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Abstract.--White-tailed prairie dog populations and habitats were studied on six towns in Wyoming. Habitats and habitat structure varied greatly both within and between towns. Prairie dog populations on each town were found to fluctuate by more than 50% between consecutive years. Prairie dog density was not significantly related to burrow density indicating that burrow density was not a useful predictor of population density.

INTRODUCTION

Although white-tailed prairie dog (Cynomys leucurus) ecology has been studied, most studies concentrated on various aspects of behavioral ecology (e.g., Hoogland 1979, 1981) or reproduction (Bakko and Brown 1967). Only two (Tileston and Lechleitner 1966; Clark 1977) dealt with population ecology. Even though aspects of white-tailed and black-tailed prairie dog (Cynomys ludovicianus) ecology may be similar (e.g., Clark et al. 1971), their life histories differ significantly (Tileston and Lechleitner 1966; Campbell and Clark 1981; Clark et al. 1982; Hoogland 1979, 1981). Knowledge of these differences are important in designing and implementing white-tailed prairie dog management programs.

In this paper we discuss the results of our study on the population and habitat ecology of white-tailed prairie dogs in two areas of Wyoming. We compare and contrast these data to similar data from the literature for black-tailed prairie dogs. We also discuss aspects of white-tailed prairie dog ecology that may be important in their management.

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STUDY AREA AND ANIMALS

We collected data on white-tailed prairie dog populations and habitats from six towns, three near Laramie, WY, and on three subcolonies of a prairie dog complex near Meeteetse, WY, in the Big Horn Basin. Both sites are on rolling plains interrupted by low hills and buttes (Bailey 1980). The study areas are in the Wyoming Basin Province (Bailey 1980) and are dominated by sagebrush (Artemesia spp.), greasewood (Sarcobatus spp.), wheatgrass (Agropyron spp.), and rabbitbrush (Chrysothamnus spp.). Plant species lists for all study sites are in Collins and Lichvar (1984, 1986). Study site elevations range from 2100 to 2200 m. Average monthly temperature ranges from 4 to 11 C, with average annual precipitation ranging from 125 to 350 mm (Bailey 1980). Cattle are grazed at varying rates on all grids.

White-tailed prairie dogs are large (800-1500 g), diurnal ground squirrels that inhabit high mountain basins in the Rocky Mountains of Colorado, Utah, and Wyoming (Hall 1981). They are social, and are found living in towns of various sizes, densities, and habitat characteristics. The white-tailed prairie dog's social system is similar to that of the Wyoming ground squirrel (Spermophilus elegans). It is not as complex as the social systems of the black-tailed and Gunnison's prairie dogs (Cynomys gunnisonii) (Michener 1983). Female white-tails are relatively sedentary. Juvenile males are the primary dispersing class, with dispersal occurring soon after initial emergence. Both sexes breed first as one year olds (Bakko and Brown 1967).

White-tailed prairie dogs hibernate during the winter (Harlow and Menkens 1986; Bakko and Nahorniak 1986) and follow the typical ground squirrel emergence and immergence patterns. Adult males emerge in late February or early March (Bakko and Brown 1967; Clark 1977) with adult females emerging 2-3 weeks later. Breeding occurs soon after female emergence (Bakko and Brown 1967). Juveniles emerge in late May or early June, 5-7 weeks post-partum (Tileston and Lechleitner 1966; Bakko and Brown 1967). Immergence follows the opposite pattern. Adult males become sedentary and immerge during August, followed by adult females (mid-August to early September) and then juveniles (up until October) (Tileston and Lechleitner 1966; Clark 1977).

MATERIAL AND METHODS

Prairie dog populations were studied from 1983-1986 in Laramie and from 1984-1986 in Meeteetse. Habitat data were collected for all three years in Meeteetse, and for the years 1983-1985 in Laramie.

On each town, a grid (9 to 13 ha in size) was established for trapping and vegetation sampling. Prairie dogs were live trapped twice a year (June and August) for five days each month. They were individually ear tagged, and released. Chapman's unbiased version of the Lincoln-Petersen estimator (Seber 1982; Menkens 1987) was used to estimate population size. Percent cover by grass, forbs, subshrubs (mostly *Artemesia frigida*), and shrubs was estimated using point intercept sampling (Barbour et al. 1980) at 30 random points on each grid. Shrub density and height was estimated using line intercept techniques (McDonald 1980). Large scale (i.e., town wide) topographic variation was estimated from 1:100000 scale maps using a modification of Menkens and Anderson (1987). Small scale topographic variation (i.e., within grid variation) was estimated using a modified Robel Pole (Robel et al. 1970). All burrows greater than 10 cm diameter were censused in 1983 (Laramie grids) or 1984 (Meeteetse grids), total burrow density on all grids was estimated in 1986 by randomly sampling approximately 50% of the grid.

RESULTS AND DISCUSSION

Habitat

White-tailed prairie dog towns vary from being flat to those whose topographic heterogeneity index value is greater than 75% (Menkens 1987). Large scale topographic variation results because individual towns may contain hills that rise up to 20 m or more above the surrounding prairie. Towns may also be dissected by large gullies. The magnitude of large scale topographic diversity in white-tailed towns contrasts with the lack of such variation in black-tailed towns. Black-tailed prairie dogs seem to be limited to sites of less than 5% slope (Tileston and Lechleitner 1966; Knowles 1982)

Spatial variation in habitat variables, particularly shrub characteristics and topographic features, results in significant differences in inter- and intra-town habitat structural diversity (Tileston and Lechleitner 1966; Clark 1977; Menkens 1987). Shrub densities on towns range from a median of 0.0 to 3100 shrubs/ha and shrub height ranges from a median of 22 to 35 cm (Menkens 1987). Using our measure of within grid topographic variation, topographic diversity between towns ranges from 39 to 120%. Significant inter-town differences in topographic diversity results from the presence of small hills and gullies on some grids. The presence of many large maternity mounds (Clark 1977; Flath and Paulick 1979) on some grids but few on others, also contributes to topographic differences.

The degree of intra-town habitat diversity on white-tailed towns contrasts with the apparent lack of such diversity on black-tailed prairie dog towns. In addition to only inhabiting flat sites, black-tailed prairie dogs greatly modify the vegetation (and thus its structure) on their towns by clipping it to a short height and actively maintain this low stature (Tileston and Lechleitner 1966; Hoogland 1979; Coppock et al. 1983). White-tails do not visibly modify their habitats to the same degree. Because extensive vegetation modification by black-tails results in distinct town boundaries permitting easy delineation of towns from aerial photographs (Cheatheam 1973; Dalsted et al. 1981), it is possible to concentrate management efforts in well defined areas. Lack of visible habitat modification by white-tails, combined with their dispersed, uneven distribution throughout the habitat (Tileston and Lechleitner 1966; Clark 1977) makes town boundary delineation difficult. If white-tailed prairie dog management is to include poisoning, a knowledge of town boundaries is critical because incomplete treatment may lead to rapid recovery approaching pre-treatment population levels (e.g., Matschke et al. 1982; Knowles 1986). Boundary delineation may be accomplished using techniques and environmental features such as ground checking and mapping of the peripheral burrows, the use of gross topographic features (e.g., perennially flowing creeks, very steep slopes, etc.), and extensive soil barriers (e.g., alkaline soils, perpetually moist, or very sandy soils).

Since black-footed ferrets (*Mustela nigripes*) live on prairie dog towns, search techniques need to take into account habitat. The high degree of structural diversity, and prairie dog's dispersed populations will influence design and performance of nocturnal ferret searches on white-tailed towns (see Clark et al. 1984 for a description of this technique). While spotlight beams may extend up to several hundred meters on black-tailed towns; shrubs, tall grass, and hills and gullies on white-tailed towns will greatly reduce the light's effective distance. Reduced sighting distance requires that more effort be expended on a town in order to obtain full search coverage. A lower limit of 10 burrows/ha has been recommended for defining town boundaries when conducting black-footed ferret searches (Forrest et al. 1985).

During this study, burrow densities changed significantly over time on only two towns while population densities changed on all but one (Table 1). On five of six towns, no apparent correlation existed between population and burrow densities (Menkens 1987). We also examined the relationship between population and burrow densities using linear regression on the pooled town population and burrow data for the first and last year of study. In both analyses (Table 1), the slope of the regression line was not significantly different from zero. These results also show that no significant relationship exists between burrow density and white-tailed prairie dog density. Although King (1955) did not explicitly test this relationship for black-tails, he reached the same conclusion. Thus burrow density on a town is not a reliable or useful predictor of either white-tailed or black-tailed prairie dog density.

Population Fluctuations

White-tailed prairie dog populations fluctuate greatly within towns (Clark 1977; Menkens 1987)(Table 2). The magnitude of temporal variation in density exhibited in this town (Table 2) is typical of the remaining five towns in this study (Menkens 1987). It can be seen that between year density changes can approach 50% or more. These changes are not predictable from habitat variables, climatic parameters, or from the previous year's density (Menkens 1987).

Density fluctuations have two impacts on management and control of white-tailed prairie dogs. First, they suggest that with potentially high reproductive output along with possibly high immigration rates (Menkens 1987), white-tails could recover from poisoning campaigns as rapidly (1-2 years) as do black-tails and Wyoming ground squirrels (Matschke et al. 1982; Knowles 1986). White-tailed prairie dog populations that have been nearly eradicated by epizootics of sylvatic plague (Yersinia pestis) have returned to pre-dieoff levels within four to five years (Barnes 1982).

The second effect of density fluctuations on white-tailed prairie dog management is that

Table 1.--Results of regressions examining the relationship between total prairie dog density and burrow density. BLM-13A grid excluded from the first regression because its burrow density was estimated whereas complete censuses were performed on the remaining grids in the first year of each study. All grids were included in the analysis of the final year's data. All population densities except Goulds differ significantly between the first and last year of the study. Burrow densities differ significantly between the first and last year of the study - for the Nunn and Pitchfork towns only. Burrow density in burrows/ha, prairie dog density in prairie dogs/ha. (from Menkens 1987).

Town	Burrow Density	Prairie Dog Density
	First Year of Study (1983 or 1984)	
Bath	106.3	9.1
Nunn	205.4	21.8
Pitchfork	65.3	4.3
Gould	106.0	17.1
91	84.7	18.4
	Prairie Dog Density = 3.77 + 0.09 * Burrow Density; r^2=47.0 F=2.66 $p < 0.05$	
	1986	
Bath	107.2 ± 13.9	15.3
Nunn	154.4 ± 28.2	7.6
Pitchfork	80.8 ± 13.1	12.3
Gould	88.9 ± 17.4	20.9
91	72.0 ± 13.1	9.9
BLM-13A	137.0 ± 21.7	2.0
	Prairie Dog density - 23.3 = .11 * Burrow Density; r^2=32.1 F=1.89 $p < 0.05$	

town boundaries or the boundary between active and inactive portions of the towns may shift between years. Thus, one must be aware of the difference between the town's physical and "biological" boundaries when designing management programs.

Table 2. Estimated white-tailed prairie dog densities (± 1SD) for the Gould town 1984-1986. Densities are given in prairie dogs/ha. Densities in the same row with the same numerical superscript are not significantly different at P = 0.05 using Fishers least significant difference (from Menkens 1987).

	Year		
	1984	1985	1986
Adults	7.7^{1} (.7)	5.4^{12} (.6)	4.6^{2} (.6)
Juveniles	9.4^{1} (.4)	8.4^{1} (.8)	16.3^{2} (2.1)
Total	17.1^{12} (.8)	13.9^{1} (1.0)	20.9^{2} (2.2)

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