Cattle Grazing and Small Mammals on the Sheldon National Wildlife Refuge, Nevada[1]

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Abstract.—We studied effects of cattle grazing on small mammal microhabitat and abundance in northwestern Nevada. Abundance, diversity, and microhabitat were compared between a 375-ha cattle exclosure and a deferred-rotation grazing allotment which had a three-year history of light to moderate use. No consistent differences were found in abundance, diversity, or microhabitat between the two areas.

Grazing by livestock is a common and economically important practice throughout much of the western United States. Because grazing alters wildlife habitat, much attention has centered on its impact on wildlife abundance, diversity, and habitat use. However, relatively little information exists on effects of grazing on small mammal communities. Such information would aid development of effective grazing programs where small mammals are a management concern.

Several authors have demonstrated that removal or alteration of cover can cause changes in small mammal communities (Birney et al. 1976, Geier and Best 1980, Grant et al. 1982, LoBue and Darnell 1959). More specifically, grazing altered rodent species diversity through changes in plant species diversity on several habitats in northeastern California (Hanley and Page 1982). Similarly, Grant et al. (1982) found differential changes in several small mammal community parameters between grazed and ungrazed sites in four western grassland communities; tallgrass and montane grasslands appeared to be most affected by grazing.

In assessing grazing impacts on small mammal communities, Hanley and Page (1982) stressed the importance of evaluating effects on a habitat-type basis. Grant et al. (1982) concluded that the response of a small mammal community to grazing depended on the site and the original mammal species composition.

In 1980, the Sheldon National Wildlife Refuge (SNWR) initiated a deferred-rotation grazing system on the 6,954-ha Badger Mountain grazing allotment to improve soil and range conditions. The management plan was designed to graze 1,444 animal-unit-months (AUMs) with the grazing period alternating between mid-June through early August during one year and early August through late October the next (five-year average, David Franzen, Range Conservationist, SNWR, pers. comm.). Prior to 1979, the allotment had been on a season-long grazing system from early April through September with an estimated 1,700 AUMs being removed from the unit (U.S. Fish and Wildlife Service 1980).

In Spring 1981, we constructed a 375-ha cattle exclosure on the Badger Mountain allotment to evaluate the effects of cattle grazing on wildlife and their habitat (Oldemeyer et al. 1983). The purpose of this element of the study was to evaluate the effect of the grazing system on small mammals. Specifically, we wanted to determine the following: (1) is there a difference in small mammal abundance and diversity between the areas over time, (2) is there a difference in the available small mammal habitat between areas, and (3) what microhabitat characteristics are indicative of capture sites by individual small mammal species for the two ecosites? We tested the null hypothesis of no significant difference between the exclosure and the allotment.

Study Area and Methods

The Badger Mountain allotment ranges from 1,890-2,152 m elevation and is composed of two dominant range ecosites (Anderson 1978). The shrubby rolling hills (SRH) ecosite occurs on moderate to deep soils and is dominated by big sagebrush *(Artemisia tridentata)* and antelope bitterbrush *(Purshia tridentata)* with grass understory dominated by Idaho fescue *(Festuca idahoensis)*. The mahogany rockland (MR) ecosite occurs on rocky ridges and slopes with bedrock outcrops. Curlleaf mountain mahogany *(Cercocarpus ledifolius)* is predominate in this ecosite with a grass understory dominated by western needlegrass *(Stipa occidentalis)* (fig. 1). Precipitation on Badger Mountain ranges from 27-33 cm an-

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nually with most coming as snow and as spring and autumn rains (U.S. Fish and Wildlife Service 1980).

We conducted the study during the summers of 1983 and 1984, four and five years, respectively, after initiation of the deferred-rotation grazing system. Grazing intensities were 1,650 AUMs from 10 July to 10 August, 1980, 1,770 AUMs from 7 August to 30 September, 1981, and 1,036 AUMs from 24 June to 22 August, 1982. In 1983, cattle were grazed on the allotment from 1 August through 15 October at a rate of 980 AUMs. The following year, the unit supported 1,337 AUMs during a 28 June to 18 August grazing period (David Franzen, Range Conservationist, SNWR, pers. comm.).

In 1983, eight live trap grids were established with trap stations 15 m apart. Four grids were located inside the exclosure and four were located in the allotment. We arranged each 7 X 7 grid so that approximately half of the traps were in the SRH ecosite and half were in the MR ecosite. We sampled only four grids (two in the exclosure and two in the allotment) in 1984, but we increased the size of the grids to 64 (8 X 8) trap stations.

We trapped from 1 July through 11 August in 1983, and 19 June through 1 July in 1984. Only one pair of grids were trapped at a time (one grid in the exclosure, one in the allotment), for a total of four trap sessions in 1983, and two sessions in 1984. A Sherman live trap containing a handful of cotton wool and baited with rolled oats was placed at each station. Trapping began in the afternoon and continued for five consecutive days. Traps were opened each day between 1600-1730 hrs and closed the following morning between 0730-1100 hrs to prevent daytime trap mortality. Species, trap number, age (adult or juvenile), sex, weight and tag number were recorded. We used toe clips or aluminum ear tags to identify individuals.

We estimated relative abundance of small mammals as the total number of individuals captured per trap night (catch/effort) for each ecosite type, area and grid. Abundance was calculated for all small mammals as well as for each individual species.

Small mammal diversity was derived for each area using Patil and Taillie's (1979) diversity profiles. This is a graphic ordering of the diversity of two or more communities. The y-axis represents the percent of small mammals remaining in the sampled population when a species is removed. This is plotted against the number of species that have been removed from the sampled population, with species removal being cumulative.

The profile of an intrinsically more diverse community will plot above that of a less diverse community. If profile lines intersect, then the communities do not differ in diversity.

Vegetation measurements describing microhabitat structure were taken at each station prior to trapping. The characteristics we measured are similar to those reported in other small mammal studies (e.g. Geier and Best 1980, Hallett 1982). These included:

1. Percent canopy cover of grass, forbs, and litter (all downed dead material; e.g. twigs, dead grass, leaves) in a 1.0 X 0.5 m quadrat having the trap station stake as its center;

2. Height (cm) of the nearest shrub (crown foliage >2 dm in diameter) in each quarter around the trap station stake;

3. Line intercept distance (cm) of living and dead shrubs (in the 25 to 50 cm layer above the ground) occurring within two perpendicularly oriented 2-m transects centered at the trap station stake.

Five microhabitat variables were derived from these measurements for analysis. These included: (1) % forb cover, (2) % grass cover, (3) % litter cover, (4) total shrub interception distance (cm), and (5) mean height (cm) of the live shrubs around each stake.

Small mammal abundance data were analyzed using a three-way analysis of variance to determine if

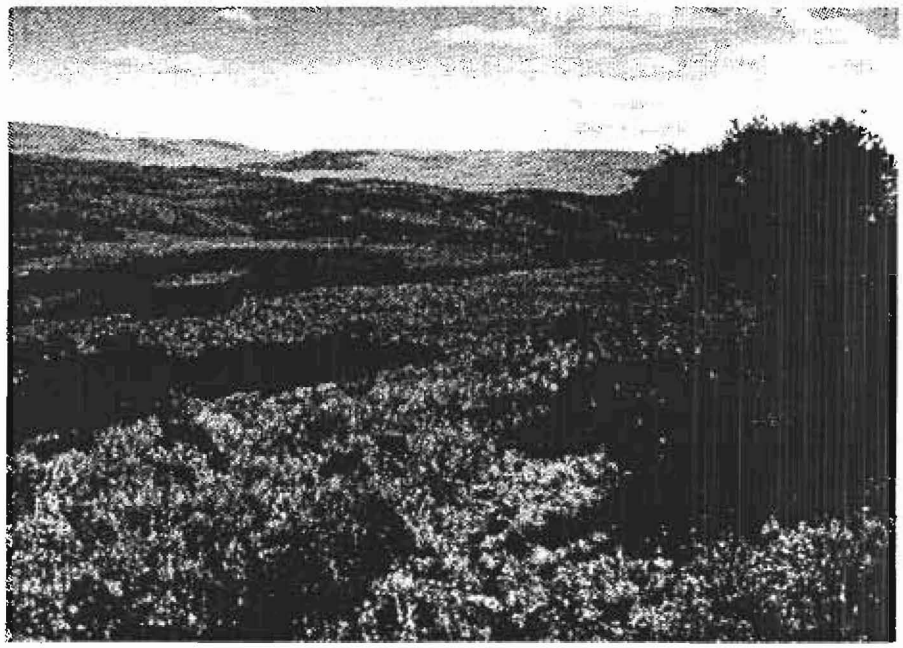

Figure 1.—View from the study site on Badger Mountain, Sheldon National Wildlife Refuge, Nevada.

small mammal abundance differed between areas, years, and ecosites. We used a one-way analysis of variance test to detect differences between areas for individual years and ecosites. To determine the microhabitat preferences of individual species we coded trap locations as being either capture or non-capture stations. We employed a nested two-way analysis of variance to test these preferences among areas and codes, the interaction of areas by codes, and the nested interaction of grids within areas. We considered P<=0.1 to be significant. Subsequent discussion of small mammal microhabitat selection concerns only the two most abundant species, the deer mouse *(Peromyscus maniculatus)* and the least chipmunk *(Tamias minimus)*.

Results and Discussion

Species Composition

Species of small mammals occurring in the two ecosites of our study area are widely distributed throughout the Great Basin (Hall 1946). These species and their percentage of the total catch were: deer mouse (46.7%), least chipmunk (29.8%), Great Basin pocket mouse *(Perognathus parvus)* (12.3%), sagebrush vole *(Lagurus curtatus)* (7.8%), Townsend's ground squirrel *(Spermophilus townsendii)* (1.2%), golden-mantled ground squirrel *(Spermophilus lateralis)* (1.2%), and long-tailed vole *(Microtus longicaudis)* (0.6%).

Abundance

Total relative abundance of small mammals did not differ between year or area (table 1). However, more animals were captured in the SRH ecosite than in the MR ecosite (P=0.05).

There was a general decline in deer mouse (P=0.08) and least chipmunk (P=0.06) abundance from 1983 to 1984, although this probably reflects the difference in season and length of trapping between the two years. We found no significant difference in abundance for these two species between areas or ecosites. This is not surprising given the opportunistic, adaptable, nature of these small mammals. Others have found that heavy grazing in big sagebrush habitat appears to promote an increase in deer mice (Black and Frischknecht 1971, Larrison and Johnson 1973), and least chipmunk numbers (Larrison and Johnson 1973). Hanley and Page (1982) observed a different response for the two species on their big sagebrush-Idaho fescue site 60-80 km west of Badger Mountain. In that study, deer mice were captured in the same numbers in both grazed and ungrazed sites, while least chipmunks were four times more abundant in the grazed site than in the ungrazed site.

Great Basin pocket mice were more abundant (P<0.01) in 1983 than 1984, and they were more commonly captured in the SRH ecosite than in the MR ecosite (P=0.08). However, there was no significant difference in abundance between the areas. Others have found Great Basin pocket mice to be more abundant on ungrazed big sagebrush sites (Black and Fris-

Table 1.—Abundance of small mammals (number caught per trap night) by year, area and ecosite on the Sheldon National Wildlife Refuge, 1983-84.

Species	Area	Shrubby-Rolling Hills		Mohogany Rocklands	
		1983 #/trapnite(S.E.)	1984 #/trapnite(S.E.)	1983 #/trapnite(S.E.)	1984 #/trapnite(S.E)
Deer mouse	Excl.	0.081(0.012)	0.047(0.014)	0.061(0.019)	0.050(0.011)
	Allot.	0.063(0.005)	0.052(0.017)	0.064(0.027)	0.018(0.002)
Least chipmunk	Excl.	0.029(0.007)	0.020(0.005)	0.067(0.017)	0.037(0.006)
	Allot.	0.046(0.025)	0.031(0.010)	0.049(0.011)	0.005(0.005)
Great Basin pocket mouse	Excl.	0.013(0.005)	0.028(0.003)	0.003(0.003)	0.029(0.014)
	Allot.	0.011(0.007)	0.031(0.004)	0.005(0.003)	0.014(0.006)
Sagebrush vole	Excl.	0.019(0.010)	0.038(0.020)	0.002(0.002)	0.004(0.004)
	Allot.	0.004(0.003)	0.019(0.004)	0	0
Long-tailed vole	Excl.	0	0.004(0.004)	0	0
	Allot.	0	0.009(0.002)	0	0
Townsend's ground squirrel	Excl.	0	0	0	0
	Allot.	0.005(0.005)	0	0	0.005(0.005)
Golden-mantled ground squirrel	Excl.	0.006(0.006)	0	0.007(0.007)	0
	Allot.	0	0	0	0
Total Catch	Excl.	0.149(0.013)	0.135(0.027)	0.141(0.024)	0.120(0.028)
	Allot.	0.154(0.030)	0.143(0.005)	0.119(0.026)	0.042(0.018)

chknecht 1971), or more abundant on grazed sagebrush sites (Hanley and Page (1982).

Relative abundance of the sagebrush voles and long-tailed voles could not be compared statistically because of the small number of voles captured. There was, however, a general trend for microtine rodents to be more abundant in the SRH ecosite even though grass and forb cover in the MR ecosite were higher. Birney et al. (1976) and Grant et al. (1982) have discussed the importance of cover for microtine rodents in grasslands. Although grass cover was lower in the SRH ecosite, the combination of higher litter cover and shrub intercept in that ecosite may provide better habitat for these rodents. The sagebrush vole was more abundant in the exclosure than in the allotment. Although we were unable to test this trend, it is possible that the sagebrush vole found the exclosure, with its slightly greater grass and shrub cover, to be more inhabitable. It is apparent from other studies that grass and shrub cover are important components of sagebrush vole habitat (MacCracken et al. 1985, Maser et al. 1974, Maser and Strickler 1978, O'Farrell 1972).

Diversity

In 1983, diversity of small mammals in the exclosure was greater than in the grazing allotment (fig. 2). Relative abundance of deer mice, the most common species (table 1), was similar in both areas; however, we caught one more species in the exclosure. In 1984, small mammal diversity was greater in the allotment than in the exclosure. During that year, deer mice made up a somewhat smaller relative proportion of the small mammal total in the allotment (table 1); thus the line for the allotment starts higher on figure 2 indicating greater evenness in the percentage each species contributed to the population. We captured one more species in the allotment than in the exclosure which extended the tail of the profile further to the right. Because of this change from one year to the next, we were unable to conclude what impact the grazing system had on small mammal diversity. Hanley and Page (1982) observed a higher diversity index on their ungrazed sagebrush-Idaho fescue site 60-80 km west of Badger Mountain.

Vegetation on the Small Mammal Study Area

Generally, the SRH ecosite had lower grass and litter cover and a greater

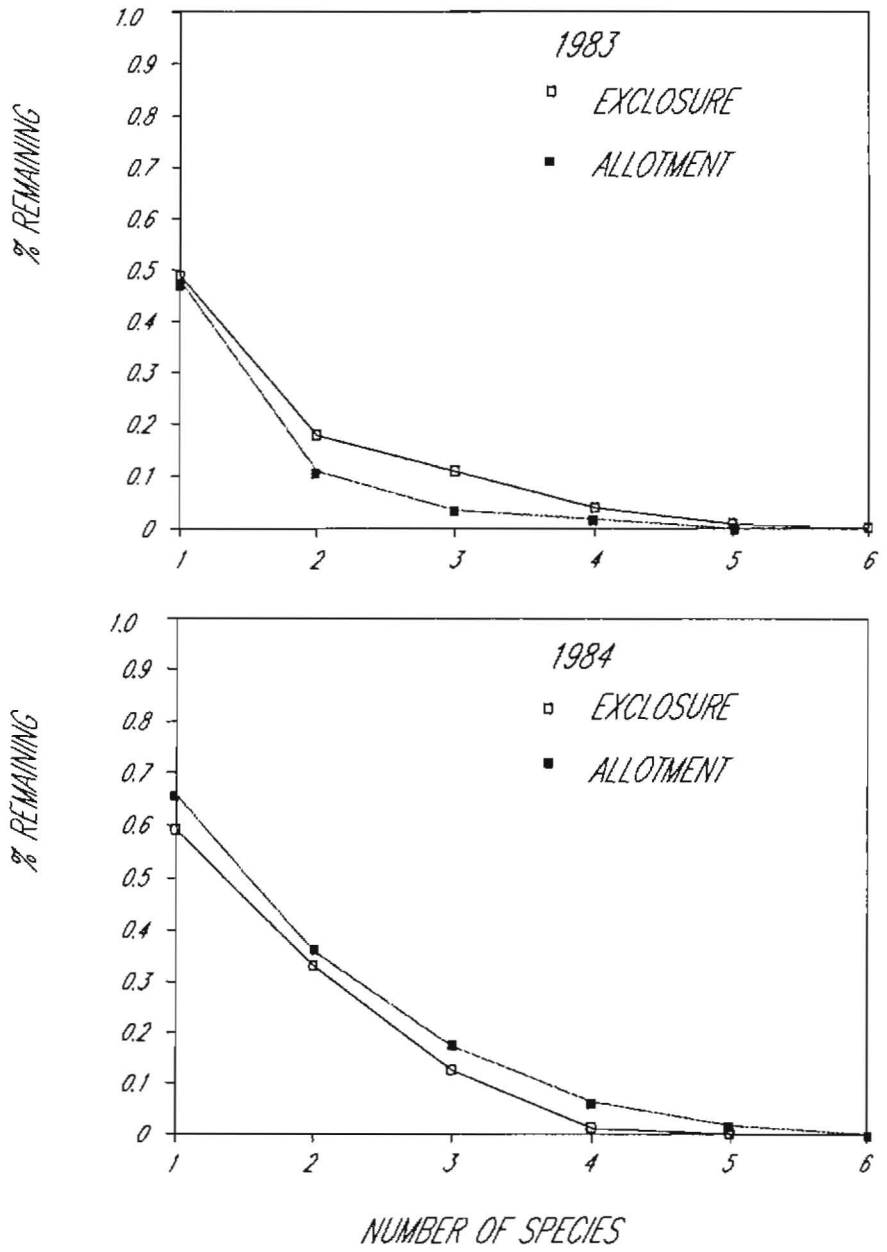

Figure 2.—Small mammal diversity profiles for the cattle exclosure and the allotment, Sheldon National Wildlife Refuge, 1983-84. If profile lines intersect, then diversity does not differ between areas (Patil and Taillie 1979).

shrub intercept value than did the MR ecosite (fig. 3). In the SRH ecosite, microhabitat characteristics did not differ between the exclosure and allotment, except for 1983 when shrub height in the allotment was lower (P<0.05) than that in the exclosure. In the MR ecosite, shrub intercept was lower (P<0.03) in the allotment than in the exclosure both years and grass cover was higher (P<0.10) in the exclosure in 1983. In both ecosites, there was a general trend for cover of both grasses and forbs to be lower in the allotment than in the exclosure.

This trend is probably due to the cattle grazing. However, the fact that the means are relatively similar (especially in the SRH ecosite) and do not differ significantly between areas indicates that the grazing effect is within goals established by the refuge.

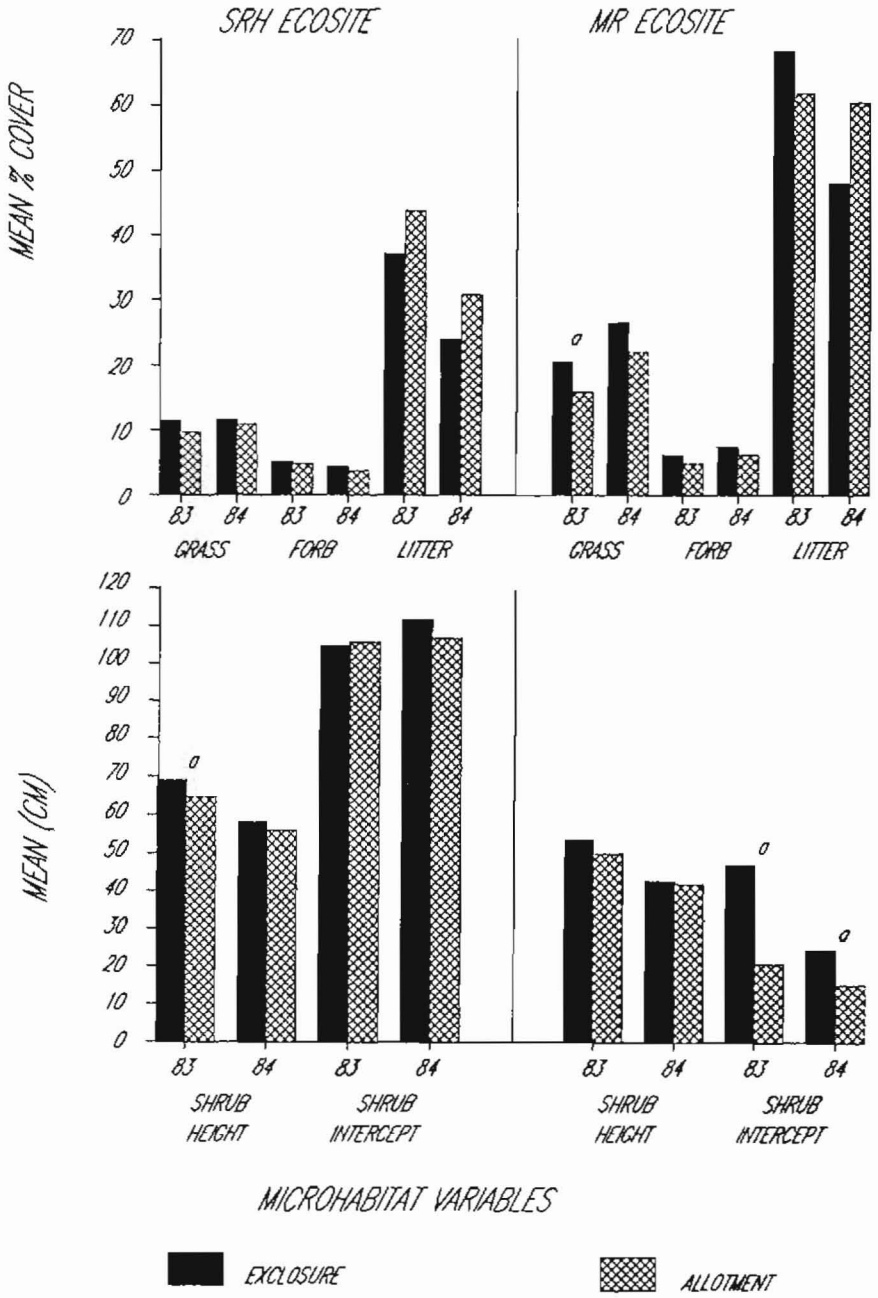

Figure 3.—Microhabitat characteristics around trap stations in the shrubby-rolling hills and mahogany rocklands, Sheldon National Wildlife Refuge. Variables with an "a" denote a P value of <0.1 between the two areas.

Microhabitat Characteristics of Deer Mice Catch Sites

In the SRH ecosite, traps where deer mice were caught had significantly greater litter cover (P=0.07 in 1984), shorter shrubs (P=0.09 in 1984), and greater shrub intercept (P=0.10 in 1983) than traps where deer mice were not caught (fig. 4). These patterns tended to hold for both years.

In the MR ecosite, litter cover, which is greater than in the SRH ecosite, did not appear to be a significant vegetative characteristic (fig. 4). Grass cover in 1984 was lower (P=0.06) and shrub height (P=0.02) and shrub intercept (P=0.08) were greater at traps where deer mice were caught than where they were not caught.

In both the SRH and MR ecosites, deer mice appeared to use microhabitat that had greater shrub intercept. This corresponds with the findings of Feldhamer (1979) who noted an increase in deer mouse density with increased foliage in the shrub layer. Other studies have found that deer mice were associated with light cover in heavily grazed sites (Black and Frischknecht 1971), with increasing forb cover (Geier and Best 1980), or with no measured habitat variable (Hallett 1982).

Microhabitat Characteristics of Chipmunk Catch Sites

In the SRH ecosite, shrub height was lower (P<0.08 in 1984) in catch locations in the exclosure and the allot-

ment than in non-catch locations. This pattern held in 1983 (fig. 5).

In the MR ecosite there were no consistent patterns of chipmunk microhabitat use (fig. 5). Shrub interception, in 1984, was greater ($P<0.05$) in chipmunk catch locations than non-catch locations; however this pattern was not evident in 1983.

Microhabitat selection by the least chipmunk lacked a consistent pattern for either ecosite or year. However, the fact that the least chipmunk is an opportunistic forager and is the most widespread of all North American chipmunks (Hall 1981), suggests that this rodent adapts rapidly to a variety of habitat types. Sullivan (1985) found that the least chipmunk was associated with a wide variety of ecological situations in the southwest and suggested that this species may be predisposed to exploiting marginal environments.

Conclusions

These results indicate that the grazing regime initiated on the Badger Mountain allotment had no discernible impact on the relative abundance and diversity of small mammals, four and five years after its implementation. The dominance of two opportunistic species on the study area probably contributed to this lack of difference. We suggest future monitoring of the study area to determine the long-term response of small mammals to the grazing program. Particular attention should be given to the two vole species which are the most sensitive to changes in cover.

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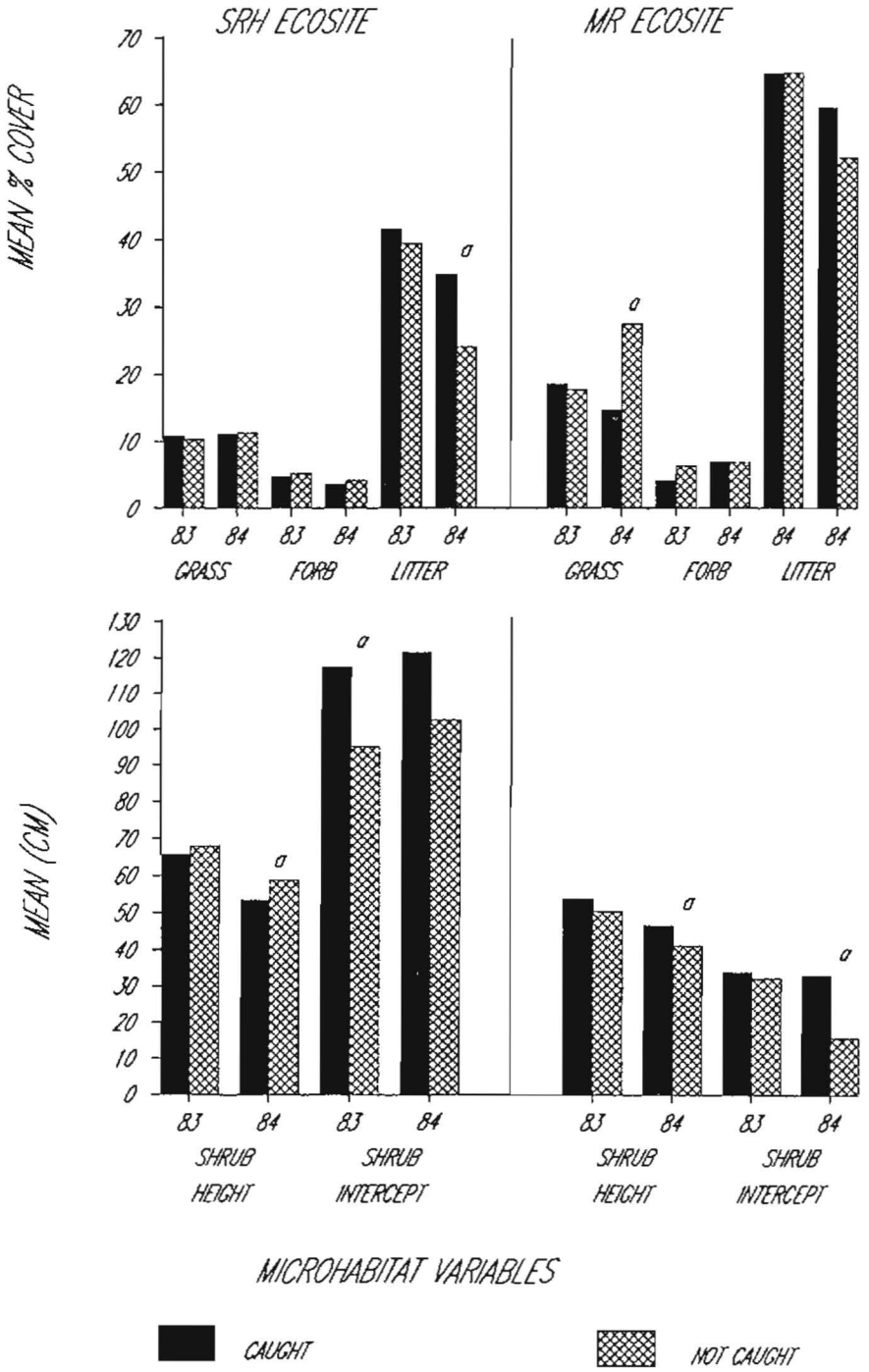

Figure 4.—Microhabitat characteristics around traps where deer mice were captured and not captured by year and ecosite, Sheldon National Wildlife Refuge. Variables with an "a" denote a P value of <0.1 between the two areas.

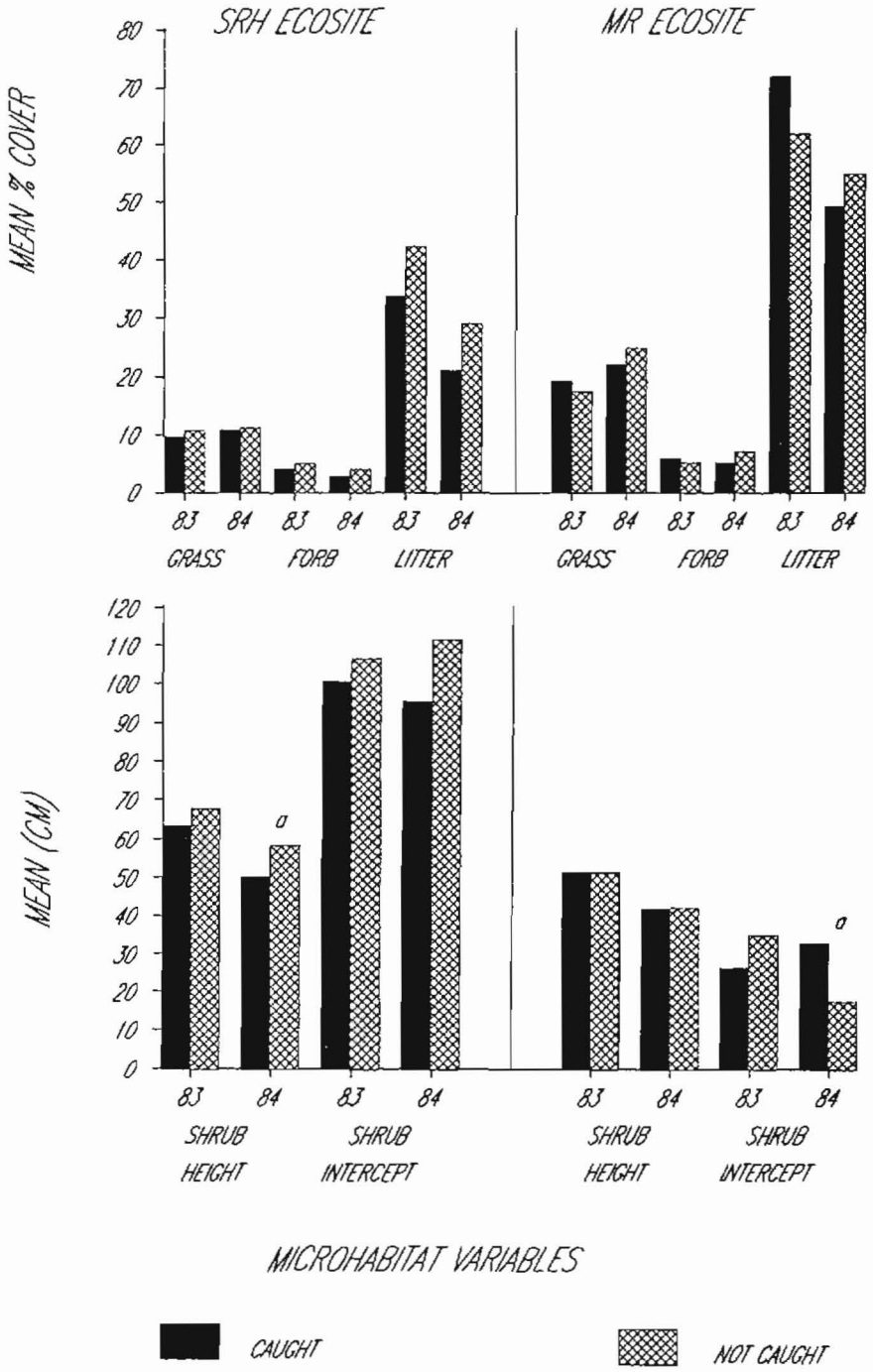

Figure 5.—Microhabitat characteristics around traps where least chipmunks were captured and not captured by year and ecosite, Sheldon National Wildlife Refuge. Variables with an "a" denote a P value of <0.1 between the two areas.

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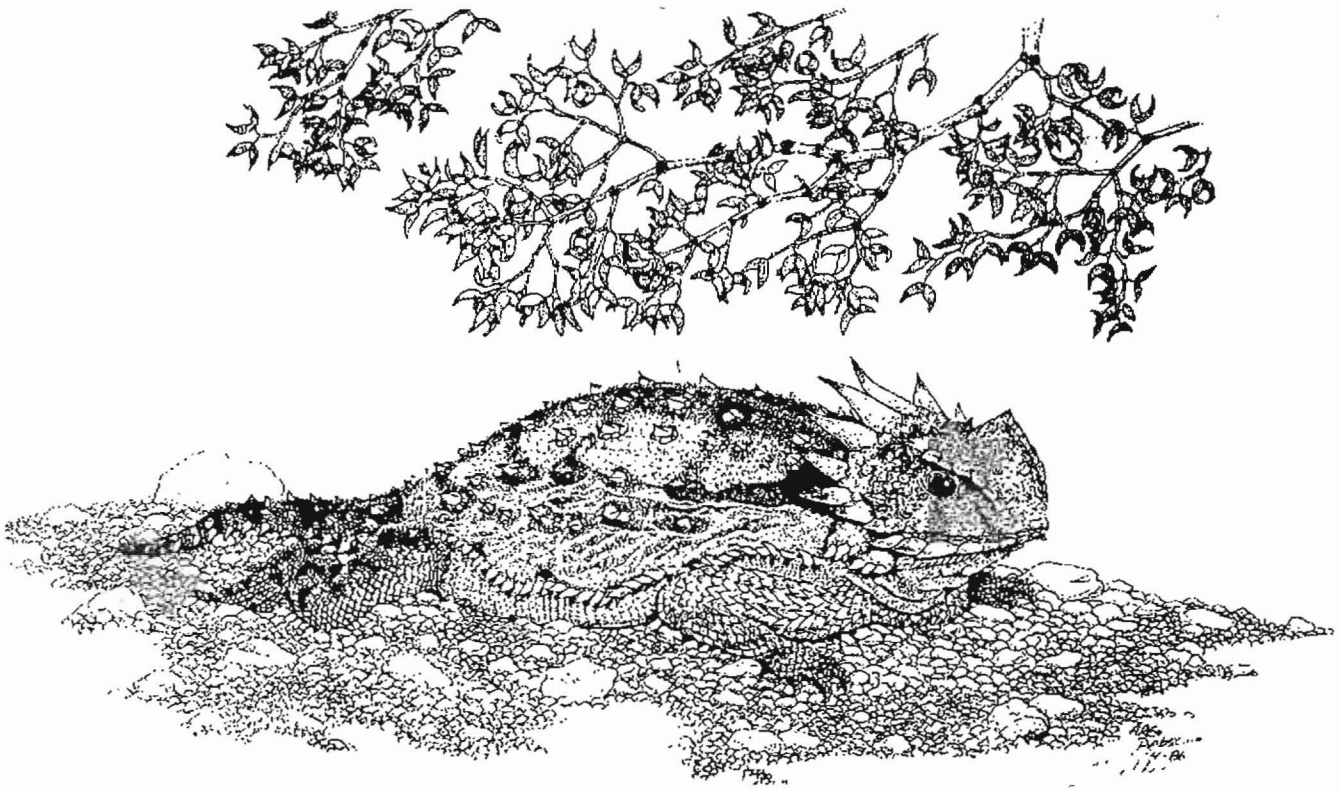

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