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# Rodent-Vegetation Relationships in Southeastern Montana

## Abstract

Plant communities of southeastern Montana were surveyed for rodents over a two year period. Deer mice (*Peromyscus maniculatus*) were the most abundant rodent species found on the study area. Prairie voles (*Microtus ochrogaster*), meadow voles (*M. pennsylvanicus*), sagebrush voles (*Lagurus curtatus*), Wyoming pocket mice (*Perognathus fasciatus*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), least chipmunks (*Eutamias minimus*), and eastern fox squirrels (*Sciurus niger*) also were captured. Grassland, riparian, and sagebrush communities showed the greatest rodent abundance and species diversity. There was a significant positive relationship between rodent abundance and the cover provided by some understory plant species and tree density on the study area.

## Introduction

Small mammals are important components of most natural ecosystems in North America. Dusek and McCann (1973) considered some of the aesthetic, recreational, and ecological values of deer mice (*Peromyscus maniculatus*) that also apply to many other rodent species. McCann (1974) stressed the need for more information on rodent ecology in Montana.

Investigators have inferred from their data that microhabitat features such as vegetation structure, cover and height, relative humidity, litter depth, and foliage height diversity, are important plant community variables affecting rodent abundance (M'Closkey and Fieldwick 1975, Birney *et al.* 1976, Kirkland 1976, Holbrook 1978, Carroll and Genoways 1980). These features are directly related to the life form and growth pattern of specific plant species within a plant community.

This paper presents estimates of relative abundance and population size of small mammals in relation to plant cover in southeastern Montana.

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#### Study Area

The study area of approximately 11,300 ha was located immediately west of the town of Alzada, Carter County, in extreme southeastern Montana. Elevations ranged from 1040 to 1130 m and annual precipitation averaged 37 cm. A majority of the area (74 percent) was dominated by sagebrush-grass vegetation associations. The most abundant plants were big sagebrush (*Artemisia tridentata*) and buffalograss (*Buchloe dactyloides*). Riparian areas, primarily wooded stream bottoms, were the next most prevalent type (14 percent), composed of green ash (*Fraxinus pennsylvanicus*) and snowberry (*Symphoricarpos* sp.). Pine forests, on 8 percent of the study area, occupied higher elevations. Major plants in this forest were ponderosa pine (*Pinus ponderosa*) and western wheatgrass (*Agropyron smithii*). Grassland areas covered the least amount of land (0.2 percent) and were composed of western wheatgrass and neddleleaf sedge (*Carex eleocharis*). The remainder of the study area (3.8 percent) was classified as land disturbed by bentonite mining. Plant names follow those given by Scott and Wasser (1980).

Cattle and sheep were managed on a rest-rotation grazing system on the study area.

#### Methods

In both the riparian and sagebrush communities four sampling sites were selected. Two sites each were studied in pine forest and grassland communities. Sites were selected as representative of the variability within a plant community. The number of replications established in a plant community were based on that variability and land area occupied.

Each site was surveyed for small mammals with two trap lines approximately 61 m apart. Each line consisted of a total of 20 Sherman live traps ( 9 X 8 X 23 cm) being spaced at 10 m intervals. Rodents were trapped during the second week of each month from April through October during 1979 and 1980. A mixture of rolled oats, bird seed, and peanut butter was used as bait. Traps were prebaited for one night, then opened for the following three nights. Traps were exposed 6720 and 3360 trap nights in sagebrush and riparian communities and in pine forest and grassland communities, respectively. Captured rodents were identified as to species, weighed, marked, and released.

Relative abundance of rodents was estimated as the total number of a species captured, including recaptures, per 100 trap nights. Abundance figures were averaged across consecutive months to provide seasonal estimates. April through June comprised the spring season, July and August summer, and September and October fall. Comparisons in rodent abundance among seasons were made.

Rodent population size was estimated using the CAPTURE computer program as described by Otis *et al.* (1978). Estimates were made for each species, for each year, and plant community if sufficient data were available. We chose one model to estimate population size based on the initial results and tests for population closure.

Percent canopy cover of understory plant species was determined at each trapping site using methods described by Daubenmire (1959). At each set of trap lines, three 50 m line transects were established approximately 30.5 m apart and parallel to the trap lines. Canopy coverage class of each plant species was estimated in 50 two by five dm plots systematically spaced every meter along each transect line. Tree densities were estimated by counting all trees within a 50 x 50 m plot at each trapping site.

Differences in relative abundance of the three most abundant small mammals were analyzed with factorial analysis of variance for significance between years, seasons, plant communities, and species. Tukey's method was used to determine which factors produced differences. Product-moment correlation compared rodent abundance and canopy cover of plants, litter, and bare ground, as well as tree densities. For each year of study, plant community parameters were stable whereas rodent captures fluctuated monthly. Differences were considered significant at the 5 percent level of probability.

### Results

Rodents captured, in decreasing order of abundance, were, deer mice, meadow voles (*Microtus pennsylvanicus*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), least chipmunks (*Eutamias minimus*), prairie voles (*M. ochrogaster*), Wyoming pocket mice (*Perognathus fasciatus*), sagebrush voles (*Lagurus curtatus*), and eastern fox squirrels (*Sciurus niger*) (Table 1).

Three categories of rodent abundance were examined: year, season, and plant community. Total populations were higher in 1979 than 1980. Deer mouse abundance was greater ($P < 0.01$) in 1979 than 1980 in grasslands during spring, in pine and sagebrush habitats during summer, and in riparian habitat during all seasons. *Microtus* spp. and *Lagurus curtatus* were not captured in 1980. No other species exhibited significant differences in abundance between years.

Only deer mouse abundance exhibited significant seasonal differences, and only during 1979 (Table 1). Deer mice were most abundant during spring, less so in summer, and least in fall.

Rodent abundance was generally higher in grassland and riparian communities, but seasonal differences were noted. Again, only deer mice exhibited significant differences in relative abundance between community types, and only during 1979 (Table 1).

Deer mice and voles (*Microtus* spp.) were the most abundant rodents in 1979 in most plant communities. During 1980, deer mice and thirteen-lined ground squirrels were most abundant (Table 1). No differences in abundance ($P > 0.05$) were evident among rodent species captured in 1980 (Table 1).

Rodent population size was estimated using the model for heterogeneous trapping probabilities among individuals (Table 2). Population estimates could be derived for deer mice, voles, and ground squirrels for 1979; however, only deer mice populations could be estimated in 1980.

Rodent populations were greatest in riparian habitat during both years. Rodent population estimates were greatest for all plant communities during 1979. Deer mice were the most abundant rodent in any habitat based on population estimates (Table 2). Generally, estimated population size closely followed trends in relative abundance. The test for closure was significant ($P < 0.03$) in all cases. The model for capture probability varying among individuals fit the data best and was used for all population estimates (Table 2). However, in a few cases, the

TABLE 1. Mean (± SE) relative abundance (numbers/100 trap nights) of rodents on a seasonal basis during 2 years of study in 4 plant communities of southeastern Montana.

| Community and Species | Season | | | | | |
|---|---|---|---|---|---|---|
| | Spring | | Summer | | Fall | |
| | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 |
| Grassland | | | | | | |
| *Peromyscus maniculatus* | 11.3 ± 3.8 | 3.3 ± 1.2 | 5.4 ± 1.2 | 2.1 ± 1.8 | 5.8 ± 3.5 | 0.4 ± 0.4 |
| *Spermophilus tridecemlineatus* | 0.8 ± 0.8 | 0.8 ± 0.3 | 1.9 ± 1.7 | 0.4 ± 0.3 | 0.4 ± 0.2 | * |
| *Perognathus fasciatus* | | 0.4 ± 0.3 | 0.4 ± 0.3 | 0.4 ± 0.3 | | |
| *Lagurus curtatus* | | | 0.4 ± 0.3 | | | |
| Pine | | | | | | |
| *Peromyscus maniculatus* | 6.3 ± 0.3 | 2.9 ± 0.3 | 9.3 ± 0.9 | 2.5 ± 0.6 | 2.9 ± 0.9 | * |
| *Eutamias minimus* | | 0.8 ± 0.8 | 0.8 ± 0.8 | | 1.3 ± 1.2 | |
| *Perognathus fasciatus* | | | 0.2 ± 0.1 | | | |
| *Microtus ochrogaster* | | | 0.2 ± 0.1 | | | |
| *Lagurus curtatus* | | | | | | * |
| Riparian | | | | | | |
| *Peromyscus maniculatus* | 7.7 ± 2.5 | 2.7 ± 0.3 | 6.5 ± 2.1 | 0.7 ± 0.3 | 6.7 ± 1.2 | 0.4 ± 0.2 |
| *Microtus pennsylvanicus* | 1.9 ± 0.7 | | 3.1 ± 1.5 | | 1.5 ± 0.5 | |
| *Microtus ochrogaster* | | | 0.2 ± 0.2 | | | |
| *Spermophilus tridecemlineatus* | * | 0.2 ± 0.1 | 0.2 ± 0.2 | 0.2 ± 0 | | * |
| *Lagurus curtatus* | | | * | | | |
| *Perognathus fasciatus* | | * | | | | |
| *Sciurus niger* | | * | | | | |
| Sagebrush | | | | | | |
| *Peromyscus maniculatus* | 6.0 ± 1.8 | 2.9 ± 0.5 | 5.4 ± 1.4 | 1.3 ± 0.4 | 2.9 ± 0.8 | 0.8 ± 0.4 |
| *Spermophilus tridecemlineatus* | 0.2 ± 0.2 | 0.4 ± 0.2 | 0.4 ± 0.2 | 0.2 ± 0.2 | 0.4 ± 0.2 | * |
| *Perognathus fasciatus* | 0.2 ± 0.2 | 0.2 ± 0.1 | 0.2 ± 0.2 | * | 0.2 ± 0.1 | |
| *Microtus ochrogaster* | * | | 0.2 ± 0.2 | | * | |
| *Lagurus curtatus* | | | 0.2 ± 0.2 | | 0.4 ± 0.1 | |

* < 0.1

TABLE 2. Population estimates of some rodents ($\bar{x} \pm SE$) for four plant communities in southeastern Montana during 1979 and 1980.

| Year and Rodent Species | Plant Community | | | |
|---|---|---|---|---|
| | Grassland | Pine | Riparian | Sagebrush |
| **1979** | | | | |
| *Peromyscus maniculatus* | 128 ± 44 | 43 ± 2 | 138 ± 23 | 74 ± 13 |
| *Microtus pennsylvanicus* | | | 117 ± 41 | |
| *Spermophilus tridecemlineatus* | 12 ± 2 | | | |
| **1980** | | | | |
| *Peromyscus maniculatus* | 16 ± 6 | 25 ± 6 | 39 ± 7 | 37 ± 16 |

model for capture probability varying due to a behavioral response to capture, variation over time, and for probability of capture remaining constant, were significant.

Significant correlations ($P < 0.05$) among understory plant species canopy cover, and tree densities, with rodent abundance were detected. Only deer mice, voles and thirteen-lined ground squirrels were included in correlation analysis (Table 3).

Vole abundance was positively associated with cover of smooth brome (*Bromus inermis*), japanese brome (*B. japonicus*), common timothy (*Phleum pratense*), macoun's wildrye (*Elymus macouni*), bluegrasses (*Poa* spp.), and density of chokecherry (*Prunus virginianus*), green ash, and boxelder maple (*Acer negundo*). Snowberry cover was also significantly correlated with vole abundance.

Deer mouse distribution was positively related to cover of wheatgrasses, macoun's wildrye, japanese brome, and total cover, as well as to the density of peachleaf willow (*Salix amygdaloides*).

Significant correlations among thirteen-lined ground squirrel abundance and cover of western wheatgrass, bare ground, and plains prickly pear (*Opuntia polyacantha*) were observed (Table 3).

## Discussion

This investigation indicates that some rodent species occupied only one or two plant communities, while others were found in a variety of communities throughout the study area. Other studies have shown the same thing (Zimmerman 1965, Geluso 1971, Stinson 1978, Feldhammer 1979, Stamp and Ohmart 1979). Necessary microhabit features are present within broad habitat types where rodents occur in southeastern Montana. Presumably plant species that are correlated with rodent abundance are an integral part of those microhabitats.

Correlations among rodent abundance and habitat features indicates the relative importance of cover provided by a relatively few plant species. Correlations were based on rodent and plant abundance over the entire study area, and are not limited to a specific plant community-rodent relationship. Correlations indicate that voles are associated with plant communities where grasses, shrubs, and trees are major

TABLE 3. Product moment correlations among understory plant species and bare ground canopy cover, tree densities, and rodent abundance in southeastern Montana. * = P < 0.05, ** = P < 0.01, *** = P < 0.0001 at 146 d.f.

| | Rodents | | |
|---|---|---|---|
| | *Peromyscus maniculatus* | *Spermophilus tridecemlineatus* | *Microtus* spp. |
| Bare ground | −0.06 | 0.42*** | −0.42 |
| Total cover | 0.34*** | −0.08 | 0.44*** |
| Grasses | | | |
| *Agropyron* spp. | 0.45*** | −0.09*** | 0.21* |
| *A. smithii* | 0.34*** | 0.37*** | −0.02*** |
| *Bromus inermis* | 0.04*** | −0.14 | 0.31*** |
| *B. japonicus* | 0.47*** | −0.06 | 0.27** |
| *Elymus macouni* | 0.35*** | −0.13 | 0.23** |
| *Phleum pratense* | 0.22** | −0.14 | 0.36*** |
| *Poa* spp. | 0.25** | −0.19* | 0.53*** |
| Shrubs | | | |
| *Artemisia tridentata* | 0.05 | 0.21* | 0.22** |
| *Symphoricarpos* spp. | 0.17* | −0.15 | 0.49*** |
| *Opuntia polyacantha* | 0.10 | 0.48*** | −0.21* |
| Trees | | | |
| *Acer negundo* | −0.06 | −0.16 | 0.48*** |
| *Fraxinus pennsylvanicus* | 0.04 | −0.23** | 0.50*** |
| *Prunus virginianus* | 0.001 | −0.14 | 0.37*** |
| *Salix amygdaloides* | 0.30*** | −0.01 | −0.05 |

features. Vole abundance was highest in riparian communities where grass, shrub, and tree abundance was great. Deer mice were also associated with areas of abundant grass cover, and peachleaf willow density was also a major habitat feature. Deer mice were abundant over the entire study area, but most abundant in riparian habitat where grass cover was greatest and peachleaf willow was present. Thirteen-lined ground squirrels were associated with grass cover as well as plains prickly pear, and bare ground. These ground squirrels were captured in every area except those occupied by pine communities. Ground squirrels, which were most abundant in sagebrush and grassland communities, were also captured in a riparian area that was in close juxtaposition to both a sagebrush and grassland community.

It should be noted that correlations do not necessarily represent cause and effect relationships. Rodents in southeastern Montana may occupy habitat based on features other than plant cover. These features may be correlated with plant abundance, as are seed production, insect populations, and moisture gradients. Nevertheless, cover provided by plants is one of many important habitat features.

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