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Mammal Use of Shortgrass Prairie and Associated Riparian Habitat in Wyoming

Abstract

Small mammal habitat relations were investigated in shortgrass prairie and riparian plant associations in southeast Wyoming in 1994 and 1995. Capture of sagebrush voles (Lemmiscus curtatus), *western harvest mice* (Reithrodontomys megalotis), *and deer mice* (Peromyscus maniculatus) *were associated with short cover or larger amounts of bare ground, habitat typical of upland areas of shortgrass prairie. Capture of prairie voles* (Microtus ochrogaster) *and dwarf shrews* (Sorex nanus) *were associated with tall cover, little bare ground, and short distances to water, habitat typical of riparian areas. Our results show what habitat features are associated with capture of individual species in a shortgrass prairie ecosystem.*

Key words: small mammals, sagebrush voles, western harvest mice, deer mice, prairie voles, dwarf shrews

Introduction

Numerous studies have investigated habitat use by small mammals in different habitats (Belk *et al*. 1988, Stroh and Fleharty 1988, Douglass 1989, Fa *et al*. 1990), but few studies have focused on high-plains shortgrass prairie (Ribble and Samson 1987). Specific information on habitat associations of the sagebrush vole (*Lemmiscus curtatus*) (Carroll and Genoways 1980) and the dwarf shrew (*Sorex nanus*) is limited. We describe habitat components of small mammals on a shortgrass prairie and associated riparian areas in southeastern Wyoming. Specific objectives were to: (1) describe relative abundance of small mammals in shortgrass prairie and riparian areas, and (2) show habitat preference by abundant small mammal species within each habitat type.

Study Area

F. E. Warren Air Force Base is 2,375 ha in area with elevation ranging from 1,851 to 1,943 m above sea level. Mean annual precipitation is 34 cm (Martner 1986). The base was established as a cavalry fort in 1867 and has been in use by the military since. It presently serves as a support base for underground missile sites. A fish and wildlife management and habitat improvement program has been in practice since the 1950's.

Several plant associations occur on the base, but shortgrass prairie dominates. Uplands consist of rolling hills with a few small rock outcrops on slopes. Snow accumulates in the small valleys between the rolling hills and, depending on soils, some of these areas have small accumulations of moisture during the spring. Vegetation consists of short grasses, including buffalo grass *(Buchloe dactyloides)* and blue grama

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(Bouteloua gracilis), and low-growing forbs, such as Virginia creeper *(Phlox muscoides)*, with interspersed patches of bare ground (Knight 1994).

Crow Creek, a small perennial stream, and Diamond Creek, an intermittent stream, flow through the southern portion of the base. Due to the semi-arid climate, riparian corridors are narrow and have been substantially reduced along portions of Crow Creek by mowing and herbicide application, but these practices were halted in 1989. Currently, riparian vegetation is re-establishing along both creeks with stands of young willows (*Salix* spp.) along the majority of Crow Creek and some sections of Diamond Creek. Beaver *(Castor canadensis)* ponds in the upper portion of Crow Creek contribute to willow reestablishment. Riparian areas consisting of willows and other shrubs are interspersed with wet meadows. A few patches of bare ground in riparian habitat are often a result of human activity.

Methods

Small mammals were captured using Sherman live traps (7 x 9 x 23 cm) baited with cracked oats. Traps were placed 30 paces apart in a grid pattern. Trap grids ranged from 2 x 8 to 8 x 8 matrices, depending on the area being trapped. Trapping grids were systematically selected by random numbers from sites of appropriate size to avoid interference with military activities. Twenty grids, nine in the shortgrass prairie habitat and 11 in the riparian habitat, were trapped between 11 May and 5 July 1994, and six grids, two prairie and four riparian, were trapped between 4 and 12 August 1994. Trapping occurred on 20 grids, 14 in riparian habitat and six in shortgrass prairie, between 17 May and 25 June 1995.

Traps were opened in the evening then checked and closed the following morning before 0900 hours over four consecutive nights. Species, sex, and location were recorded for each captured animal. Animals were marked by toe clipping to determine if they were recaptured. Habitat variables were measured in 0.01-ha plots established around those locations. When habitat sampling was completed at 20 plots around capture locations of a species within a habitat type, every other capture location for that species was measured up to 30 captures. Habitat variables were measured at 10 plots located diagonally across each grid at 20 pace intervals. We started at the corner of each and proceeded 20 paces toward the opposite diagonal corner. Our trapping scheme and habitat sampling were assumed to be representative of the area.

At all plots, a 2x5 dm Daubenmire frame (Daubenmire 1959) was used to measure the proportions of bare ground, ground cover of grass-like vegetation, and cover of forbs at the center of each capture and each available plot. A Robel pole (Wight 1938) was used to measure mean height of cover at the center of each site. A single pole with marks at 10-cm intervals was used and heights were recorded at each of the cardinal directions at the edge of each 0.01-ha plot. The height of the 10-cm interval that was completely obscured by vegetation was recorded. These four readings were used to determine mean cover height for the 0.01-ha plot. The point-quarter method (Cottam and Curtis 1956) was used to determine the minimum distances to a road, building, tree, shrub, water, log, rock greater than 30 cm in diameter, and patch of bare ground greater than 30 cm in diameter in each of the four quarters. These values were averaged for each 0.01-ha plot. The maximum distance measured was 10 m because features over 10 m away probably would not influence use of a particular site by small mammals.

Habitat plots, sampled in 1994 and 1995, were compared using paired *t*-tests to determine if data could be pooled. Several variables differed significantly between years, so separate analyses were performed for each year. Using available habitat plots, *t*-tests determined if differences existed between the habitat types. Sites where small mammals were trapped were compared with available habitat plots using *t*-tests.

An index of relative abundance (number of animals captured per trap night) was computed for each grid. Simple correlations were performed between relative abundances and means of the available habitat variables. Mean relative abundance values were figured for each habitat type. Because we observed no significant differences in captures per trap night between early and late trapping in 1994 using paired *t*-tests, we pooled data from both sampling periods. Differences in captures per trap night between habitat types were tested using *t*-tests. Alpha for all tests was set at $P < 0.05$. All statistical analyses were performed with SPSS version 4.0.1 (SPSS-PC 1990).

Results

In 1994, the means of percent bare ground, ground covered by grass, and forbs as well as mean cover height, differed between habitat types. Bare ground, grass cover and cover height also differed in 1995. In addition, distance to downed logs and distance to bare ground differed between used and available plots, but forb cover did not differ (Table 1).

During the two field seasons, 9,460 trap nights yielded 569 animals captured among 12 species (Elliott 1996). The four most abundant species were western harvest mice, deer mice, prairie voles, and sagebrush voles (Table 2). Stream-side riparian habitat consistently yielded the higher numbers of species, six in 1994 and nine in 1995, while shortgrass prairie yielded lower numbers of species (six in both years).

Table 1a. *Means of 12 habitat variables compared between habitat types (prairie and stream), 1994.*

Variable[1]	Means	
	Prairie (n=9)	Stream (n=11)
OPGR%	28.00[a]	20.80[a]
CVRGR%	48.95[a]	65.77[a]
CVRFBS%	23.47[a]	13.35[a]
CVRHGTAV	2.91[a]	7.65[a]
DROADAV	1100.00	1078.11
DBUILDAV	1100.00	1100.00
DTREEAV	1100.00	1001.34
DSHRBAV	1100.00	1001.87
DWTRAV	1100.00	1063.14
DDLAV	1100.00	1026.95
DRCKAV	1088.47	1076.21
DOPGRAV	740.10	782.99

Table 1b. *Means of 11 habitat variables compared between habitat types (prairie and stream), 1995.*

Variable[1]	Means	
	Prairie (n=6)	Stream (n=14)
OPGR%	46.13[a]	34.29[a]
CVRGR%	29.58[a]	45.54[a]
CVRFBS%	24.28	19.64
CVRHGTAV	4.47[a]	24.27[a]
DROADAV	1100.00	1090.37
DTREEAV	1100.00	931.02
DSHRBAV	1100.00	797.43
DWTRAV	1100.00	921.15
DDLAV	1099.41[a]	1039.66[a]
DRCKAV	1100.00	1088.3
DOPGRAV	821.14[a]	714.00[a]

[a] denotes pairs of habitat types with significant difference in means at $\underline{P}$ <0.05

[1] OPGR% = percent bare ground, CVRGR% = percent cover by grasses, CVRFBS% = percent cover by forbs, CVRHGTAV = mean cover height, DROADAV = mean minimum distance to a road, DBUILDAV = mean minimum distance to a building, DTREEAV = mean minimum distance to a tree, DSHRBAV = mean minimum distance to a shrub, DWTRAV = mean minimum distance to water, DDLAV = mean minimum distance to a down log, DRCKAV = mean minimum distance to a rock, and DOPGRAV = mean minimum distance to bare ground.

Table 2. *Total captures, mean captures per 100 trap nights and standard deviation in parenthesis of small mammals captured in prairie and riparian habitats in 1994 and 1995.*

	1994		1995	
Species	Prairie	Riparian	Prairie	Riparian
(Total Captures)	(3072)	(2812)	(1472)	(2104)
Dwarf Shrew	0	4 (0.18 ± 0.34)	0	3 (0.20 ± 0.41)
13-Lined Ground Squirrel	9 (0.27 ± 0.38)	6 (0.11 ± 0.35)	4 (0.33 ± 0.63)	2 (0.07 ± 0.28)
Wyoming Ground Squirrel	3 (0.05 ± 0.10)	0	2 (0.13 ± 0.20)	0
Plains Pocket Gopher	0	0	0	1 (0.05 ± 0.19)
Olive-backed Pocket Mouse	9 (0.24 ± 0.39)	0	0	0
Western Harvest Mouse	0	13 (0.50 ± 0.65)	0	18 (1.01 ± 0.95)
Plains Harvest Mouse	0	0	0	9 (0.44 ± 1.67)
Prairie Vole	0	41 (1.23 ± 1.11)	2 (0.13 ± 0.32)	30 (1.87 ± 1.80)
Sagebrush Vole	33 (1.07 ± 0.74)	1 (0.02 ± 0.08)	5 (0.35 ± 0.39)	2 (0.08 ± 0.20)
Deer Mouse	228 (1.75 ± 1.90)	55 (1.82 ± 1.79)	15 (1.09 ± 0.86)	93 (4.83 ± 6.24)
Northern Grasshopper Mouse	5 (0.09 ± 0.17)	0	2 (0.13 ± 0.24)	0
Meadow Jumping Mouse	0	0	0	4 (0.19 ± 0.51)

Western harvest mice were found only in the riparian habitat in both 1994 and 1995 (Table 2), and their numbers were relatively similar (13 and 18) during both years. In riparian habitat, Western harvest mice were captured in plots that had significantly more bare ground and were further from shrubs and water than available habitat plots.

Deer mice were the most abundant mammal captured in both 1994 and 1995 in both prairie and riparian habitats. Their captures were much higher in 1994 (228 total in the prairie habitat) than in 1995 (15) (Table 2).

In 1994, deer mice were captured in plots of prairie habitat with significantly less grass cover than observed among plots describing available habitat. In 1995, deer mice were captured in prairie habitat with significantly shorter cover than was observed in available plots (Table 3).

Prairie voles were found primarily in riparian habitat (Table 2) and significantly further from roads, logs, and bare ground than was available. They were also found in plots that were significantly further from bare ground and closer to woody vegetation (trees and shrubs) than was observed among plots in available habitat (Table 3).

In 1995, prairie vole captures in riparian habitat were negatively correlated with distance to trees ($r = -0.90$), shrubs ($r = -91$), and water ($r = -0.80$), and were positively correlated with percentage forb cover ($r = 0.65$), distance to bare ground ($r = 0.67$) and cover height ($r = 0.57$).

The relative abundance of sagebrush vole in prairie habitat was positively correlated ($r = 0.77$) to the percentage of bare ground and negatively correlated ($r = -0.71$) to cover height whereas prairie voles and dwarf shrews, species typical of wetter habitats, were associated with taller cover and greater distance from bare ground.

Discussion

Shortgrass prairie was the dominant habitat type within the Base. This habitat was subject to disturbance from equipment and provided little protection from harsh weather (wind and snow in winter and rain, drought, and hail in summer) or predators, especially raptors. Small mammals occurring on shortgrass prairie are adapted to a harsh environment.

The sagebrush vole was most strongly associated with shortgrass

Table 3. *Comparison of used habitat to available habitat for small mammals by habitat in prairie (P) and riparian (R) habitat in 1994 and 1995. Only relations significant at $\underline{P} < 0.05$ are included.*

	Western Harvest Mouse				Deer Mouse				Prairie Vole				Sagebrush Vole			
	1994		1995		1994		1995		1994		1995		1994		1995	
Variables[1]	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R
OPGR%				+[2]		+		+								
CVRGR%					-[3]	-										
CVRFBS%																
CVRGHTAV								-								
DROADAV						+				+						
DTREEAV						-		+				-				
DSHRBAV				+		-		+				-				
DWTRAV				+				+								
DDLAV								-		+						
DRCKAV																
DOPGRAV								-		+		+				

[1] *OPGR% = percent bare ground, CVRGR% = percent cover by grasses, CVRFBS% = percent cover by forbs, CVRHGTAV = mean cover height, DROADAV = mean minimum distance to a road, DTREEAV = mean minimum distance to a tree, DSHRBAV = mean minimum distance to a shrub, DWTRAV = mean minimum distance to water, DDLAV = mean minimum distance to a down log, DRCKAV= mean minimum distance to a rock, and DOPGRAV = mean minimum distance to bare ground*

[2] *+ denotes greater use of a habitat feature than its availability*

[3] *- denotes less use of a habitat feature than its availability*

prairie (Table 2). Others have reported its occurrence in shortgrass prairie (O'Farrell 1972) but it is more associated with sagebrush (Hall 1928, Mullican and Keller 1986). In this study, sagebrush voles were associated with large amounts of bare ground and short cover, demonstrating the variety of habitats in which this species occurs.

Others have recognized deer mice as a generalist species (Maxwell and Brown 1968, Hallett *et al.* 1983, Lemen and Freeman 1986, Olson and Knopf 1988). We captured them in both shortgrass and prairie riparian habitats but their microhabitat associations (shorter cover and shorter distances to bare ground) (Table 3) were more typical of shortgrass prairie than riparian areas (Elliott 1996). The lack of association with tall ground cover was similarly reported by Wywialowski (1987), Foster and Gaines (1991), and Crompton (1994). A generalist strategy may give them a competitive advantage in the highly variable shortgrass prairie habitat, particularly when habitat is subject to disturbance.

Prairie voles have been associated with dense grass areas having little bare ground (Lemen and Freeman 1986, Stokes 1995). We noted an avoidance of bare ground and an association with woody vegetation.

Western harvest mice, which were strongly associated with riparian areas (Table 2), inhabited areas with more bare ground and fewer trees than was generally available within riparian areas. The dependence of western harvest mice on tall grass (Stroh and Fleharty 1988, Heske *et al*. 1994), and avoidance of trees (Ribble and Samson 1987) is well established.

Finally, dwarf shrews had a higher abundance in areas with taller ground cover and a high proportion of forb cover. Dwarf shrews commonly occur in rocky areas at high elevations (Brown 1967, Thompson 1977) but also occur in wetter habitats at lower elevations (Martin 1971). We found little information on the microhabitat associations of this species, especially at lower elevations.

Overall, species richness (12 species) and composition on the base were similar to those reported in other studies in similar habitats, but the species found in riparian areas differed from those reported from other areas (Table 2). Olson and Knopf (1988) captured only two species (deer mouse and western harvest mouse) in the stream-side riparian zone of the South Platte River, but trapping effort was much lower than in this study. Both species were found on the Base. In another riparian site in a foothills zone, Olson and Knopf (1988) captured five species, including three species (deer mouse, western harvest mouse, and prairie vole) found on the base. Grant and Birney (1979) report five species of small mammals in a shortgrass prairie within the South Platte River drainage, including three (thirteen-lined ground squirrel, deer mouse, and northern grasshopper mouse) found on the base. Maxwell and Brown (1968) captured 12 species in mixed grass habitat of east-central Wyoming including seven species (deer mouse, thirteen-lined ground squirrel, prairie vole, western harvest mouse, plains harvest mouse, olive-backed pocket mouse, and northern grasshopper mouse) found on the base.

Our trapping scheme sampled small mammals at trap sites. We assumed that a capture in a trap represented a preference by the animal for the habitat surrounding the trap. Because this has been shown to be invalid for deer mice (Douglass 1989), we recognize that bias may exist. However, our results did provide some clear patterns, and depending on the bias created by the traps, may reflect true habitat associations.

It appears that the common small mammals within the base were predominantly microhabitat generalists associated with variable features of shortgrass prairie with some species primarily associated with riparian habitat. The adaptable deer mice and sagebrush voles predominated in the shortgrass prairie. The deer mouse was also common in riparian habitat but selected microhabitats that were similar to shortgrass prairie. In riparian habitat, prairie voles and western harvest mice demonstrated microhabitat specialization, thereby reducing competition by segregating themselves from other species. Dwarf shrews utilized a microhabitat that was not heavily used by other small mammals, so they may also be microhabitat specialists.

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