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Some relationships of black-tailed prairie dogs to livestock grazing

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SOME RELATIONSHIPS OF BLACK-TAILED PRAIRIE DOGS TO LIVESTOCK GRAZING

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ABSTRACT.—Relationships of black-tailed prairie dogs (*Cynomys ludovicianus*) to livestock grazing were studied from 1973 to 1983 on the Charles M. Russell National Wildlife Refuge and the Fort Belknap Indian Reservation in northeast Montana. A total of 154 prairie dog colony sites was examined, and most were in association with livestock watering sites and/or areas where the topsoil was disturbed by human activity. Roads and cattle trails were found in 150 of the prairie dog colonies. Prairie dog colonies were found to be located significantly ($p < 0.001$) closer to livestock water developments and homestead sites than randomly located points. Observations showed cattle to occur significantly ($p < 0.05$) more on quarter sections with prairie dog colonies as opposed to quarter sections without prairie dog colonies. Forage utilization at one prairie dog colony was estimated at 90% by midsummer. Prairie dogs consumed about a third of the vegetation, with grasses the predominant forage class used.

Habitat characteristics of black-tailed prairie dogs (*Cynomys ludovicianus*) colonies have been reported on over a wide geographic region (Reid 1954, Koford 1958, Smith 1967, Hassien 1976). Prairie dogs are frequently associated with areas of low-growing vegetation and areas intensively grazed by ungulates (Mead 1898, Osborn and Allan 1949, King 1955, Koford 1958, Smith 1967). Although many authors have commented on this relationship, little quantitative information exists on the subject. Furthermore, it is not clear in the literature if prairie dog colonies develop at intensively grazed sites or if the presence of prairie dogs attracts ungulates to an area. There are documented cases of declining prairie dog numbers following reduction or elimination of ungulates from an area (Mead 1898, Osborn and Allen 1949, Uresk and Bjugstad 1983). Knowledge of the spacial distribution and habitat use of ungulates and prairie dogs over a broad area is important to understanding prairie dog-ungulate relationships. The purpose of this study was to investigate the distribution, habitat use, and forage utilization of black-tailed prairie dogs and domestic livestock in northeastern Montana.

STUDY AREA AND METHODS

Data were gathered from 1973 through 1975 and from 1978 through 1980 on the Charles M. Russell National Wildlife Refuge (CMRNWR) and during 1983 on the Fort Belknap Indian Reservation (FBIR) in northeast Montana. The CMRNWR is typified by rough, river breaks country merging with rolling prairies on either side of the Missouri River. Coniferous forest habitats dominated by ponderosa pine (*Pinus ponderosa*) and Rocky Mountain juniper (*Juniperus scopulorum*) are commonly found on the steeper slopes along the Missouri River and cover about 36% of the land area. Shrub-grassland and grassland habitats occur on the broad ridge tops and coulee bottoms that extend from the prairies onto the CMRNWR. Glaciated prairies with relatively little topographic relief compose the majority of the FBIR. Shrub-grassland and grassland habitats dominate these sites. Coniferous habitats occur only on the foothills of the Little Rocky Mountains that border the FBIR on the south.

Prairie dog colonies on both the CMRNWR and the FBIR are restricted to the shrub-grassland and grassland habitats. Western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), green needlegrass (*Stipa viridula*), and needle-and-thread grass (*S. comata*) are the predominant grasses in these habitats. Common forbs include fringed sagewort (*Artemisia frigida*), plains prickly pear (*Opuntia polycantha*), and yellow sweetclover (*Melilotus officinale*). The shrub layer

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is composed largely of big and silver sagebrush (*Artemisia tridentata, A. cana*) and greasewood (*Sarcobatus vermiculatus*). The CMRNWR and the FBIR are grazed primarily by cattle, although sheep and horses are present in a few grazing allotments. Native ungulates are pronghorns (*Antilocapra americana*), elk (*Cervus elaphus*), and mule and white-tailed deer (*Odocoileus hemionus, O. virginianus*).

The CMRNWR was surveyed for prairie dog colony sites in 1979. Colonies were mapped on frosted mylar plastic over 1:24,000 aerial photos while driving or walking the perimeter of the colony. The area of each colony was determined with an electronic digitizer. Prairie dog colonies on the FBIR (survey area boundaries described in Knowles and Knowles 1984) were surveyed in 1983 and were mapped on 7.5′ USGS topographic maps. Area for each colony was determined with a dot grid. At each prairie dog colony site, I recorded presence or absence of prairie dogs, livestock developments (reservoirs, wells, salt licks, and calf feeders), homesteading activity, roads, and well-established cattle trails. Complete survey coverage was made of each study area. However, on FBIR inactive colony sites were not investigated nor was one small colony located around a private residence.

Special effort was made to study prairie dogs at the west end of the CMRNWR north of the Missouri River because of the number (36) and density (6.3 colonies/100 km^2) of prairie dog colonies. All stock water developments and homestead sites were accurately located on a map over a 570 km^2 area. I used a Students t-test to test the hypothesis that mean distance from the geographic center of each prairie dog colony in this area to the nearest stock water development or homestead site was not different than the mean distance to such features for 120 randomly chosen points. In this same area, I made weekly surveys of cattle each summer and fall from 1973 to 1975 in two pastures (20,244 ha) of the four-pasture Nichols Coulee rest-rotation grazing system as part of another study (Knowles and Campbell 1982). Quarter section location, habitat type, and slope were recorded for each cattle group when first observed. The quarter section distribution of cattle was compared to the quarter section distribution of prairie dog colonies occurring in these two pastures using a chi-square test of homogeneity. Habitat type designation followed Mackie (1970) except for analysis purposes, where observations of cattle in the *Xanthium strumarium* and *Agropyron-Symphoricarpos* habitat types were combined and observations in the *Artemisia longifolia* and *Pinus-Juniperus* habitat types were combined.

Spring/summer forage utilization of prairie dogs, prairie dogs and other wildlife (primarily mule deer and elk), and prairie dogs and cattle was investigated at a prairie dog colony located next to a reservoir site in the Nichols Coulee allotment. A 7.7 ha area of the 16.4 ha colony was fenced to exclude cattle in July 1978. Ten agronomy cages were placed on each side of the fence that passed through the center of the colony in pairs at 5 m intervals. The 10 cages within the exclosure had a mesh of 25 × 50 mm, and the other 10 cages had a mesh size of 51 × 76 mm. The larger mesh allowed prairie dogs to enter the cages. The cages were placed on the site in November 1979 (pasture rested in 1979), and in early August 1980 a 1.2 m^2 area was sampled in each cage. In addition, 10, 1.2 m^2 areas were sampled on either side of the exclosure fence midway between each agronomy cage. Forbs and grasses were bagged separately, oven dried, and weighed to the nearest gram. A Kruskal-Wallis one-way analysis of variance was used to statistically test for differences among grazing regimes.

RESULTS

A total of 112 prairie dog colony sites was found on the CMRNWR (Table 1). Ninety-six of these colonies were active, occupying a total of 2,122 ha and averaging 22 ha in size (se ± 47 ha, range < 1 – 307 ha). Approximately 0.6% of the land area was inhabited by prairie dogs, with 2.8 active prairie dog colonies per 100 km^2. On the FBIR, 42 active prairie dog colonies were surveyed totaling 2,786 ha ($\bar{x}$ = 66 ha, se ± 91 ha, range 3 – 372 ha). Prairie dogs occupied about 2.1% of the survey area on the FBIR, with 3.0 colonies per 100 km^2.

The majority of prairie dog colonies both on the CMRNWR and FBIR were located in ar-

TABLE 1. Distribution of prairie dog colonies found in association with livestock developments, natural bodies of water, homesteads, and roads and cattle trails.

Study area	n	Percentage of colony sites located next to			
		Livestock developments	Streams & lakes	Homesteads	Trails & roads
CMRNWR[1]	112	62	18	26	97
FBIR[2]	42	60	29	17	98

[1]Charles M. Russell National Wildlife Refuge.
[2]Fort Belknap Indian Reservation.

eas of intensive livestock grazing and/or areas of topsoil disturbance by human activity. Livestock developments (reservoirs, wells, salt licks, and calf feeders) were found at 62% of the colony sites on the CMRNWR and 60% of the colony sites on the FBIR (Table 1). Nine colonies on the CMRNWR had salt licks or calf feeders in them; four of these colonies were located away from a stock watering area. Many colonies at the east end of the CMRNWR were adjacent to the waters of Fort Peck Reservoir. On the FBIR, 29% of the colonies were found along perennial streams or around dry lakes. These sites were areas of intensive livestock grazing on both study areas.

Homestead activity was found at 26% and 17% of the colony sites on the CMRNWR and FBIR, respectively. Stock watering areas and areas formerly cultivated were frequently found at homestead sites. Only one small colony (< 1 ha) was found in a grain field currently under cultivation. Included in this group is a prairie dog colony on the CMRNWR that started at a site where gravel was removed for road construction and another that started on a greasewood bottomland site that was mechanically cleared and leveled to make a pasture for horses at a refuge field station. Roads (usually two-track vehicle trails) and/or well-established cattle trails were found at 109 of the 112 prairie dog colony sites on the CMRNWR and at 41 of 42 colonies on the FBIR. Roads alone intersected 88% of the prairie dog colonies on the CMRNWR. Roads and cattle trails on both the CMRNWR and the FBIR interconnected livestock watering areas and homestead sites.

In the northwest portion of the CMRNWR, the mean distance from the geographic center of 36 prairie dog colony sites to the nearest stock water development or homestead site (0.5 km) was less than ($p < 0.001$, $t = 1084.36$, 154 d.f.) the mean (1.3 km) for the 120 random points. Thirty of the 81 stock water developments in this area had colonies at them. The quarter section locations of 1,772 observations of cattle groups recorded from 1973 to 1975 in the Nichols Coulee allotment were not distributed homogeneously with respect to quarter sections with prairie dog colonies ($p < 0.05$ $X^2 = 4.90$, 1 d.f.). Cattle were observed with greater than expected frequency on quarter sections with prairie dog colonies. However, the distribution of cattle observations on quarter sections with reservoir sites lacking prairie dog colonies was homogeneous to the distribution of cattle observations on quarter sections with prairie dog colonies ($0.50 < p < 0.75$, $X^2 = 0.16$, 1 d.f.), suggesting that the concentration of cattle on quarter sections with colonies is related primarily to a source of water.

Cattle were observed to primarily use the *Artemisia-Agropyron* and *Sarcobatus-Agropyron* habitat types during both summer and fall (Table 2). Use of shrub-grassland habitats averaged 85% over both seasons for all years. These habitats, as determined from aerial photos, composed only 54% of the two pastures. More than three-fourths of the observations of cattle were on slopes with inclinations of less than 11 degrees. Cattle, for the most part, restricted their use to the shrub-grassland habitats along the main ridge tops and major drainages where water developments (reservoirs and wells) had been established. All prairie dog colonies in these two pastures were located in shrub-grassland habitat types (*Artemisia-Agropyron*, 88%; *Sarcobatus-Agropyron*, 12%). Without exception, these colonies were located primarily on slopes of less than 7 degrees. Prairie dog colonies occupied 2.8% of these two pastures, which was considerably above the average for the CMRNWR. Number of colonies per 100 km^2 (8.9)

TABLE 2. Use of habitat type and slope by cattle during summer and fall in the Nichols Coulee allotment.

Habitat type	Percentage of observations	
	Summer	Fall
Artemisia-Agropyron	44	42
Sarcobatus-Agropyron	29	27
Agropyron-Symphoricarpos	13	15
Pinus-Juniperus	14	16
Degrees of slope		
0–10	81	79
11–25	14	13
26–35	5	7
36+	<1	1

in these two pastures was also above the average for the CMRNWR.

Total plant production along the utilization transect averaged 867 kg/ha (Table 3). Plant biomass for each plant category varied significantly among grazing regimes (total plants $p < 0.01$, $H = 12.18$, 3 d.f., grass $p < 0.005$, $H = 15.78$, 3 d.f., forbs $p < 0.05$, $H = 7.91$, 3 d.f.) (Table 3). Utilization by prairie dogs was estimated at 29%, by prairie dogs and other wildlife at 56%, and by prairie dogs, other wildlife, and cattle at 90%. Observations throughout the summer indicated that elk were the primary wildlife species to graze on the prairie dog colony, and most of this activity was confined to the exclosure. Utilization by prairie dogs was directed largely at grasses, whereas utilization was more evenly distributed among grasses and forbs when prairie dogs grazed in conjunction with other ungulates.

DISCUSSION

Prairie dogs on the CMRNWR and the CBIR were associated with areas intensively grazed by livestock and/or areas where the topsoil had been disturbed by human activity. The association of prairie dog colonies with intensive grazing by ungulates, with rangelands in poor condition, with stock watering sites, or with homestead sites, has been noted by others (Mead 1898, Osborn and Allen 1949, Reid 1954, King 1955, Koford 1958, Smith 1967, Hassien 1976, Hillman et al. 1978, and Dalsted et al. 1981, Uresk and Bjugstad 1983). On the CMRNWR I was able to establish that prairie dog colonies appeared after the disturbance in five instances. In addition, conversations with local ranchers indicated that the prairie dog colonies at stock reservoirs came after construction of the reservoirs. Moreover, it is doubtful that homesteads were purposely located in a prairie dog colony. Based on these observations, it appears that in my study areas prairie dog colonization at stock watering sites and homesteads followed the intensive grazing and soil disturbance.

At least four factors may be important in explaining this high association of prairie dog colonies with intensively grazed sites. (1) In the Nichols Coulee allotment, the habitat types and topographic situations most used by cattle were also sites most suitable for prairie dog colonization. (2) Roads and trails appear to facilitate prairie dog dispersal (Koford 1958, Knowles 1985). Dispersing prairie dogs following roads and trails have an increased chance of finding disturbed sites because roads and trails on both study areas interconnected livestock developments and homesteads. The high occurrence of roads and trails in prairie dog colonies has not been previously reported. However, I found roads or trails through prairie dog colonies of study area maps for Anthony and Foreman (1951), Reid (1954), Klatt (1971), Stockrahm (1979), and Coppock (1981). (3) Extracolony dispersing prairie dogs are at least a year old upon dispersal (Garrett 1982, Knowles 1985) and may actually recognize and select for heavily grazed areas (Uresk and Bjugstad 1983). (4) Predation mortality of colonizing prairie dogs at grazed sites may be lower than at ungrazed sites. Although this explanation seems plausible, there is little factual information supporting it, and more research on prairie dog dispersal and predation is needed.

Although cattle appeared to selectively use quarter sections with prairie dog colonies in the two pastures of the Nichols Coulee allotment, it may have been related to a source of water in most colonies. Hassien (1976) found significantly greater numbers of cattle droppings in prairie dog colonies than adjacent areas. Greater use of prairie dog colonies may also be attributed to increased abundance of forbs (Osborn and Allan 1949, King 1955, Koford 1958, Hassien 1976, Coppock 1981, O'Meilia et al. 1982, Knowles et al. 1982), increased vegetative production (Uresk and

TABLE 3. Comparison of total plant, grass, and forb biomass under different grazing regimes at a prairie dog colony in the Nichols Coulee allotment.

Grazing category	Biomass kg/ha (% utilization)		
	Total plant[1]	Grass[1]	Forbs[1]
Ungrazed	867	364	503
Prairie dogs	613 (29)	135 (63)	478 (5)
Prairie dogs/wildlife	379 (56)	138 (62)	241 (52)
Prairie dogs/cattle	85 (90)	24 (93)	61 (88)

[1]Kruskal-Wallis 1-way ANOVA, significant ($p < 0.05$) difference among grazing categories.

Bjugstad 1983), increased soil nutrients (Hassien 1976), and greater nitrogen concentration in plants (Coppock 1981) in prairie dog colonies.

The relatively greater abundance of prairie dogs in the Nichols Coulee allotment when compared to the rest of the CMRNWR was probably related to a greater availability of prime habitat for prairie dogs in this area. However, construction of numerous reservoirs and wells in association with implementation of the rest-rotation grazing system in the mid-1960s undoubtedly played a role in the establishment of prairie dog colonies in this grazing system. It is also possible that the early turn-in date (1 April) and intensive, early grazing associated with two pasture treatments facilitated pioneering prairie dogs in establishing colonies.

Forage utilization in the unrestricted portion of the utilization transect (90%) was already excessive by midsummer. Cattle were only present in this pasture from 1 April through 31 July. O'Meilia et al. (1982) found forage utilization in his prairie dog–cattle pastures to be 95% and 96%, whereas in cattle-only pastures it was 80% and 92%. They estimated use by prairie dogs to range from 33% to 37% through September under a density of prairie dogs (21 to 30/ha) very similar to that which I observed in my study colony (9 to 31/ha, Knowles 1982). Hansen and Gold (1977) estimated total reduction in vegetation because of prairie dogs at 18%; basing this figure on density of prairie dogs at their study site (7.3/ha), food requirements, and denuded area of mounds. The selection of grasses by prairie dogs at this colony is consistent with recent prairie dog food habits studies (Summers and Linder 1978, Fagerstone et al. 1981, Wydeven and Dahlgren 1982, Uresk 1984).

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