

Comparison of Big Sagebrush Vegetation in Northcentral New Mexico under Moderately Grazed and Grazing Excluded Conditions

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Abstract

Vegetation canopy cover on upland and lowland sites inside and outside a 22-year-old enclosure in big sagebrush (*Artemisia tridentata tridentata*) range was evaluated by sampling for canopy cover. The area outside the enclosure had received moderate use of grazable forage by cattle in the late winter and spring for the past 22 years. The two sites did not show a consistent response to grazing. Big sagebrush canopy cover was higher inside the enclosure on the upland site and higher outside the enclosure on the lowland site. Big sagebrush dominated the canopy cover both inside and outside the enclosure on both sites and relatively little understory was present. Forbs were nearly absent from the area, which is attributed to a past history of heavy sheep grazing. Elimination of grazing had little effect on vegetation composition on both sites studied.

Because of its size (approximately 50 million hectares) the big sagebrush (*Artemisia tridentata*) range type is of considerable importance in the western United States. Major provinces within the big sagebrush range type include the following: Columbia River (Hironaka 1979); the Great Basin (West 1979); the high plains of Montana, Wyoming and the Dakotas (Johnson 1979); and the Colorado plateau (West 1979). The Colorado plateau province of southwestern Colorado and northwestern New Mexico has had the longest history of livestock grazing, which dates back to the seventeenth century (Carlson 1969). Because of both widespread and heavy grazing in the nineteenth and early twentieth centuries by first sheep and later cattle (Wooten 1908), little is known about the original vegetation. Our review of the literature shows the Colorado Plateau has received the least study of the four big sagebrush provinces. Information concerning successional changes that result from reduction or removal of livestock grazing pressure is not available for this province.

Enclosures can be a useful tool to the range manager for evaluating and interpreting both short-term and long-term grazing influences of domestic and wild animals (Daubenmire 1968). Moderate to light grazing appears to be beneficial to most range plant communities (Holechek 1980) although further study is needed. Changes in vegetation that result from grazing management are difficult to separate from those that result from changes in climate unless ungrazed areas are available for comparison with grazed areas within the same pasture.

The objective of this study was to compare the vegetation canopy cover of different moderately grazed basin big sagebrush (*Artemisia tridentata tridentata*) sites in northcentral New Mexico with that of the same sites when they had received 22 years of protection.

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Methods

The study area was located 40 km northwest of Taos, N. Mex., in a 25–35 cm precipitation zone at 1800–2,000-m elevation. Most (65%) of precipitation occurs in the spring and summer; July and August are months of peak rainfall. Soils of the area belong to the order aridisol and the suborder argid due to their high clay content. Soil texture ranges from a clay loam on lowland sites to a silty clay loam on upland sites. Soil depth averages about 170 cm on lowland sites and 140 cm on upland sites.

Vegetation is heavily dominated by big sagebrush (*Artemisia tridentata tridentata*) with an understory of primarily blue grama (*Bouteloua gracilis*) on the upland sites and western wheatgrass (*Agropyron smithii*) on the lowland sites. Other species found on the study area included fourwing saltbush (*Atriplex canescens*), galleta (*Hilaria jamesii*), common winterfat (*Ceratoides lanata*), cactus (*Opuntia* sp.), scarlet globemallow (*Sphaeralcea coccinea*), Russian thistle (*Salsola kali*), broom snakeweed (*Xanthocephalum sarothrae*), summer cypress (*Kochia scoparia*), ring muhly (*Muhlenbergia torreyi*), and crested wheatgrass (*Agropyron cristatum*) (Stephenson 1982). Forbs are almost entirely absent with the exception of well-traveled roadsides.

The pasture selected for study is controlled by the Bureau of Land Management. We believe it is typical of big sagebrush ranges in northern New Mexico in terms of precipitation, soils, vegetation, grazing history, and grazing management. It is characterized by relatively flat rolling terrain (uplands) with slight depressions (lowlands) caused by water drainage. Uplands comprise about 80% of the area with lowlands comprising about 20%. During the past 25 years the study pasture had been grazed by cattle at a moderate stocking rate (30 to 50% use of current years growth) during the late winter and spring until early June. In 1958 an enclosure of approximately 16 ha was built with woven wire to prevent use by both livestock and game animals. It was located in a "key area" as discussed by Stoddart et al. (1975). The western half of the enclosure was on a lowland site and the eastern half was on an upland site.

A modification of the line-intercept procedure of Canfield (1941) was used to sample vegetation canopy cover in August 1981. For sampling canopy cover, a stick of 1 m in length incremented in millimeters was used instead of an extended line. Eight transects were randomly selected based on consecutive numbering of fence posts at the west and east ends of each enclosure. Ten-meter buffer areas immediately inside and outside the ends of each enclosure were omitted from sampling to avoid influences of the fence. Each transect involved 10 subunits of 5 m in length. Cover was sampled for all 10 subunits of each transect by perpendicular orientation of the meter stick to the left side at the end of each subunit. Two observers independently sampled each location. The number of jackrabbit pellets intercepting the meter stick was recorded for all subunits. A one-way completely randomized design with observers as subsamples was used to evaluate experimental results (Steel and Torrie 1960).

Table 1. A comparison of vegetation canopy cover % on 2 sites in a moderately grazed pasture and a 22 year old enclosure.

Plant species	Upland site		Lowland site	
	Outside enclosure	Inside enclosure	Outside enclosure	Inside enclosure
Big sagebrush	14.2 ^a	19.0 ^b	13.6	8.5
Fourwing saltbush	0.1	0.1	0.2	0.3
Winterfat	0.1	0.0	—	—
Total shrubs	14.4 ^a	19.1 ^b	13.8 ^a	8.8 ^b
Broom snakeweed	0.2	0.2	<0.1	<0.1
Scarlet globemallow	0.1	0.1	0.1	<0.1
Russian thistle	<0.1	<0.1	—	—
Total forbs	0.4	0.4	0.2	0.2
Galleta	<0.1	<0.1	—	<0.1
Blue grama	2.7 ^a	1.3 ^b	4.7 ^a	1.2 ^b
Western wheatgrass	<0.1	<0.1	0.6 ^a	2.3 ^b
Ring muhly	<0.1	0.1	1.0	0.6
Total grasses	2.9 ^a	1.5 ^b	6.3 ^a	4.1 ^b
Total Cover	17.7	21.0	20.3	13.1*

^{a,b}Significant at $P < 0.05$ within site.

Results and Discussion

The interaction between site and grazing treatment was significant ($P < 0.05$) (table 1). Big sagebrush canopy cover was significantly ($P < 0.05$) greater outside than inside the enclosure on the lowland site while the reverse was true on the upland site. Blue grama canopy cover was greater outside the enclosure than inside the enclosure on both sites. Western wheatgrass canopy cover was reduced outside the enclosure compared to inside the enclosure on the lowland site. Other species were present in such low amounts that no conclusions can be drawn concerning grazing.

The reduced canopy cover of western wheatgrass and the greater canopy cover of blue grama on the grazed area compared to the ungrazed enclosure on the lowland site are explained by past grazing management. Western wheatgrass growth occurs primarily in the spring while that of blue grama occurs during the summer (Albertson 1937). Under the past regime of spring grazing and summer rest, blue grama is favored over western wheatgrass.

Jackrabbit pellets did not differ significantly ($P < 0.05$) between areas inside and outside the enclosure at either site. The number of pellets per transect was less than one. This suggests jackrabbits had small influence on the vegetation.

The almost total absence of forbs on both sites may have resulted from 2 centuries of widespread heavy grazing by sheep. Large numbers of sheep grazed this area as early as the late 1600's (Carlson 1969). However, the complete lack of ungrazed relict areas and early descriptions of vegetation for the area make the previous statement speculative. It does appear that present grazing management has had little influence on vegetation composition. The lower canopy cover of sagebrush and higher canopy cover of blue grama on the grazed upland site compared to the enclosure suggests that grazing may actually have been beneficial on this site.

Unfortunately, records are unavailable on the vegetation composition of the sites studied when the enclosure was built. However, complete dominance of big sagebrush and lack of understory vegetation both inside and outside the enclosure indicates that little

improvement in range condition has occurred over the past 22 years regardless of grazing.

Our results are consistent with several other studies showing that recovery of depleted rangeland is slow to nonexistent in arid environments (Anderson and Holte 1980, Gardner 1950, Hughes 1980, Norton 1978, Rice and Westoby 1978, Smeins et al. 1976). In southeastern Idaho, Anderson and Holte (1980) reported that canopy cover of big sagebrush increased 54% and minimal recovery of understory grasses occurred under 28 years of complete protection from grazing. Hughes (1980) found that 25 years of protection from grazing resulted in a 30 to 40% density increase in big sagebrush with a similar decrease in grasses in northwestern Arizona.

In conclusion, total elimination of grazing for 22 years did not cause any real improvement in range condition on upland or lowland sites when compared with adjacent moderately grazed areas. The heavy dominance of big sagebrush and lack of understory indicates very poor condition for both livestock and wildlife on both sites. Control of big sagebrush coupled with reseeding using a mixture of grasses, forbs and shrubs appears to be the most practical means of range improvement.

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