THE INFLUENCE OF LIVESTOCK GRAZING ON NON-GAME WILDLIFE

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Abstract.

Non-game populations and vegetative structure were compared in heavily grazed and ungrazed sites within seven habitat types: shadscale, greasewood, low sage, two big sage, upland meadow, and aspen. It is evident that non-game wildlife react specifically when livestock alter the vegetative structure of the ecosystem. Vegetation structure and animal species richness (variety and number) were generally lower in grazed than ungrazed communities. However, animal species responses varied with habitat type.

INTRODUCTION

Livestock grazing has long been known to have a significant influence on both the flora and fauna of the ecosystem. Numerous studies have been conducted in the past to determine the effect of livestock grazing on the vegetataive components of the ecosystem (Houston 1954; Hormay and Talbot 1961; Robertson 1971). Several studies have shed light on the effects of vegetative changes on big game wildlife (Longhurst et al. 1952; Dasman 1959; Leopold et al. 1951; Salwasser 1972). With the recent increased public awareness of non-game wildlife, a need has developed to understand the effects of livestock management applications on these animals.

The Great Basin is a fragile environment and livestock grazing seems to have the greatest persistent impact of all of mans actions on the ecosystem. Leopold (1974) suggested that we have seriously under-estimated the impact of grazing on the capacity of wild lands to support native animal populations. Direct results of grazing include removal of vegetative cover and trampling of grass and brush. Indirect or delayed effects of grazing include altered forage composition, reduced vigor of plants, and accelerated soil erosion resulting in a reduction of land productivity. Long term effects of heavy grazing often result in vegetative changes toward more xeric conditions (Weins & Dyer, 1975).

The effect of grazing on non-game wildlife is difficult to study due to the hundreds of species involved. Each individual bird and mammal has its own habitat requirements, consequently grouping non-game animals in the broad rodent and bird catagories for research purposes is not practical. Generally, the greater the intensity of grazing, the greater the effect on vegetative structure and consequently changing non-game wildlife habitat. Black (1968) found that different species of rodents exhibit definite preferences for areas which were grazed at different intensities. He found western

harvest mice were more than twice as abundant in lightly grazed rangelands compared to heavily grazed areas. One component in the habitat requirements for this species includes large amounts of grass cover. Phillips (1936), Hall (1946), and Bond (1945) have shown similar relationships with other mammal species.

Several studies have indicated that some mammal species have shown preference for heavily grazed areas with reduced vegetation. California and antelope jackrabbits (Taylor, Vorhies, and Lister 1935; Smith 1940; Taylor and Lay 1944), and ground squirrels (Smith 1940; Grinnel and Linsdale 1936; Horn and Fitch 1942) appear to be discouraged from heavy stands of tall grasses. Buechner (1942) and Garlough (1937) indicated pocket gophers prefer range in deteriorated condition because of the greater proportion of tap-rooted and bulbous-rooted plants. Vorhies and Taylor (1940) suggested meadow mice are most favored by range in climax or near-climax condition. MacArthur (1964) and Tramer (1969) determined bird numbers and varieties of species increase in vegetation communities which have numerous strata. Data obtained by Monson (1941) demonstrated that an increase of cover on the range had the effect of doubling the small bird population. Overmire (1963) found that the populations of dickcissels and Bill's vireos were 50 percent lower on grazed than ungrazed lands. Just as some plant species are range condition indicators (increase and decrease with grazing), some species of non-game wildlife also seem to react to changes in range condition.

STUDY AREA

The study areas are habitat types (Table 2) on public lands administered by the Bureau of Land Management in the Cowhead-Massacre Planning Units. The planning units consist of 1,090,000 acres in Modoc County, California and Washoe and Humboldt Counties, Nevada. The study technique compared the distribution and relative abundance of birds and non-game mammals to grazed and ungrazed specific habitat "types" (Table 1). The habitat types within the study area were classified on site potential vegetation based on soil-climate relationships (Daubenmire 1942, 1952).

Ungrazed comparison areas (Table 3) for Nevada bluegrass/sege (upland) meadow habitat type were located at Hart Mountain National Antelope Refuge, Lake County, Oregon. Ungrazed aspen habitat type was inventoried at Marlette Lake, Washoe County, Nevada. The ungrazed shadscale and greasewood habitat types were studied on the Sierra Army Depot, Lassen County, California. Ungrazed low sage and big sage habitat types were selected near Mahogany Creek in northwest Humboldt County, Nevada. Each habitat type and its comparison area were selected on the basis of equalivalent site potential (Daubenmire 1952, 1959, 1968).

METHODS

Small mammals were censused by placing five trap lines; two lines of snap traps, two lines of Sherman livetraps, and one line of pitfall can traps. The snap traps were laid out in two parallel lines 15 m. apart with each line consisting of 56 stations, 6 m. apart. Two museum special snap traps were placed at each station, except a commercial rat trap replaced a museum special at every fourth station. Moistened oatmeal was used as bait.

Sherman livetraps were placed in two lines of 25 stations each spaced 6 m. apart and at least 15 m. from the snap trap lines. Each station consisted of one Sherman livetrap baited with dry oatmeal.

Table 1. Vegetation zones, association groups, and selected habitat types in the proposed study area arranged along a soil moisture gradient, first by zones, then by association groups, then by habitat types.

Zones	Association Groups	Habitat Types	Habitat Type Number
xerix ▲	shadscale	shadscale/Indian ricegrass	HT-4
big sage/blue-bunch wheatgrass	greasewood	greasewood/Great Basin wildrye	HT-2
	low sagebrush	low sage/Idaho fescue	HT-17
	big sagebrush	big sage/bluebunch wheatgrass big sage/Idaho fescue	HT-20 HT-7
	aspen	aspen	HT-26
	Nevada bluegrass	Nevada bluegrass-sedge	HT-13

Table 2. Condition of grazed habitat types 1/

Habitat Type	Percent Condition % Site Potential	Condition Rating
shadscale/Indian ricegrass	11	Poor
greasewood/saltgrass	11	Poor
low sage/Idaho fescue	32	Fair
big sage/bluebunch-Thurber's big sage/Idaho fescue	19 16	Poor Poor
aspen	8	Poor
Nevada bluegrass-sedge	18	Poor

1/ Range condition determined in 1977 during a BLM planning unit vegetative survey.

Table 3. Comparision areas

Habitat Types Inventoried	Ungrazed Site No.	Years Ungrazed	Dates Inventoried Grazed	Ungrazed
shadscale/Indian ricegrass	35		08/30-09/02	09/13-09/16
greasewood/saltgrass	35		08/30-09/02	09/13-09/16
low sage/Idaho fescue	5		08/15-08/18	08/15-08/18
big sage/bluebunch wheatgrass/ Thurber's needlegrass	5		09/08-09/11	09/13-09/16
big sage/Idaho fescue	*		09/20-09/23	09/20-09/23
aspen	87		06/21-06/24	07/18-07/22
Nevada bluegrass-sedge	17		07/05-07/08	07/11-07/14

* Livestock were in the area but due to lack of water or other factors little grazing had occurred at the site.

Pitfall can traps were spaced 10 m. apart with a maximum of 50 stations at each site. Each station was made by burying a one-gallon steel can with the mouth of each can flush with the ground. Each can was filled 1/3 full of water. All traps were left out three consecutive nights and checked each morning and evening. A uniform area was sampled at each study site to justify the comparison of trapping results. Trapping results are computed using the catch per trap-day method. Absolute densities were not determined for small mammals as the methods utilized allowed only for the calculation of abundance indices (trapping success per unit effort). However, density and the catch indices are closely correlated (Hanson 1967; Petticrew and Sadlier 1970). We believe these data reflect density changes in the populations. Standard measurements and data were collected from all mammals trapped. Except for a small reference collection all mammals were sent to the University of Kansas Museum of Natural History for identification and storage.

Birds were inventoried using a one-mile strip census method (Emlen 1971). Species and density data were collected three consecutive mornings on a standard route.

Vegetation structure was sampled at each site using twenty-1 m^2 quadrats distributed along a line transect every 5 m. With each quadrat the following were recorded; height and species composition of canopy, midstory and understory, percent cover, and number of rooted species. Ten litter depth measurements were taken in each quadrat (Table 4).

RESULTS AND DISCUSSION

Shadscale/Indian Ricegrass

The most evident differences in non-game populations in the shadscale habitat type is in the increased richness (species and number) of small mammals in the ungrazed site. Four more mammal species were trapped in the ungrazed than in the grazed shadscale (Table 5). The increased richness of rodents may be due in part to the increased food supply of grass and forbs in the ungrazed area. Chipmunks and pocket mice are species which are closely tied to seed sources, the latter mainly to grass seeds (Kritzman, 1974). This was the only habitat type where deer mice did not increase with grazing. The xeric site seems to provide deer mice habitat only in an ungrazed condition.

The only mammal trapped in the grazed shadscale was the Great Basin kangaroo rat. Our total of five individuals may not accurately reflect densities of kangaroo rats in the area, since numerous tail drag marks were found around the pitfall traps. Larrison and Johnson (1973) found Great Basin kangaroo rats to be more abundant in "healthy" shadscale and deer mice to be more abundant in depleted shadscale. The reason why our research data disagree with deer mice and kangasroo rats in shadscale habitat is not known.

The results from the bird census in shadscale is inconclusive (Table 6). Because of the mobility of birds during the midsummer and fall more extensive data should be obtained.

Greasewood/Saltgrass

In the greasewood habitat there was an increase from five species of small mammals in the grazed area to eight in the ungrazed (Table 7). The ungrazed site had a large

Table 4. Vegetative structure of habitat types.

Habitat Type		Canopy Height (cm)	Midstory Height (cm)	Understory Height (cm)	Vegetative % Cover	Litter Depth (mm)
shadscale	G	34	22	10	17	1.7
	U	35	23	5	13	3.0
greasewood	G	55	21	6	22	1.6
	U	86	47	10	32	9.7
low sage	G	27	13	7	27	2.1
	U	53	27	6	39	3.9
big sage/ bluebunch wheat/Thurber's needlegrass	G	75	45	17	47	7.4
	U	65	38	15	50	3.3
big sage/ Idaho fescue	G	77	39	13	40	7.9
	U	82	44	20	33	4.2
aspen	G	802	400	32	79:5*	17.7
	U	903	380	118	45;78	33.6
Nevada blue-grass-sedge	G	33	absent	5	36	1.1
	U	50	absent	33	60	24.9

* % canopy cover; % ground cover

Table 5. Results of small mammal census in Shadscale/Indian Ricegrass. Abundance Index = No./100 trap nights.

	Ungrazed			Grazed		
Species	No.	Index	% Total	No.	Index	% Total
Least Chipmunk	2	.25	18			
Great Basin Pocket M.	1	.1	7			
Little Pocket Mouse	2	.25	18			
Chisel-Toothed K-Rat	3	.4	29	5	.6	100
Deer Mouse	3	.4	29			
Total	11	1.4	100	5	.6	100

Table 6. Bird strip census results in Shadscale/Indian Ricegrass habitat type. Number of birds per 100 acres.

Species	Ungrazed	Grazed
Mourning Dove	1	0
Gray Flycatcher	0	4
Horned Lark	15	0
Rock Wren	0	5
Loggerhead Shrike	0	1
Brewer's Blackbird	52	3
Western Meadowlark	0	3
Vesper Sparrow	0	1
Sage Sparrow	11	3
Brewer's Sparrow	1	5
Totals	80	25

stand of Great Basin wildrye grass and it was within this grass area of the trap line that most of the animals were caught. The most significant difference was in the densities of pocket mice and western harvest mice, which were closely tied to Great Basin wildrye. The harvest mouse, pocket mice and wildrye are almost absent in the grazed sites, but are abundant in the ungrazed site. Desert wood rats, least chipmunks, and white-tailed antelope squirrels also seemed to be tied into this Great Basin wildrye stand. Deer mice increased in the grazed site. Our data corroborate earlier findings that depletion of range favors deer mice (Phillips 1936; Quast 1948; Larrison and Johnson 1973) and tends to reduce harvest mice and pocket mice (Reynolds and Haskell 1949). The bird data did not present a clear picture of the relationship of grazing to bird populations (Table 8).

Low Sage/Idaho Fescue

The vegetative structure differences between heavily grazed and ungrazed low sage was quite significant (Table 4). In the grazed site grass was either sparse or was heavily cropped and in low vigor while in the ungrazed site grasses were very dense and provided excellent cover which almost obscured vision of the low sage. The ungrazed site also contained a larger variety of forbs and grasses.

Sagebrush voles were absent from the grazed low sage, but made up 10% of the mammals taken in the ungrazed site (Table 9). Sagebrush voles use grass for both cover and food (Moore 1943 and Maser 1974). Great Basin pocket mice are also associated with grass, as evidenced by their greater abundance in the ungrazed area. Black and Frischknecht (1971) also found this species to be most abundant in lightly grazed sagebrush habitats.

An average of 130 birds were recorded in the ungrazed site while only eight were recorded in the grazed site (Table 8). The largest differences were attributed to the horned lark, Brewer's sparrow, Western meadowlark and vesper sparrow numbers. The latter two species were absent in the grazed area and show distinct preferences for areas with stands of grass.

Three bird species illustrate the importance of grass in low sage habitats. All three are ground-nesters. Meadowlark habitat consists of grassy areas "in which grass is present in fairly large tracts and is thick enough or deep enough to permit concealment by crouching" (Grinnell and Miller 1944). Vesper sparrows prefer grassy habitats; they were quite numerous in the ungrazed low sage and absent from the grazed. Another species which prefered grass was horned larks. They were the most common bird in the ungrazed low sage, comprising 43% of all birds censused (Table 10).

Big Sagebrusah/Bluebunch-Thurber's and Big Sagebrush/Idaho Fescue

The variety of plants and their physical structure in the upper, middle and lower vegetative layer seems to be the most important factors effecting non-game wildlife in these habitat types. Upper and middle structure layers consisted of tall, vigorous perennial grass, a variety of forbs, and big sage. The layers in the grazed sites were made up mostly by big sage and rabbitbrush. The variety of plants in the ungrazed sites provided food and nesting sites for wildlife. Three mammal species, the long-tailed and montane meadow mice and the sagebrush vole were found in the ungrazed sites but were mostly lacking in the grazed site (Table 11 and 12). All three of these species require high amounts of grass and forb cover which is present in the ungrazed condition but absent in grazed areas. Sagebrush voles require grass for lining their burrows and nests, and are not found where there is inadequate cover (Moore 1943; Maser 1974), but are associated with large bunchgrasses (O'Farrell 1972). Hall (1946)

Table 7. Results of small mammal census in Greasewood/Great Basin Wildrye. Abundance Index = No./100 trap nights.

Species	Ungrazed No.	Ungrazed Index	Ungrazed Total	Grazed No.	Grazed Index	Grazed Total
Nuttall's Cottontail	1	0.1	2.8			
White-tailed Ant. Squ.	4	0.5	11.1	1	.1	5.9
Least Chipmunk	4	0.5	11.1			
Little Pocket Mouse	9	1.0	25.0			
Chisel-toothed K. Rat	4	0.5	11.1	4	.4	23.5
Western Harvest Mouse	8	0.9	22.2	1	.1	5.9
Deer Mouse	2	0.2	5.5	10	1.1	58.8
Desert Wood Rat	4	0.5	11.1			
Dark Kangaroo Mouse				1	.1	5.9
Total	35	4.2	100.0	17	1.8	100.0

Table 8. Bird strip census results in Greasewood/Great Basin Wildrye. Number of birds per 100 acres.

Species	Ungrazed	Grazed
Marsh Hawk	1	0
Mourning Dove	0	4
Horned Lark	7	0
Scrub Jay	0	1
Sage Thrasher	0	5
Western Meadowlark	0	8
Vesper Sparrow	0	8
Sage Sparrow	25	21
Brewer's Sparrow	11	1
White-crowned Sparrow	3	0
Total	47	48

Table 9. Results of small mammal census in Low Sage/Idaho Fescue. Abundance Index = No./100 trap nights.

Species	Ungrazed No.	Ungrazed Index	Ungrazed Total	Grazed No.	Grazed Index	Grazed Total
Least Chipmunk	9	1.0	18.4			
Great Basin Pocket M.	19	2.1	38.8	6	.7	60
Deer Mouse	16	1.8	32.6	3	.4	30
Sagebrush Vole	5	0.6	10.2			
Western Harvest M.				1	0.1	10
Total	49	5.5	100.0	10	1.2	100

Table 10. Bird strip census results in Low Sage/Idaho Fescue habitat type. Number of birds per 100 acres.

Species	Ungrazed	Grazed
American Kestrel	1	
Common Flicker	1	1
Horned Larks	57	3
Western Meadowlark	16	
Vesper Sparrow	19	
Brewer's Sparrow	37	
Scrub Jay		2
Mountain Bluebird		1
Loggerhead Shrike		1
Total	131	8

Table 11. Results of small mammal census in Big Sagebrush/Bluebunch-Thurber's. Abundance Index = No./100 trap nights.

	Ungrazed			Grazed		
Species	No.	Index	Total	No.	Index	Total
Least Chipmunk	11	1.2	27.5	5	0.6	18.5
Great Basin Pocket M.	6	0.7	15.0	4	0.5	14.8
Deer Mouse	14	1.6	35.0	18	2.2	66.7
Long-tailed Meadow M.	4	0.4	10.0			
Montane Meadow Mouse	1	0.1	2.5			
Sagebrush Vole	4	0.4	10.1			
Total	40	4.4	100.0	27	3.3	100.0

Table 12. Results of small mammal census in Big Sage/Idaho Fescue. Abundance Index = No./100 trap nights.

	Ungrazed			Grazed		
Species	No.	Index	Total	No.	Index	Total
Least Chipmunk	8	0.9	22.2	33	3.7	54.2
Deer Mouse	26	3.0	72.0	26	2.9	42.6
Sagebrush Vole	2	0.2	5.5	1	0.1	1.6
Long-tailed Weasel				1	0.1	1.6
Total	36	4.1	100.0	61	6.8	100.0

also confirmed that meadow mice habitat requirements include moderate amounts of grass.

The increase in least chipmunks at bluebunch ungrazed site is thought to be related to the sites variety of forbs.

Deer mice comprised two thirds of the mammals trapped at the grazed bluebunch big sage site.

Avifauna data did not give accurate conclusive differences between grazed and ungrazed big sage sites. The site was not inventoried until after the end of the breeding season. This seemed to allow considerable movement in bird use patterns (Table 13).

Nevada Bluegrass/Sege

In the Nevada bluegrass/sege habitat type (upland meadow) very drastic differences were detected in both small mammal and bird populations between the ungrazed and grazed sites (Table 14 & 15). The ungrazed meadow supported a dense stand of grasses, rushes and sedges 1/2 m. high in the more moist sections, and dense grasses, iris and other forbs on the drier, shallower soils. In comparison, the grazed meadow consisted of a low-growing upland sedge understory 5-7 cm high with a scattered canopy of big sage and rabbitbrush. Litter at the grazed site was about 1 m. deep and was concentrated at the bases of the shrubs. At the ungrazed site litter averaged 25 m. deep and was present throughout the meadow. These drastic changes in the floral composition caused alterations in the non-game population. In the ungrazed site montane meadow mice were by far the most common mammal, followed by the vagrant shrew. Grazing accounted for their absence in the grazed area because both species require dense, rank growth of grass and marshy vegetation. The grazed meadow had a much more diverse mammal composition (ten species compared to three) but only one species, the ubiquitous deer mouse, was common to both. Of the ten species found in the grazed meadow, the majority are considered invaders, being closely tied to the invading big sage. Birds such as the vesper sparrow, Savannah sparrow, Brewer's blackbird and Western meadowlark were much more abundant in the ungrazed area as they are closely tied to dense stands of grass and meadow vegetation. The Brewer's sparrow, gray flycatcher, and sage thrusher were found only in the grazed meadow and were associated with shrubland habitat.

Aspen

The greatest impacts on non-game wildlife habitat were observed in the aspen habitat type. Major changes in both the floral and faunal composition were evident (Table 16 & 17). In the ungrazed site a lush 1 m. deep understory of numerous forbs existed with young aspen and willow in the midstory. The midstory was almost absent from the grazed aspen and its understory consisted of snowberry, young big sage and nettles. Litter was twice as deep at the ungrazed site.

Four species, vagrant and dusky shrews, long-tailed vole, and Western jumping mouse, comprising about 50% of the mammals caught in the ungrazed aspen are associated with the herbaceous understory. None of these species were trapped in the grazed aspen, although all three historically occurred in the area.

Seventy-nine percent of all mammals trapped in the grazed aspen were deer mice. Three other species characteristic of big sagebrush habitat were also found in the grazed aspen: Heermann's kangaroo rat, least chipmunk and golden-mantled ground squirrel.

Table 13. Bird strip census results in Big Sage/Bluebunch Wheat-Thurber's habitat type. Number of birds per 100 acres.

Species	Ungrazed	Grazed
Common Flicker	3	8
Scrub Jay	0	8
Mountain Chickadee	4	0
Rock Wren	0	16
Western Meadowlark	2	12
Green-tailed Towhee	3	0
Vesper Sparrow	3	0
White-crowned Sparrow	3	16
Brewer's Sparrow	30	32
Total	48	92

Table 14. Results of small mammal census in Nevada Bluegrass/Sedge habitat type. Abundance Index = No./100 trap nights.

	Ungrazed			Grazed		
Species	No.	Index	Total	No.	Index	Total
Pygmy Rabbit				1	0.1	2.6
Townsend G. Squ.				1	0.1	2.6
Least Chipmunk				13	1.3	34.2
Sagebrush Vole				1	0.1	2.6
Northern Grasshopper M.				1	0.1	2.6
Deer Mouse	4	0.3	4.3	11	1.1	29.0
Great Basin Pocket M.				6	0.6	15.8
Ord Kangaroo Rat				3	0.3	8.0
Dark Kangaroo Mouse				1	0.1	2.6
Vagrant Shrew	6	0.9	14.0			
Montane Meadow Mouse	76	5.2	81.7			
Total	86	6.4	100.0	38	3.8	100.0

Table 15. Bird strip census results in Nevada Bluegrass/Sedge habitat type. Number of birds per 100 acres.

Species	Ungrazed	Grazed
Sage Grouse	97	
Tree Swallow	4	
Western Meadowlark	24	4
Red-winged Blackbird	42	
Brewer's Blackbird	23	8
Savannah Sparrow	40	
Vesper Sparrow	11	
Sage Sparrow	5	8
Brewer's Sparrow	22	40
Killdeer		4
Gray Flycatcher		5
Rough-winged Swallow		1
Sage Thrasher		4
Total	268	74

Table 16. Results of small mammal census in Aspen. Abundance Index = No./100 trap nights.

Species	Ungrazed No.	Ungrazed Index	Ungrazed Total	Grazed No.	Grazed Index	Grazed Total
Vagrant Shrew	14	1.7	20.6			
Dusky Shrew	2	0.25	3.0			
Yellow Pine Chipmunk	2	0.25	3.0			
Deer Mouse	33	4.1	29.7	52	8.7	78.8
Long-tailed Meadow M.	14	1.7	20.6			
Jumping Mouse	2	0.25	3.0			
Nuttall's Cottontail				1	0.2	1.5
Golden-mantled G. Squ.				4	0.7	6.1
Least Chipmunk				1	0.2	1.5
Great Basin Pocket M.				2	0.3	3.0
Heermann's K. Rat				6	1.0	9.1
Total	67	8.25	100.0	66	11.0	100.0

Table 17. Bird strip census results in Aspen habitat type. Number of birds per 100 acres.

Species	Ungrazed	Grazed
Calliope Hummingbird	13	
Rufous Hummingbird	283	
Common Flicker	8	13
Yellow-bellied Sapsucker	15	
Hairy Woodpecker	8	
Empidonax sp.	21	8
Western Wood Pewee	37	
Tree Swallow	24	
Mountain Chickadee	32	8
House Wren	29	43
Robin	13	45
Hermit Thrush	8	
Mountain Bluebird	8	12
Warbling Vireo	27	19
Yellow-rumped Warbler	11	
Macgillivray's Warbler	48	
Wilson's Warbler	45	
Black-headed Grosbeak	3	8
Cassin's Finch	19	
Pine Grosbeak	17	
Dark-eyed Junco	40	16
White-crowned Sparrow	24	
Fox Sparrow	59	
Blue Grouse		3
Mourning Dove		33
Great Horned Owl		1
Downy Woodpecker		8
Steller's Jay		2
Scrub Jay		36
Yellow Warbler		16
Brewer's Blackbird		8
Brown-headed Cowhead		16
Hooded Oriole		8
Northern Oriole		32
Green-tailed Towhee		27
Rufous-sided Towhee		13
Total	792	385

The lush understory of flowering forbs provided excellent feeding sites for rufous hummingbirds (over 300 per 100 acres) which were not found in the grazed area. Wilson's and Macquillivary's warblers were abundant in the midstratum of young aspen and willow but were absent in the grazed site. Ground feeding species which prefer open areas such as the robin, green-tailed towhee and mourning dove were common at the grazed site.

CONCLUSION

These data indicate that livestock grazing in the study area resulted in vegetation changes, mostly reduction of perennial grasses and forbs, which has resulted in changes in non-game animal species richness and abundance. Animal species response varied with habitat type, however. Some mammals such as pocket mice, deer mice and chipmunks that appeared to decrease with grazing-induced changes in the drier habitats (shadscale and greasewood dominated communities) appeared to increase as a result of grazing in the more mesic habitats (aspen, Nevadas bluegrass-sedge) while other animals strongly depend upon a dense herbaceous cover, such as voles and shrews, appeared to be consistent "decreasers." Effects on birds appear to be more complicated than those on mammals; although livestock grazing appears to have negatively affected ground-nesters, such as vesper sparrows, horned larks, Savannah sparrows and western meadow-larks in the sagebrush and meadow habitat types. The most dramatic difference in avifauna were found in the aspen communities, where bird species such as Wilson's and Macqillivay's warblers were reduced when a particular structure layer was removed. These birds were inturn replaced by robins, mourning doves and green-tailed towhees which perfer open habitat.

Although these data are preliminary, they do indicate that livestock grazing has a serious potential impact on non-game wildlife in a variety of Great Basin communities. Furthermore, the impact appears to vary with habitat, and some animal species that act as "decreasers" in some communities may act as "increasers" in others. We have not speculated on the effects of such influence on higher trophic levels (through predator-prey relationships) or community complexity and functions, but we do suggest that more intensive research concerning such relationships may prove fruitful.

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