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Small Mammal Populations in a Grazed and Ungrazed Riparian Habitat in Nevada

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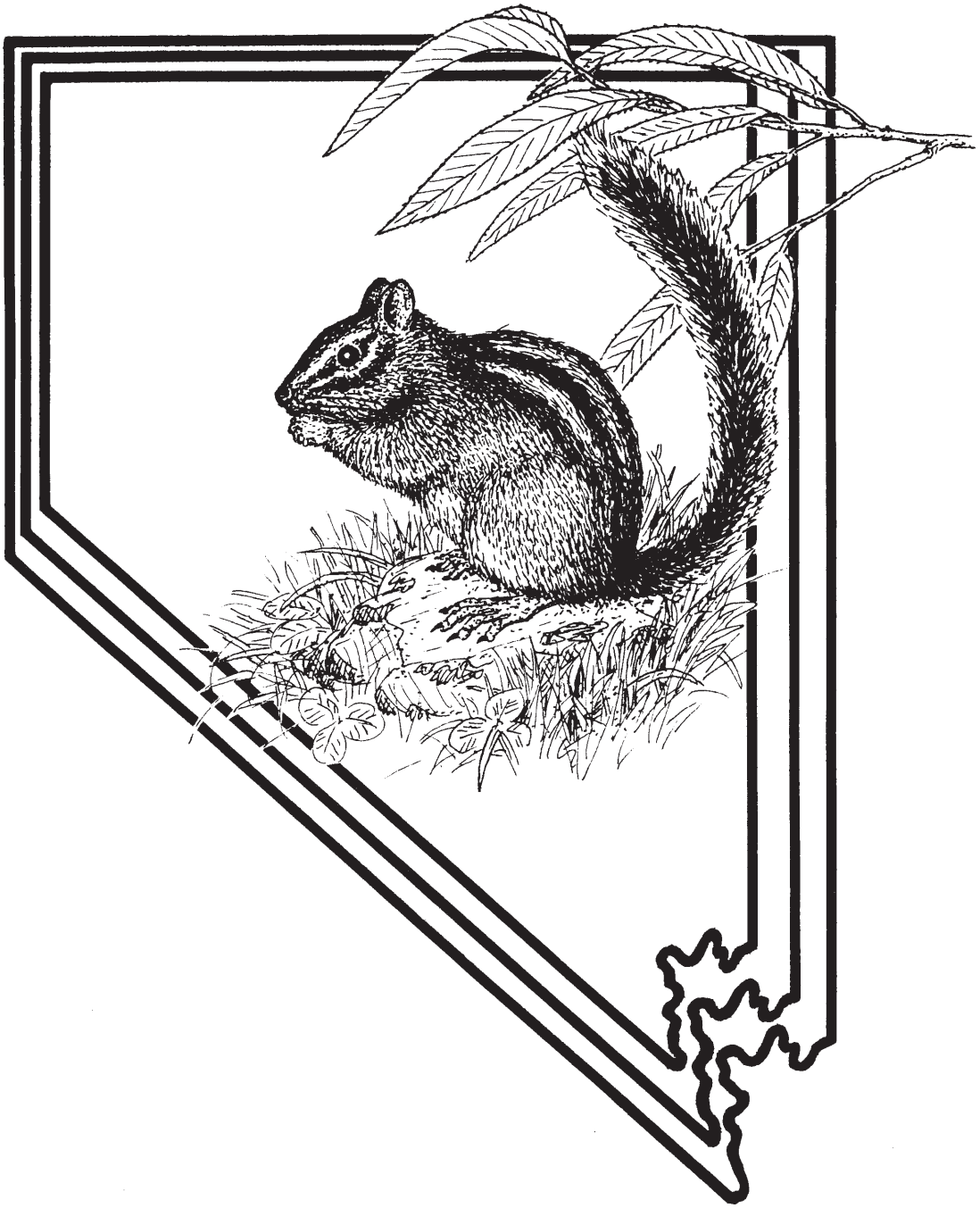

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RESEARCH SUMMARY

Community composition and relative abundance of small mammal populations were compared between an aspen (*Populus tremuloides*)/willow (*Salix* spp.) riparian habitat seasonally grazed by cattle and a comparable adjoining habitat protected from grazing for the previous 11 years by an exclosure. The exclosure, constructed in 1977, is on the West Fork of Deer Creek in northeastern Nevada. Small mammal populations were compared by removal trapping over a 5-day period in late summer 1988.

Four species accounted for 82 percent of the total number of individual animals trapped. These were deer mouse (*Peromyscus maniculatus*), western jumping mouse (*Zapus princeps*), least chipmunk (*Tamias minimus*), and Great Basin pocket mouse (*Perognathus parvus*).

Other small mammals trapped either irregularly or in smaller numbers on the study site included golden-mantled ground squirrel (*Spermophilus lateralis*), vagrant shrew (*Sorex vagrans*), long-tailed vole (*Microtus longicaudus*), montane vole (*Microtus montanus*), Townsend's ground squirrel (*Spermophilus townsendii*), northern pocket gopher (*Thomomys talpoides*), and bushy-tailed woodrat (*Neotoma cinerea*).

Estimated density of small mammals was over a third higher in the ungrazed habitat as compared to the grazed area. Small mammal standing crop biomass, species richness, and species diversity were 3.24, 1.83, and 1.25 times higher, respectively, on the ungrazed site. Each of the 11 species recorded during the study was trapped inside the protected area. Only six species were trapped in the grazed habitat. The grazed study site did not appear to have received excessive use by cattle in recent years compared to nearby riparian habitats.

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INTRODUCTION

Small mammals constitute a major part of wildlife communities in riparian habitats. They may fill important roles in ecosystem function (Sieg 1988). Small mammals have significant influences on vegetation and soils, exert predatory pressure on insects and other small mammals, and provide an important prey base for mammalian, reptilian, and avian predators. Small mammals are among the least studied and most poorly understood taxonomic groups in the riparian habitat (Szaro 1988).

Riparian ecosystems are sensitive to livestock grazing. Grazing by cattle can alter the structure and composition of riparian plant communities (Kauffman and Krueger 1984). Alterations in vegetational features may, in turn, affect the quality of the riparian habitat for small mammals (Kauffman and others 1982; Moulton 1978). The effects of grazing are amplified in the geographically limited riparian landscapes of the arid and semiarid West.

We compare community composition and the relative abundance of small mammal populations between a riparian habitat grazed by cattle and a comparable adjacent area protected from grazing for the previous 11 years by a large (100+ acres) fenced exclosure. The exclosure, constructed in 1977, is on the West Fork of Deer Creek in northeastern Nevada. Small mammal populations were compared by removal trapping during late summer 1988.

STUDY AREA

The Deer Creek study site is 34 miles north of Wells in Elko County, NV, at an elevation of about 6,200 ft. It is near the southern boundary of the Columbia Plateau (Fenneman 1931) in the Salmon Falls Creek drainage. The Great Basin lies immediately south. West Fork of Deer Creek originates from springs and flows in a narrow, V-shaped canyon cut in mid-Tertiary rhyolitic rock. Soils are generally fine-textured; depths range from shallow on steep residual slopes to deep on relatively level alluvial fans and floodplains (Platts and others 1988).

Average annual precipitation at Wells (elevation 5,650 ft) is about 10 inches, with peaks in May and June and November and December. Mean annual snowfall is 60 inches. The growing season is short, averaging less than 100 days at Wells. Warm days and cool nights provide a large difference in daily high and low temperatures (U.S. Department of Commerce 1970).

Eight major and several minor vegetation community types were identified in the riparian zone and adjoining upland (Platts and others 1988). For our study, we consolidated the community types into six general categories based on similarities in vegetational composition and structure:

Kentucky bluegrass (*Poa pratensis*)
Willow (*Salix* spp.)/mesic herbaceous
Big sagebrush (*Artemisia tridentata*)/Kentucky bluegrass
Big sagebrush/upland
Aspen (*Populus tremuloides*)/mesic herbaceous
Aspen/big sagebrush

The stream is closely bordered by clumped communities of aspen, willow, and other deciduous shrubs including common chokecherry (*Prunus virginiana*), golden currant (*Ribes aureum*), redosier dogwood (*Cornus stolonifera*), and Woods rose (*Rosa woodsii*). Slender wheatgrass (*Agropyron trachycaulum*), Kentucky bluegrass, Baltic rush (*Juncus balticus*), field horsetail (*Equisetum arvense*), and common dandelion (*Taraxacum officinale*) are common grasses and forbs.

The gallery-like riparian zone is isolated from similar arboreal vegetation by a surrounding mosaic of upland shrub habitats dominated by sagebrush and including rubber rabbitbrush (*Chrysothamnus nauseosus*), Woods rose, bush oceanspray (*Holodiscus dumosus*), antelope bitterbrush (*Purshia tridentata*), and mountain snowberry (*Symphoricarpos oreophilus*). Cheatgrass (*Bromus tectorum*), basin wildrye (*Elymus cinereus*), Sandberg bluegrass (*Poa secunda*), tansymustard (*Descurainia* spp.), and white stoneseed (*Lithospermum ruderale*) are common associates.

Floodplains with dead and downed aspen are common both inside and outside the exclosure. These remnants of aspen/mesic herbaceous communities were once flooded by beaver impoundments that killed the aspen. Although washed-out dams are still evident, there is no current evidence of beaver activity.

The 11,555-acre Deer Creek pasture, located largely on public lands under the jurisdiction of the Bureau of Land Management, U.S. Department of the Interior, has an estimated grazing capacity of 2,495 animal unit months (AUM's). Records indicate that during the 1960's and 1970's, seasonal (May through September) stocking levels were about 4,000 to 5,000 AUM's. Historic grazing levels were much higher (Crispin 1981). Recent stocking has varied from about 2,300 to 4,100 AUM's with a grazing season from about mid-July to mid-November (table 1).

Table 1—Livestock grazing summary for the 11,555-acre Deer Creek pasture, Nevada, 1978 to 1988[1]

Year	Season of use	Animal unit months	Type of livestock
1978	7/15-11/29	2,680	Yearlings, cows, bulls
1979	7/16-11/22	4,140	Cows, bulls
1980	8/07-10/19	2,310	Cows, bulls
1981	7/12-10/10	2,800	Cows, bulls
1982	No information	No information	No information
1983	8/09-11/15	3,150	Cows
1984	8/01-10/09	2,310	Cows, bulls
1985	7/15-10/10	2,720	Cows, bulls
1986	7/17-10/15	2,990	Cows
1987	8/16-11/15	2,600	Cows, bulls
1988	7/19-10/25	2,780	Cows, bulls

[1]From Phillips (1989).

METHODS

The rectangular cattle exclosure, about 3,200 ft long and of variable width, is oriented lengthwise along the West Fork. Two 2.8-acre trapping grids, one in the upper section of the exclosure and the other in the adjoining (upstream) unprotected area, were established to estimate small mammal populations. The trapping grids were placed near the center of larger (22.5-acre) plots established to census bird populations (Medin and Clary in press). Grazed and ungrazed plot locations were carefully selected on the basis of topographic and vegetational similarities. Forty trapping stations were located and marked in both the grazed and ungrazed habitats. Ten stations were placed at 82-ft intervals along two parallel trapping lines on each side of the stream. The inner lines were placed near the edge of the stream; the outer lines were placed 82 ft from the stream.

Two Museum Special mouse traps and one Victor rat trap were placed near each station. Traps were baited with a mixture of peanut butter and rolled oats and examined daily for 5 consecutive days from July 20 to 24, 1988.

Vegetation and other features of the grazed and ungrazed areas were measured from August 15 to September 2, 1988. A 50- by 50-cm (0.25-m^2) quadrat was located at each of 12 systematically positioned sample locations in each vegetation community type-treatment combination for a sample size of 72 per treatment. (All plot dimensions used in the study were in metric units.) Canopy cover (Daubenmire 1959) was ocularly estimated for the total of each plant life form (graminoid, forb, shrub) and recorded as the midpoint of one of eight percent cover classes (0-1, 1-5, 5-10, 10-25, 25-50, 50-75, 75-95, 95-100). Percentages of litter, rock, bare ground, and lichen-moss were similarly estimated. The vegetative height (excluding flower and seed-head heights) of each graminoid, forb, and shrub nearest the center of each quadrat was recorded.

Biomass of graminoids, forbs, and small shrubs was estimated by clipping vegetation from ground level upward within a vertical projection from the 0.25-m^2 quadrats. Clipped materials were bagged, ovendried, and weighed. A 3- by 3-m (9-m^2) plot, concentric to each 0.25-m^2 quadrat, was used to sample biomass of large and medium shrubs. Basal diameter, maximum height, and species were recorded for each shrub stem rooted within the plot. Equations provided by Brown (1976) were used to estimate shrub biomass.

Height and diameter at breast height (d.b.h.) were recorded for each tree stem rooted within 10- by 10-m (100-m^2) plots that were concentric to each 0.25-m^2 quadrat. Biomass of downed woody material was sampled midway between vegetation sample plots. The methods followed Brown (1974) except that slope corrections were not made and there were no measures of litter or duff depth.

Scientific and common names of small mammal species follow Jones and others (1982). Authorities for plant names are in Welsh and others (1981).

RESULTS AND DISCUSSION

Few structural (physiognomic) differences in vegetation existed between the grazed and ungrazed sites on Deer Creek. Eleven species of small mammels were trapped on the study sites.

Vegetation

The most evident structural difference was in the herbaceous layer where graminoid biomass and graminoid and forb height values were reduced on the grazed site (table 2). Graminoid biomass on the grazed plot was only about half that inside the exclosure. Shrub biomass, mostly willows, was not significantly different on the grazed and ungrazed sites. Estimates of graminoid, forb, and shrub canopy coverage were similar on the grazed and ungrazed areas. The relatively larger standard deviation (SD) of the shrub biomass component on the ungrazed area suggests more structural variability in that vegetation factor on the protected plot.

Tree density, including all size classes, was 442 stems per acre on the ungrazed plot and 415 stems per acre on the grazed plot (table 2). Aspen was the only tree species found on the study area. Patches of live aspen of various

Table 2—Vegetation and other features of grazed and ungrazed study plots, Deer Creek, Nevada, 1988

Item	Ungrazed		Grazed		Probability[2]
	$\bar{x}$[1]	SD	$\bar{x}$[1]	SD	
Graminoid					
Biomass (lb/acre)	1,538	1,135	806	621	< 0.001
Canopy cover (%)	50.5	21.7	49.4	22.6	.766
Height (ft)	1.2	.5	.8	.7	< .001
Forb					
Biomass (lb/acre)	135	147	127	131	.716
Canopy cover (%)	7.1	8.8	6.8	9.2	.842
Height (ft)	.5	.4	.4	.4	.068
Shrub					
Biomass (lb/acre)	15,275	87,207	12,090	30,229	.770
Canopy cover (%)	6.7	13.3	6.9	13.2	.928
Height (ft)	4.0	3.4	4.4	3.9	.542
Tree					
Density (n/acre)	442	608	415	818	.819
Diameter (inches)	2.6	1.5	3.0	3.0	.230
Height (ft)	19.4	10.8	22.3	17.7	.241
Other					
Downed woody (lb/acre)[3]	45,182	33,066	71,413	50,722	<.001
Bare ground (%)	10.4	18.5	11.6	14.6	.666
Litter (%)	26.1	19.3	23.1	17.4	.329
Rock (%)	5.4	14.6	8.1	18.4	.331
Lichen-moss (%)	.1	.9	< .1	.4	.606

[1] $N = 72$.
[2] Probabilities associated with unpaired *t*-tests. Small probabilities suggest a significant difference between grazed and ungrazed areas.
[3] Dead twigs, branches, stems, and boles of trees and shrubs that have fallen and lie on or above the ground.

size classes were irregularly distributed along the stream and sometimes on adjacent residual slopes. Single stems and occasional broken stumps of standing dead aspen were scattered throughout the riparian zone. A single stand of large aspen trees on the grazed area tended to inflate average values of tree diameter and height on the grazed plot.

Downed woody material, mostly the result of earlier beaver activity in the drainage, was more abundant on the grazed plot. Most of the downed woody material was aspen tree boles and branches strewn crosswise throughout much of the riparian zone. Other features of the two areas, including estimates of bare ground, rock, and litter coverage, were similar.

The grazed study site did not appear to have received excessive use by cattle in recent years compared to other riparian habitats in the general locality. The exclosure, placed across the riparian zone and including the steep adjacent uplands of the V-shaped canyon, may function as a drift fence that restricts the normal movement of cattle along the stream.

Small Mammals

The 11 species of small mammals trapped on the study site were:

vagrant shrew (*Sorex vagrans*)
least chipmunk (*Tamias minimus*)
Townsend's ground squirrel (*Spermophilus townsendii*)
golden-mantled ground squirrel (*Spermophilus lateralis*)
northern pocket gopher (*Thomomys talpoides*)
Great Basin pocket mouse (*Perognathus parvus*)
deer mouse (*Peromyscus maniculatus*)
bushy-tailed woodrat (*Neotoma cinerea*)
montane vole (*Microtus montanus*)
long-tailed vole (*Microtus longicaudus*)
western jumping mouse (*Zapus princeps*)

Of these, deer mice, western jumping mice, least chipmunks, and Great Basin pocket mice accounted for 82 percent of the total number of individual animals caught. Other species were trapped irregularly or in smaller numbers. Five species, including Townsend's ground squirrel,

northern pocket gopher, bushy-tailed woodrat, montane vole, and long-tailed vole, were trapped only in the ungrazed habitat.

The total number of small mammals trapped was larger in the protected area when compared to the grazed area (table 3). Estimated density was over a third higher in the ungrazed habitat. Further, small mammal standing crop biomass, species richness, and species diversity values were higher inside the exclosure. Each of the 11 species recorded during the study was trapped in the protected area. Only six species were trapped in the grazed habitat.

Deer Mouse—The deer mouse was the most often trapped small mammal in both the grazed and ungrazed habitats (table 3). Naive density (Johnson and others 1987) was only slightly higher on the ungrazed plot. Most of the deer mice were trapped in the big sagebrush/upland community type adjacent to the riparian zone. A few were trapped in each of the other community types sampled. The deer mouse is one of the most widespread and generalized of all North American rodents (Baker 1968). Overall, deer mice are probably Nevada's most abundant mammal (Hall 1946). They are found in a wide variety of habitats including swamps, waterways, forests, grasslands, and deserts, and among rocks and cliffs (Larrison and Johnson 1981). Thomas (1979) assigned the deer mouse a high habitat versatility rating with respect to its reproduction and feeding orientation. It occupies a variety of plant successional stages (Thomas 1979).

Others have reported contradictory results when comparing the abundance of deer mice in grazed versus ungrazed habitats. Kauffman and others (1982) found more deer mice in eastern Oregon riparian habitats after late-season grazing (late August to mid-September) than in ungrazed riparian habitats. But by late summer of the following year, and before grazing, the species composition of small mammal communities was not significantly different between grazed and ungrazed plots. Similarly, Moulton (1978) found a positive response by deer mice to grazing in a cottonwood (*Populus sargentii*) riparian habitat in eastern Colorado. Samson and others (1988) also found deer mouse densities consistently higher on grazed pastures before and after the introduction of winter grazing by cattle in an eastern Colorado cottonwood floodplain habitat. Conversely, Rucks (1978) reported fewer deer mice in grazed versus ungrazed riparian communities in the Gunnison Basin of southwestern Colorado.

Table 3—Relative abundance, naive density, diversity, and other attributes of small mammal populations on grazed and ungrazed study plots, Deer Creek, Nevada, 1988

Species	Foraging guild[1]	Relative abundance (*n*/100 trap nights)		Naive density[2] (*n*/acre)	
		Ungrazed	Grazed	Ungrazed	Grazed
Vagrant shrew (*Sorex vagrans*)	INS	0.3	0.8	0.7	1.8
Least chipmunk (*Tamias minimus*)	OMN	0.8	0.2	1.8	0.4
Townsend's ground squirrel (*Spermophilus townsendii*)	OMN	0.2	0.0	0.4	0.0
Golden-mantled ground squirrel (*Spermophilus lateralis*)	OMN	1.2	0.2	2.5	0.4
Northern pocket gopher (*Thomomys talpoides*)	HER	0.2	0.0	0.4	0.0
Great Basin pocket mouse (*Perognathus parvus*)	GRA	0.2	0.7	0.4	1.4
Deer mouse (*Peromyscus maniculatus*)	OMN	5.0	4.2	10.8	9.0
Bushy-tailed woodrat (*Neotoma cinerea*)	HER	0.2	0.0	0.4	0.0
Montane vole (*Microtus montanus*)	HER	0.2	0.0	0.4	0.0
Long-tailed vole (*Microtus longicaudus*)	HER	0.3	0.0	0.7	0.0
Western jumping mouse (*Zapus princeps*)	OMN	2.8	2.3	6.1	5.0
Total naive density (*n*/acre)				24.6	18.0
Total standing crop biomass (g/acre)				1,121	346
Species richness (*n*)				11	6
Species diversity $(1/\Sigma p_i^2)$[3]				3.62	2.89

[1]After Martin and others (1951). INS = insectivore, GRA = granivore, HER = herbivore, OMN = omnivore.
[2]After Johnson and others (1987). Effective trapping area and grid size are assumed to be identical.
[3]After Hill (1973).

Western Jumping Mouse—Jumping mice were commonly trapped in both grazed and ungrazed habitats (table 3). Most were trapped in streamside habitats with the frequency of capture highest in the Kentucky bluegrass, willow/mesic herbaceous, and aspen/mesic herbaceous community types. Rucks (1978) in Colorado and Hanley and Page (1982) in Nevada trapped the western jumping mouse only in ungrazed plant communities. Jumping mice are inhabitants of the boreal life zone in Nevada (Hall 1946). They occur most commonly adjacent to streams in alder (*Alnus* spp.), aspen, or willow habitats where moist soils support a heavy growth of herbaceous vegetation (Larrison and Johnson 1981; Linsdale 1938). Clark (1971) trapped the western jumping mouse most often in the lowland aspen community type; most were captured within 164 ft of standing water.

Least Chipmunk—More least chipmunks were trapped in the ungrazed area than in the grazed (table 3). Nearly all were caught in the big sagebrush/upland community type. The smallest of Nevada chipmunks, the least chipmunk occupies mostly sagebrush habitats from the lowest to the highest elevations (Hall 1946). They also occur in black greasewood (*Sarcobatus vermiculatus*) communities at low elevations (O'Farrell and Clark 1986). In Idaho, the species exhibits two divergent habitat preferences; one the sagebrush biome, and the other, the open forest and juniper areas of parts of southern Idaho (Larrison and Johnson 1981). It was given a low habitat versatility rating in the Blue Mountains of eastern Oregon and Washington (Thomas 1979). In northeastern California and northwestern Nevada, the least chipmunk responded negatively to grazing in dry habitats and positively to grazing in moist habitats (Hanley and Page 1982).

Great Basin Pocket Mouse—Naive density of the pocket mouse was over three times higher on the grazed plot than on the ungrazed plot (table 3). The pocket mouse was most commonly trapped in the big sagebrush/upland community type. Although this is a species of arid and semiarid habitats (Larrison and Johnson 1981), Linsdale (1938) trapped pocket mice adjacent to streams, on wet ground, and in *Microtus* runways, and suggested that the species is not restricted entirely to arid or semiarid environments. O'Farrell and Clark (1986) found the Great Basin pocket mouse among the most abundant small mammals in extensively grazed sagebrush habitats in northeastern Nevada. Hanley and Page (1982) reported a positive response by Great Basin pocket mice to grazing in mesic habitats—Nevada bluegrass (*Poa nevadensis*) /sedge (*Carex* spp.) and aspen in northeastern California and northwestern Nevada.

Other Species—Several other species of small mammals were trapped on the study site (table 3). Most of the golden-mantled ground squirrels were caught in the ungrazed habitat. All were trapped in big sagebrush/upland communities. Of these, most were caught near rock slides or clifflike rock outcrops that occurred with greater frequency in the protected area. Vagrant shrews were trapped infrequently in both grazed and ungrazed habitats. All were caught near the stream in Kentucky bluegrass communities. Incidental numbers of the Townsend's ground squirrel, northern pocket gopher, bushy-tailed woodrat, montane vole, and long-tailed vole were trapped. Each of these mainly herbivorous species was trapped only in the ungrazed area (table 3). The voles were caught in both the Kentucky bluegrass and aspen/mesic herbaceous community types.

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Small mammal populations were compared between a grazed habitat and a comparable adjoining habitat protected from grazing by an exclosure. Composition, naive density, standing crop biomass, species diversity, and other attributes of the small mammal communities were assessed. More species and higher numbers of most small mammals were found in the ungrazed habitat.

KEYWORDS: density, biomass, diversity, *Peromyscus maniculatus, Zapus princeps, Tamias minimus, Perognathus parvus*