prairie dogs because of different soil characteristics and the accumulation of run-off water.

Sixweeks fescue was abundant at the Nunn site, and its cover value was significantly greater inside the town than outside it during May. The occurrence of this species may have been greater because of prairie dog activities. Yet, the species

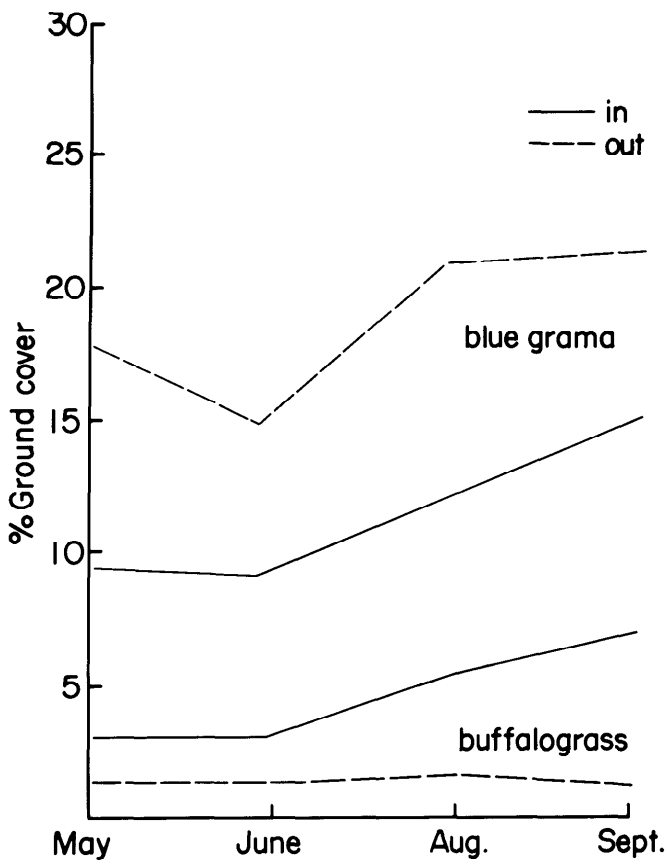

Fig. 1. *Percent ground cover of blue grama and buffalograss on the Nunn prairie dog study site, 1973. (in = in the prairie dog town; out = in adjacent area.)*

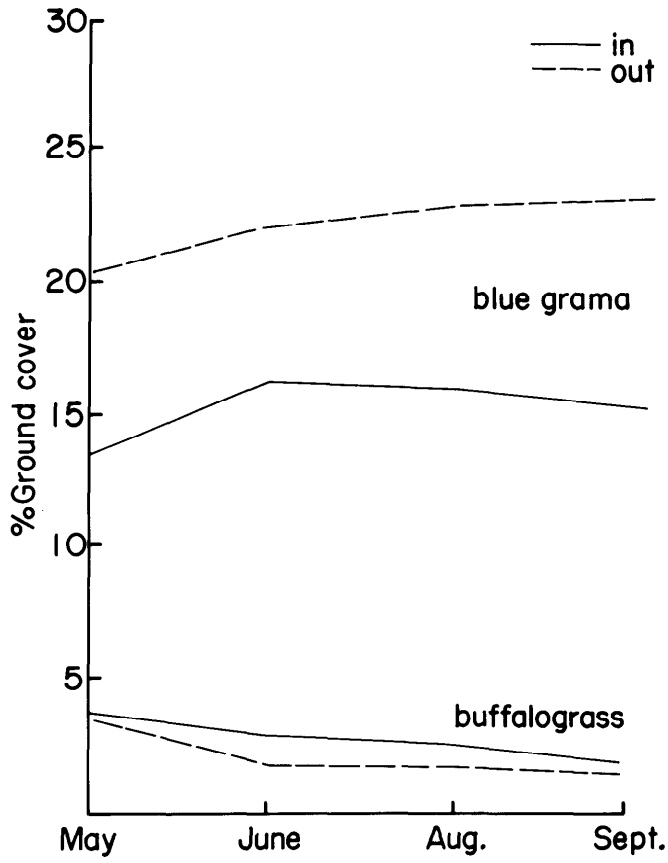

Fig. 2. *Percent ground cover of blue grama and buffalograss on the CPER prairie dog study site, 1973. (in = in the prairie dog town; out = in adjacent area.)*

did occur in the greatest amount in the depression area toward the center of this town, which collected run-off water. The species was rare on the CPER site both in and out of the town. Although sixweeks fescue was abundant in the general vicinity of the CPER site, the difference between study sites for this species was significant.

Two other grasses were common on the Nunn site but contributed little to the total ground cover of vegetation. Red threeawn (*Aristida longiseta*) and sand dropseed (*Sporobolus cryptandrus*) were not significantly different between the two sites nor between areas inside versus outside the towns. Lack of significant difference indicates that these species are not necessarily encouraged to increase by prairie dog activities.

Cover values for needleleaf sedge within and between sites were similar. This species has been reported to be resistant to cattle grazing (Hermann, 1970) and apparently is also resistant to prairie dog grazing (Tables 2 and 3).

Forbs on the Nunn site were classified into two groups: those that occurred on the disturbed areas around the prairie dog burrows and those that were more common on the overflow area. Forbs in the former category included tansyleaf aster, woolly plantain, bluebur stickseed, and little stickseed, while the latter category included bigbract verbena, prairie coneflower (*Ratibida* spp.), and prairie dogweed (*Dyssodia papposa*). Other forbs such as scarlet globemallow were found distributed throughout the area.

Annual forbs were noted to have greater cover values inside the town than outside. Woolly plantain had the greatest cover of any forb on the Nunn site, and its distribution was centered around the burrow openings. The cover of this species was consistently higher inside the town and increased as the season progressed (Table 2). This difference may have been caused by the absence of soil disturbance outside the town, since its optimum establishment seemed to have been on the mounds.

Tansyleaf aster's average cover value was approximately three times greater inside the Nunn town than outside it. This species was also more abundant in disturbed areas, such as burrows, than was woolly plantain, although the former had less cover than did the latter species.

Other annual forbs that had significantly greater cover values inside the town than in the adjacent area at the Nunn site included bluebur stickseed, little stickseed, ridgeseed spurge (*Euphorbia glyptosperma*), and prairie eveningprimrose (*Oenothera albicaulis*). Bigbract verbena was a mat-forming, perennial species which may have been favored by the lack of prairie dog grazing. Stemless springparsley (*Cymopterus acaulis*), an early perennial forb, apparently was not resistant to prairie dog grazing pressure. A number of visual observations confirmed that prairie dogs dug up the large root of the species during early spring months for food and it was further observed that its cover outside the town was three times greater than inside the Nunn town.

Scarlet globemallow did not appear to be adversely affected by prairie dog activities. On the Nunn site there was no difference in its cover values outside versus inside the town during any part of the growing season. Furthermore, it was the only abundant forb on the CPER site. Its cover values for both sites remained much the same in and out of the towns during the growing season which suggested that scarlet globemallow was not detrimentally affected by prairie dog grazing or other activities such as burrowing.

Two shrubby species, slenderbrush wildbuckwheat (*Eriogonum microthecum*) and broom snakeweed (*Gutierrezia sarothrae*) had greater cover values outside the town. Prairie dogs had continuously clipped these species because the shrub probably interferred with their vision. As a result, selective pressure by prairie dogs has been exerted against these species for years, as previously reported by Koford (1958).

Prairie Dog Food Preference

That prairie dogs have a strong food preference for grass was evident from the dietary data (Table 4). Needleleaf sedge was included with the grasses. Prairie dogs increased their consumption of grass during June and decreased it during September. Cover and frequency of the grasses increased during this period. These results suggest that declining availability apparently was not the cause for a decrease in grass consumption. However, maturation of the grasses, with an associated increase in availability of forbs, may have contributed to the September trend away from the use of grass by the prairie dogs. In addition, a change in palatability of the species available may have occurred.

The major grasses and sedge consumed by prairie dogs were blue grama, sand dropseed, and needleleaf sedge. Blue grama contributed to the sharp increase noted in grass consumption by prairie dogs in June while the intake of blue grama decreased considerably during September. During this latter period, blue grama consumption was replaced by an increased consumption of sand dropseed on the Nunn site and scarlet globemallow on the CPER site. During September, sand

Table 4. Percent relative density of species occurring in prairie dog diets on the Nunn and CPER sites.

Species	May		June		August		September	
	Nunn site	CPER site	Nunn site	CPER site	Nunn site	CPER site	Nunn site	CPER site
Grass or grass-like								
Red threeawn	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Blue grama	25.3	19.5	33.9	22.7	33.4	55.4	8.0	32.8
Buffalograss	0.0	0.0	0.0	14.4	0.0	0.0	0.1	0.0
Needleleaf sedge	30.7	64.3	1.9	14.4	8.8	14.6	26.0	33.7
Sand dropseed	10.4	4.2	13.3	48.1	40.7	13.6	60.0	7.9
Sixweeks fescue	15.3	0.3	34.8	0.0	0.6	5.9	0.7	0.0
Forbs								
Little stickseed	3.6	0.0	0.0	0.0	0.4	0.0	0.3	0.0
Woolly plantain	4.8	0.1	1.2	0.0	2.3	0.0	0.4	0.0
Scarlet globemallow	7.3	5.5	0.8	0.2	3.5	9.1	0.6	24.1
Shrubs								
Fringed sagewort	0.0	5.4	0.0	0.2	0.0	0.2	0.4	0.0
Seed	0.3	0.0	5.8	0.0	8.0	0.2	3.6	0.2

dropseed made up nearly 60% of the prairie dogs' diet, while blue grama made up less than 10%.

Needleleaf sedge was an important constituent in the diet during May when it accounted for as much as 64% on the CPER site. During June this species became dry and coarse textured, which probably affected its palatability. Sixweeks fescue made up 34% of prairie dogs' diet during June. The heavy use of this species was probably a factor in the decreased consumption of other grasses during this particular month.

It was suggested in the earlier discussion of blue grama cover that prairie dog grazing may be responsible for the slight leveling off of the peak in cover inside the CPER town during August. The dietary data support that conclusion since the cover of blue grama was the greatest during August when the heaviest use of the species by prairie dogs occurred.

Buffalograss was only a minor component in the overall diet of prairie dogs. This species was a significant portion of their diet (14%) on the CPER site during June only. This was contrasted to the Nunn site where prairie dogs grazed sixweeks fescue heavily and ignored buffalograss during June. This may suggest then that prairie dogs graze buffalograss when other species are either not available or not palatable. Buffalograss then is apparently favored by prairie dog grazing pressure against some of its competitors, while remaining essentially free from grazing pressure. Therefore, a continued increase of buffalograss in these prairie dog towns is expected.

Scarlet globemallow was the most abundant forb found in prairie dog diets on both sites. Prairie dogs increased their consumption of scarlet globemallow on the CPER site in September, when it made up 24% of their diet. Woolly plantain and little stickseed were the only annual forbs that made up a noticeable portion of the diet on the Nunn site. Other very common species such as tansyleaf aster, bluebur stickseed, ridgeseed spurge, and prairie eveningprimrose were apparently not consumed by prairie dogs. Therefore, the establishment and maintenance of populations of these species are apparently favored by prairie dog activities, including a lack of grazing pressure against them.

Summary

The number of plant species present was greater in prairie dog towns than in adjacent areas of this study. However, the presence of prairie dogs did not necessarily cause a large-scale invasion of annual species. Other environmental conditions also influenced the change in species composition.

Prairie dogs exerted selective pressure against blue grama and favored buffalograss through selective grazing. Moreover, needleleaf sedge, sixweeks fescue, and scarlet globemallow apparently are resistant to prairie dog grazing although these species were abundant in fecal samples. A decrease in the grass-forb ratio was observed in the towns, especially when a number of annual species were present. Many annual forbs, including tansyleaf aster, little stickseed, bluebur stickseed, and prairie eveningprimrose, were common on the burrow mounds but were not preferred foods of prairie dogs. Prairie dogs do alter individual species patterns within their towns by providing opportunities for the establishment of more species, both annual and perennial. Since both perennial grasses and forbs that have increased as a result of prairie dog activities are useful as livestock forage, it cannot be said that prairie dogs are always destructive to rangelands. Instead, prairie dogs do alter plant species composition to some extent and in doing so encourage an increase in plants which are more tolerant to their grazing.

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