Flora and Fauna Associated with Prairie Dog Colonies and Adjacent Ungrazed Mixed-grass Prairie in Western South Dakota

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Abstract

Vegetation, small rodents, and birds were sampled during the growing seasons of 2 years on prairie dog *(Cynomys ludovicianus)* colonies and adjacent mixed-grass prairie in western South Dakota. Prairie dog grazing decreased mulch cover, maximum height of vegetation, plant species richness, and tended to decrease live plant canopy cover compared to that on ungrazed mixed-grass prairie. Buffalograss *(Buchloe dactyloides)* was the dominant plant on prairie dog towns and western wheatgrass *(Agropyron smithii)* and blue grama *(Bouteloua gracilis)* were most common on mixed-grass prairie sites. Prairie dog towns supported greater densities of small rodents but significantly fewer species compared to undisturbed mixed-grass sites. Deer mice *(Peromyscus maniculatus)* and northern grasshopper mice *(Onychomys leucogaster)* were more abundant on prairie dog towns than on undisturbed mixed-grass sites. Density and species richness of birds were significantly greater on prairie dog towns. Horned larks *(Eremophila alpestris)* were most common on prairie dog towns, whereas western meadowlarks *(Sturnella neglecta)* were most common on mixed-grass prairie.

The black-tailed prairie dog *(Cynomys ludovicianus)* originally inhabited prairies from southern Canada to Mexico and from the eastern foothills of the Rocky Mountains to the tallgrass prairie (Hall 1981). Prairie dog colonies may occupy large areas of rangeland. A single prairie dog colony occupied about 64,750 square kilometers in Texas (Merriam 1902).

Because prairie dog feeding and burrowing activities conflict with the interests of livestock producers and some assume that prairie dogs reduce the quality of habitat for wildlife (Merriam 1902, Uresk et al. 1981, Hansen and Gold 1977), control of prairie dog populations has become a common practice (Merriam 1902, Uresk and Bjugstad 1983, Collins et al. 1984). However, little or no information is available on small rodents or birds inhabiting prairie dog towns or the impact of prairie dog control on associated fauna. The objectives of this study were to compare small rodents, birds, and vegetation on and off prairie dog colonies and provide baseline information on potential nontarget impacts from prairie dog control programs.

Study Area and Methods

The study area was located in Badlands National Park in west central South Dakota, 80 km east of Rapid City and 13 km southwest of Wall. The climate is semiarid-continental and is characterized by cold winters and hot summers. The average annual precipitation for the area is 40 cm, most of which falls as high-intensity thunderstorms during the growing season (April–September). Snowfall accumulations average 62 cm per year. Mean annual temperature is 10° C, ranging from –5° C in January to 26° C in July.

Soils are primarily sedimentary deposits of clay, silt, gravel and volcanic ash (Raymond and King 1976). The landscape includes steep gullies, sharp ridges, flat-topped buttes, spires, and pinnacles that are partly covered with vegetation and upland areas of mixed-grass prairie. Gently sloping mixed-grass sites are scattered

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Table 1. Mean (±SE) percent plant cover, mulch cover and maximum height of plants on a seasonal basis on prairie dog towns and on adjacent mixed-grass prairie sites without prairie dogs in western South Dakota in 1981 and 1982.

	Season					
	Late spring		Summer		Late summer	
Year	Prairie dog towns	Mixed-grass prairie	Prairie dog towns	Mixed-grass prairie	Prairie dog towns	Mixed-grass prairie
Canopy cover (%)						
1981	46 ± 6	51 ± 7	59 ± 7	52 ± 3	60 ± 7	58 ± 4
1982	35 ± 5	67 ± 3**	64 ± 6	75 ± 3	60 ± 6	76 ± 3*
Average	41	59	62	64	60	67
Mulch cover (%)						
1981	21 ± 2	40 ± 4**	19 ± 2	50 ± 6**	17 ± .5	48 ± 7**
1982	22 ± 6	30 ± 4	6 ± 1	28 ± 7**	8 ± 1	34 ± 6**
Average	22	35	13	39	13	34
Maximum vegetation height (cm)						
1981	8 ± .6	29 ± 1**	12 ± .6	34 ± .9**	12 ± .3	36 ± .8**
1982	6 ± .2	24 ± .3**	13 ± .4	62 ± 1**	12 ± .4	66 ± 1**
Average	7	27	13	48	12	51

* = Prairie dog towns vs. mixed-grass prairie significantly different at $P<0.05$.
** = Prairie dog towns vs. mixed-grass prairie significantly different at $P<0.01$.

throughout the area and are the major sites occupied by prairie dogs. The elevation of the study sites ranged from 820 m to 900 m. The study area was neither farmed nor grazed by domestic livestock but portions have been grazed and farmed in the past. Native ungulates inhabiting the area are American bison *(Bison bison),* pronghorn *(Antilocapra americana),* mule deer *(Odocoileus hemionus),* and white-tailed deer *(O. virginianus).*

The dominant grasses of the area are western wheatgrass, blue grama *(Bouteloua gracilis),* buffalograss, needleleaf sedge *(Carex eleocharis),* needle and thread *(Stipa comata),* and green needlegrass *(Stipa viridula).* Scarlet globemallow *(Sphaeralcea coccinia),* American vetch *(Vicia americana),* lanceleaf sage *(Salvia reflexa),* and prairie sunflower *(Helianthus petiolaris)* are the most abundant forbs; fringed sage *(Artemisia frigida)* is the dominant shrub.

Vegetation, small rodents, and birds were sampled in 1981 and 1982. Six permanent 80- by 80-m (0.64 ha) study sites were selected for sampling small rodent densities, composition, and vegetation characteristics. Six permanent 805- by 62-m (4.9 ha) transects were established adjacent to the vegetation and small rodent plots to inventory birds. Three sites were established on prairie dog towns and 3 sites on mixed-grass prairie adjacent to each prairie dog town. The mixed-grass prairie sites were 200 to 1,000 m from the prairie dog towns. Soils were fine, montmorillonitic, mesic Aridic Argiustolls of the Norrest-Blackpipe (silty clay loam) and Nunn (loam) series. Prairie dog towns selected had similar burrow densities.

Plant canopy cover, maximum plant height, and percent mulch cover were estimated. Plant canopy cover was estimated in 150, 20 by 50-cm quadrats placed at 1-m intervals along 3, 50-m line transects at each site. Line transects were spaced 20 m apart. Canopy cover was visually estimated into 6 cover classes (Daubenmire 1959). The height of the tallest plant in each quadrat was measured. Percent mulch cover was visually estimated by cover classes. Sampling was conducted in June (late spring), July (summer), and August (late summer) during 1981 and 1982.

Estimates of small rodent (not including prairie dogs) densities were evaluated on unique captures from live trapping. Sixty-four Sherman live traps, spaced at 10-m intervals, were arranged in a grid design on each site. The grids were arranged so that a 10-m border of similar habitat surrounded each trapping grid. Trapping began in May and continued at 3-week intervals through September of each year. Each sample consisted of 1 night of prebaiting followed by 4 consecutive nights of trapping. A mixture of peanut butter and rolled oats was used both inside and outside the traps to attract small rodents. Rodents were removed from the traps, identified as to species, assigned a unique number by toe amputation, then released at the capture site.

Bird censusing was conducted using a method similar to Emlen (1971, 1977). A permanently marked 805- by 62-m strip transect was established on each site. Surveys were conducted on 4 consecutive days every 3 weeks, starting at sunrise and continuing for 5 hours. Average walking time was 25 to 40 min per transect. All birds within each transect were identified visually or by vocalization and included birds which flew over the transect.

Factorial analyses of variance (Nie et al. 1975) were used to compare abundance of small rodents captured. One-way analyses of variance examined differences within year and treatment. Two-way analyses of variance included year by treatment. Paired T-tests were used for total percent canopy cover, mulch, maximum plant height measurements, and species richness between years and between treatments. Type I error level at $\alpha = 0.05$ was adapted for all tests unless stated otherwise.

Results and Discussion

Vegetation

Plant canopy cover on mixed-grass prairie sites was significantly greater in late spring and late summer of 1982 compared to that on prairie dog towns (Table 1). Cover values were similar during 1981 and in summer 1982. Plant species richness (no. of plant species) was greater on mixed-grass prairie vegetation types (75) than on prairie dog towns (54) in 1981 and 1982. Koford (1958) and Bonham and Lerwick (1976) reported a greater number of plants, primarily forbs, on prairie dog towns than on native shortgrass prairie sites in Colorado.

Buffalograss provided 34% cover and was the dominant plant on prairie dog towns, providing significantly greater cover than on mixed grass sites. Koford (1958) also reported that in mixed-grass prairie, prairie dogs alone can both produce and maintain a shortgrass association. Western wheatgrass and blue grama were the dominant plants on mixed-grass sites (24 and 17% canopy cover, respectively) and their cover values were significantly lower on prairie dog towns. The dominance of these two plants over buffalograss was attributed to lighter grazing by herbivores. Forb cover was significantly greater on prairie dog towns than on mixed-grass sites while, mulch cover was significantly less on prairie dog towns in most seasons. Maximum plant height was consistently greater on undisturbed mixed-grass sites compared to that on prairie dog towns.

Small Rodents

Rodent abundance was greater on prairie dog towns than on

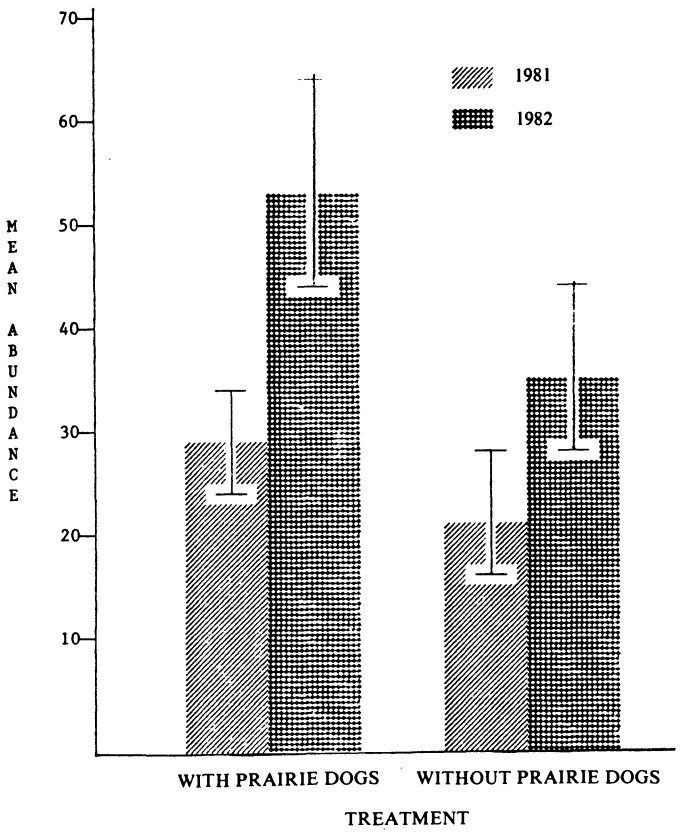

Fig. 1. *Mean abundance (numbers/1,000 trap nights ± SE) of small rodents on prairie dog towns and on adjacent mixed-grass prairie sites without prairie dogs in western South Dakota in 1981 and 1982.*

mixed-grass sites (Fig. 1); however, rodent species richness was significantly higher on mixed-grass prairie sites than on the prairie dog towns. O'Meila et al. (1982) reported similar results in Oklahoma. Decreased plant canopy cover, mulch cover, and vegetation height on prairie dog towns influenced inhabitation by certain small rodent species. Small rodents captured, in decreasing order of abundance, were deer mice *(Peromyscus maniculatus),* northern grasshopper mice *(Onychomys leucogaster),* prairie voles *(Microtus ochrogaster),* thirteen-lined ground squirrels *(Spermophilus tridecemlineatus),* western harvest mice *(Reithrodontomys megalotis),* hispid pocket mice *(Perognathus hispidus),* and house mice *(Mus musculus).* The abundance of small rodents did not vary significantly among seasons except for northern grasshopper mice.

Abundance of deer mice over 2 years was significantly greater on prairie dog towns than on mixed-grass sites (Table 2). Northern grasshopper mouse populations were greatest on prairie dog towns and stayed relatively constant between years on each of the treatments. Unused prairie dog burrows provided nesting and escape cover for these species (Blair 1940, Koford 1958, Smith 1967), and prairie dog clipping and maintenance of vegetation in a lower seral stage was particularly favorable to deer mice (Birch 1977).

Prairie voles were only captured on mixed-grass prairie sites (Table 2). Prairie voles generally inhabit areas with dense stands of vegetation (Jameson 1947, Carroll and Getz 1976). Birney et al. (1976) found increased canopy cover had an important influence on increasing Microtine populations. Thirteen-lined ground squirrels were captured most often in association with mixed-grass sites and occurred infrequently on prairie dog towns. This contrasts with Jones et al. (1983), who reported that thirteen-lined ground squirrels are most commonly found in grass that is short. Western harvest mice and hispid pocket mice occupied mixed-grass prairie sites only. House mice occupied both prairie dog towns and mixed-grass sites in low numbers.

Table 2. Mean[1] abundance (numbers/1000 trap nights) of small rodents on prairie dog towns and on adjacent mixed-grass prairie sites without prairie dogs in western South Dakota during 1981 and 1982.

Common name	Prairie dog towns	Mixed-grass prairie
deer mouse	29[a]	9[b]
northern grasshopper mouse	12[a]	3[b]
prairie vole	0[a]	8[b]
thirteen-lined ground squirrel	<1[a]	5[b]
western harvest mouse	0[a]	2[b]
hispid pocket mouse	0[a]	1[b]
house mouse	<1[a]	<1[a]
Total	41[a]	28[b]

[1]Means within a row with the same superscript are not significantly different ($P<0.01$).

Birds

Bird species diversity was significantly higher on prairie dog towns than on mixed-grass sites. A total of 36 avian species were observed on prairie dog towns compared to 29 on mixed-grass prairie sites without prairie dogs in 1981 and 1982. Bird abundance was higher, in both years and throughout the growing season, on prairie dog towns than on mixed-grass sites (Fig. 2). Total avian densities were 171 and 73 individuals per 5 ha on prairie dog towns and mixed-grass prairie sites, respectively (Table 3). Higher avifauna numbers on prairie dog towns can be attributed to "patchiness" or structural diversity, increased seed production, primarily by forbs (Agnew 1983, Uresk and Bjugstad 1983, Rotenberry and Wiens 1980), and possibly differences in plant biomass. Grzybowski (1980) found that avian estimates were higher on heavily grazed grasslands than lightly grazed grasslands in Oklahoma and Texas. The abundance of birds on prairie dog towns was variable, with a low of 112 in summer 1982 to a high of 298 in late summer 1982. Bird numbers on mixed-grass sites ranged from a high of 152 in summer 1981 to a low of 34 in late summer 1981. These wide

Table 3. Mean (±SE) abundance (number/5 ha) of birds on prairie dog towns and on adjacent mixed-grass prairie sites without prairie dogs in western South Dakota during 1981 and 1982.

Common name	Prairie dog towns	Mixed-grass prairie
horned lark	97±23	2±<1*
western meadowlark	34±7	43±6
mourning dove	13±4	6±1*
killdeer	7±2	<1±<1*
barn swallow	7±4	<1±<1*
burrowing owl	3±1	0*
common grackle	3±2	<1±<1
red-winged blackbird	2±1	6±1*
rock dove	1±1	0
upland sandpiper	<1±<1	3±1*
lark bunting	<1±<1	4±1*
grasshopper sparrow	<1±<1	2±<1
common nighthawk	0	2 ± 1
unidentified	4 ± 1	5 ± 1
Total	171	73*

* = Significantly different from prairie dog towns at $\alpha = 0.05$.
Bird species <1 per 5 ha include: northern rough-winged swallow, European starling, American crow, house sparrow, eastern kingbird, marsh hawk, northern pintail, western kingbird, chestnut-collared longspur, American kestrel, yellow-headed blackbird, loggerhead shrike, red-tailed hawk, mallard, Says phoebe, Swainson's hawk, ferruginous hawk, long billed curlew, blue-winged teal, prairie falcon, sharp-tailed grouse, turkey vulture, buteo spp., vester sparrow, great horned owl, sora, Wilson's phalarope.

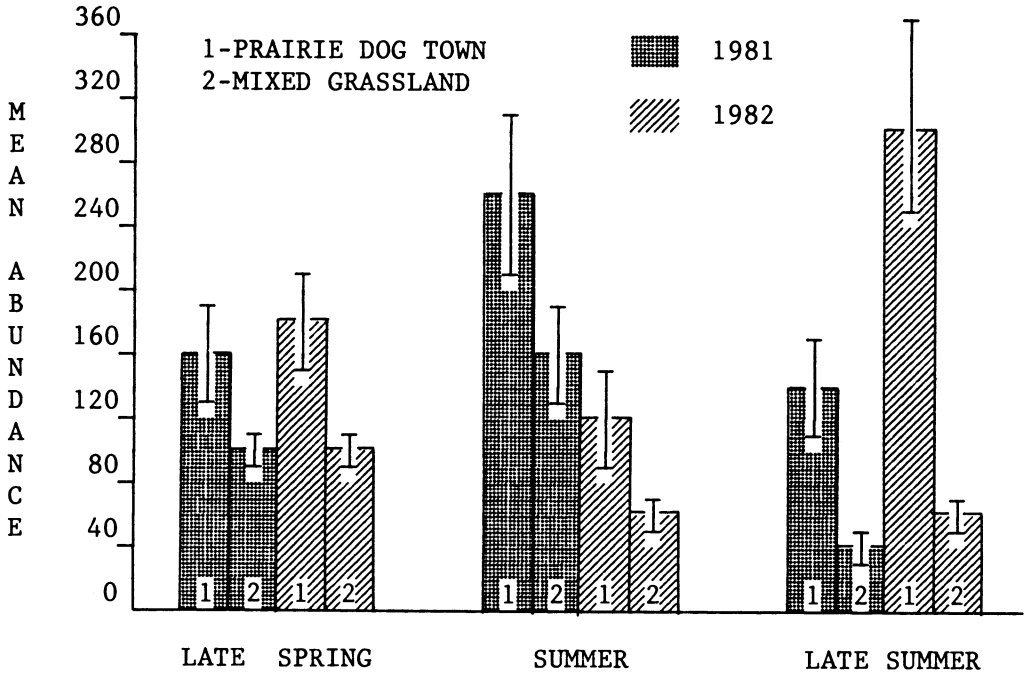

Fig. 2. *Mean abundance (numbers/5 ha ± SE) of birds on a seasonal basis on prairie dog towns and on adjacent mixed-grass prairie sites without prairie dogs in western South Dakota in 1981 and 1982.*

ranges are not uncommon for birds and similar results have been reported by Wiens and Rotenberry (1981).

Horned larks *(Eremophila alpestris)* were the most common species observed on prairie dog towns in 1981 and 1982. Abundance of horned larks varied significantly among seasons in both years and this species was significantly more abundant on prairie dog towns (97) compared to mixed-grass prairie sites (2) (Table 3). Horned larks commonly inhabit open country with low, sparse vegetation (Behle 1942, Trost 1972, Skinner 1975, Grzybowski 1980). Wein (1973) and Skinner (1975) found that horned lark densities were greater in grazed areas than ungrazed areas, apparently in response to the lower vegetative height and patchiness (Rotenberry and Wiens 1980).

Other birds commonly observed on prairie dog towns were western meadowlarks *(Sturnella neglecta),* mourning doves *(Zenaidura macroura),* killdeers *(Charadrius vacitenus),* barn swallows *(Hirundo rustica),* and burrowing owls *(Athene cunicularia).* Burrowing owls utilize abandoned prairie dog burrows as nest sites and escape over (O'Melia 1982, MacCracken et al. 1985).

Western meadowlarks were abundant on mixed-grass prairie sites and prairie dog towns (Table 3). Lanyon (1956) reported that western meadowlarks exhibited tolerance for a wide variety of plant associations, preferring large fields with short vegetation and good drainage. Grzybowski (1980) associated western meadowlarks with more dense vegetation. Other birds commonly observed on mixed-grass sites included mourning doves, red-winged blackbirds *(Agelaius phoeniceus),* lark buntings *(Calamospiza melanocorys),* upland sandpipers *(Bartramia longicauda),* and grasshopper sparrows *(Ammodramus savannarum).*

Conclusions

Prairie dogs act as ecosystem regulators by maintaining short-grass plant associations with less mulch cover and lower vegetation height. These vegetative features, combined with high burrow densities, provide quality habitat for some species of small rodents, such as deer mice and grasshopper mice. However, vegetative manipulation by prairie dogs negatively impacts rodent species associated with dense vegetation of mixed-grass sites. Greater avian densities and species richness on prairie dog towns can be attributed to patchiness due to prairie dog activity, lower amounts of mulch and lower vegetation height which may result in greater visibility of macroarthropods and seeds than that on mixed-grass sites. Although the role of prairie dogs as ecosystem regulators is not fully assessed, these results indicate that prairie dogs influence birds, small mammals, and vegetation. Prairie dog control programs can potentially influence birds and small rodents common on prairie dog towns.

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