Comparison of Vegetation on Grazed and Ungrazed Pinyon-Juniper Grassland Sites in Southcentral New Mexico[1]

REX D. PIEPER

Assistant Professor of Range Science, New Mexico State University, Las Cruces

Highlight

A study to compare vegetation on three grazed areas with that on comparable areas, protected for 12 years, on the Fort Stanton Range revealed that both herbage production and height of blue grama plants were significantly higher on protected areas for all three sites. Species composition was not significantly different between grazed and protected areas on the stony hills site, but composition of mat muhly was significantly higher on grazed areas on both loamy bottomland and loamy upland sites. Composition of blue grama and western wheatgrass was significantly lower on the grazed area on the loamy bottomland site.

The impact of grazing animals on vegetation has been recognized for many years; however, because most ranges in the West were heavily stocked during their early grazing history, and have been grazed continually since then, opportunities to study ranges which have been ungrazed or protected for a significant period of time are scarce. Much of our knowledge concerning the effects of grazing on vegetation has come from observations or inferences from isolated areas. Several papers have been written on vegetative comparisons between grazed and protected areas. Gardner and Hubbell (1943) found that the main difference between grazed and protected ranges in the ponderosa pine zone of northern New Mexico is the greater amount of *Actinea richardsoni* in the grazed areas. Cottam and Evans (1945) found that *Bromus tectorum* was much more abundant on a grazed canyon in the Wasatch Mountains of Utah than on a comparable ungrazed canyon. Ten species of perennial grasses occurred on the ungrazed canyon but not on the grazed canyon. Comparisons of grazed and protected areas in Colorado, Wyoming, and South Dakota revealed differences in size and vigor of individual plants and differences in species composition (Costello and Turner, 1941). Other studies have indicated that production and vegetative cover are higher on protected or lightly grazed areas, but plant composition is often similar to that on more heavily grazed areas (Gardner and Hubbell, 1943; Gardner, 1950; and Blydenstein et al., 1957). A review of the effects of grazing on vegetation and succession was presented by Ellison (1960).

An opportunity to compare vegetation on grazed and protected areas was presented when the New Mexico Agricultural Experiment Station signed a research agreement with the Bureau of Land Management in the spring of 1963 for the use of Fort Stanton Cooperative Range Research Station. This area had not been grazed by domestic livestock since 1952.

A study was begun to compare vegetational properties on the grazed areas with those on comparable protected areas at Fort Stanton.

Study Area and Procedure

The Fort Stanton Cooperative Range Research Station is located in the foothills between Sierra Blanca and the Capitan Mountains in Lincoln County about 70 mi west of Roswell, New Mexico. The area was grazed by livestock at varying intensities from 1900 to 1952 during which time the land was under jurisdiction of the Marine Hospital Service (Merchant Marine). In 1952 the Range was transferred to the General Services Administration and all livestock were removed. There is a small population of deer and antelope on the range in addition to rodent populations, which have been the main consumers of the vegetation since 1952.

The climate of the area is fairly mild, with warm summers and cool winters. Temperatures above 90 F are common in the summers, and they sometimes dip below zero in the winters. Precipitation records kept at the Fort Stanton headquarters nearly continuously since 1855 show that the average annual precipitation is 15.31 inches with almost two-thirds of this falling during June, July, August, and September. Some of the soils are shallow and rocky; others are fairly deep and well-developed. The range sites have been classified as stony hills, loamy upland, loamy bottomland, and shallow upland (Soil Conservation Service, 1962). The vegetation consists of pinyon-juniper and oak with grassland openings. The major species of grass are blue grama (*Bouteloua gracilis*),[2] sideoats grama (*B. curtipendula*), galleta (*Hilaria jamesii*), ring muhly (*Muhlenbergia torreyi*), and mat muhly (*M. richardsonis*).

The loamy bottomland and loamy upland sites were open grassland areas and the stony hills site was characterized by pinyon-juniper vegetation with a grass understory. All three sites were situated on gently sloping topography.

Three sites were selected at the boundary of Fort Stanton and adjacent grazed ranges. The grazed portion of these sites was comparable to the protected portion on Fort Stanton with respect to soils, topography, and aspect.

Cover and botanical composition of the vegetation were determined on the grazed and protected areas by means of line-point transects (Heady et al., 1959). The transects were 100 ft long. A reading was made at each foot mark along the tape. Ten randomly-located lines were read on each grazed and protected area. A single line constituted a sample unit. Cover conditions recorded were individual species, litter, bare ground, and rock.

Production was determined by clipping the vegetation from randomly-located 1 × 2-ft plots at the end of the growing season in late September. The method of ranked sets described by McIntyre (1952) and Morris (1964) was used. Since cattle were present on the grazed areas during the growing season, cages were used to protect the plants from grazing.

Vigor measurements included height and number of seed stalks of blue

[1] Journal Article No. 286, Agricultural Experiment Station, New Mexico State University, Las Cruces. Supported in part by McIntire-Stennis Funds.

[2] Nomenclature for scientific names follows Kearney and Peebles (1960).

grama plants. The height of 50 randomly-selected plants was measured on each grazed and protected area on each site. Because of the difficulty of defining individual plants, the number of seed stalks was counted in 1 × 2-ft plots instead of the number per plant. The number of seed stalks in 36 plots was counted for each grazed and ungrazed area on each site. On the grazed areas counts of seed stalks and measurements of plant heights were made inside the cages.

Vegetation differences between the grazed and protected areas were tested for statistical significance by "T" tests.

Results

Total herbage production was significantly higher ($P < .05$) on the protected area than on the grazed area on each site (Table 1). The greatest difference in production was on the loamy bottomland site where production on the protected area exceeded that on the grazed area by over 300 lb/acre. On both the stony hills and loamy upland sites, production was only about 100 lb/acre more on the protected areas than on the grazed areas.

There were significantly higher numbers of seed stalks of blue grama/ft² on the grazed areas than on the protected areas on both the loamy bottomland and the loamy upland sites but no significant difference on the stony hills (Table 1). On the loamy upland site there were nearly twice as many seed stalks on the protected area as on the grazed area. Blue grama plants were significantly taller on the protected areas than on the grazed areas for all sites.

There were no significant differences in total plant cover on the grazed and protected areas on the loamy upland and loamy bottomland sites (Table 2). However, on the stony hills site, total plant cover was significantly higher on the grazed area than on the protected area. The amount of litter differed little on the grazed and protected areas of the stony hills and loamy upland sites.

There were no significant differences in composition between the grazed and protected areas on the stony hills site (Table 2). Slimstem muhly (*Muhlenbergia filiculmis*) made up 5.2% of the cover on the protected area and was not encountered on the grazed area, but the difference was not significant. There were several significant differences in composition on the grazed and protected areas on the loamy bottomland site. The amounts of blue grama and western wheatgrass (*Agropyron smithii*) were significantly greater, and the amounts of mat muhly were significantly smaller on the protected area than on the grazed area. There was also significantly more mat muhly on the grazed area than on the protected area on the loamy upland site. The other difference in composition on the loamy upland site was significantly higher amounts of Carruther's sagewort (*Artemisia carruthii*) on the protected area compared to the grazed area.

Discussion and Conclusions

The basic assumption made in this study was that if all other variables influencing vegetation were the same on both sides of the fence, then any differences must be a result of grazing influences. The results showed that although production was lower on the grazed areas than on the protected areas for all three sites, there was no reduction in blue grama cover on the grazed areas compared to protected areas on the loamy upland and stony hills sites. On stony hills sites blue grama cover may actually increase under grazing and decrease under protection. Similar results were reported by Jeffries (1965) in southwestern Colorado, and Vogel and Van Dyne (1966) in Montana. Apparently lower production under grazing results from decreased vigor and growth of individual plants on some sites and replacement of blue grama by lower yielding species on other sites rather than a reduction of cover. Differences in species composition between grazed and protected areas on the loamy bottomland site may be the result of grazing pressure which appeared to be heavier on this site than on the others. Unfortunately, utilization figures for the grazed areas on each site are not available and the differences cannot be related to a particular grazing intensity.

Table 1. Total herbage production, average number of seed stalks, and average height of blue grama plants on three grazed and protected sites on Fort Stanton during 1964.

Site and item	Protec.	Grazed
Production (lb/A)		
Stony Hills	560	470*
Loamy Bottomland	610	295**
Loamy Upland	650	550*
Ave. no. seed stalks/ft²		
Stony Hills	7.32	7.78
Loamy Bottomland	16.01	10.53**
Loamy Upland	22.28	11.78**
Ave. ht. of seed stalks (ft)		
Stony Hills	1.15	0.77**
Loamy Bottomland	1.10	0.79**
Loamy Upland	0.96	0.68**

** Indicates a significant difference ($P < .01$) between protected and grazed area.
* Indicates a significant difference ($P < .05$) between protected and grazed area.

Table 2. Cover and vegetative composition (in percent) on three grazed and ungrazed sites at Fort Stanton.

Item	Stony Hills		Loamy Bottomland		Loamy Upland	
	Protec.	Grazed	Protec.	Grazed	Protec.	Grazed
Cover						
Plant Cover	11.8	18.1**	11.7	13.8	9.4	9.6
Bare Ground	34.9	23.0**	25.3	21.3	24.6	22.6
Litter	43.4	44.5	62.7	64.3	61.9	62.8
Rock	9.9	14.4	0.3	0.6	4.1	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition						
Bouteloua gracilis	88.2	90.7	73.3	44.3**	72.3	65.0
Bouteloua curtipendula	3.4	5.8	0.0	0.0	0.0	0.0
Agropyron smithii	0.0	0.0	15.0	1.7**	0.1	0.4
Muhlenbergia filiculmis	5.2	0.0	2.2	3.2	7.4	4.2
Muhlenbergia richardsonis	0.0	0.1	0.7	48.2**	1.0	25.1**
Muhlenbergia torreyi	1.5	2.1	0.1	0.3	0.0	0.6
Artemisia carruthii	0.0	0.0	4.8	1.2	13.7	1.2**
Others	1.7	1.3	3.9	1.1	5.5	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

** Indicates a significant difference ($P < .01$) between the grazed and protected area.
* Indicates a significant difference ($P < .05$) between the grazed and protected area.

LITERATURE CITED

BLYDENSTEIN, JOHN, C. R. HUNGERFORD, GERALD I. DAY, AND R. R. HUMPHRY. 1957. Effect of domestic livestock exclusion on vegetation in the Sonoran Desert. Ecology 38:522–526.

COSTELLO, D. F., AND G. T. TURNER. 1941. Vegetation changes following exclusion of domestic livestock from grazed ranges. J. Forest. 39: 310–315.

COTTAM, WALTER P., AND F. R. EVANS. 1945. A comparative study of the vegetation of grazed and ungrazed canyons of the Wasatch Range, Utah. Ecology 26:171–181.

ELLISON, LINCOLN. 1960. Influence of grazing on plant succession of rangelands. Bot. Rev. 26:1–78.

GARDNER, J. L. 1950. Effects of thirty years of protection from grazing in desert grassland. Ecology 31:44–50.

GARDNER, J. L., AND D. S. HUBBELL. 1943. Some vegetational responses after eight years protection from grazing. Ecology 24:409–410.

HEADY, HAROLD F., ROBERT P. GIBBENS, AND ROBERT W. POWELL. 1959. A comparison of the charting, line intercept, and line point methods of sampling shrub types of vegetation. J. Range Manage. 12:180–188.

JEFFRIES, NED W. 1965. Herbage production on a gambel oak range in southwestern Colorado. J. Range Manage. 18:212–213.

KEARNEY, THOMAS H., AND ROBERT H. PEEBLES. 1960. Arizona flora. University of Calif. Press, Berkeley. 1085 p.

MCINTYRE, G. A. 1952. A method for unbiased selective sampling using ranked sets. Austral. J. Agric. Res. 3:385–390.

MORRIS, MEREDITH J. 1964. The use of rating or ranking in vegetation measurement. *In* Range Research Methods. U.S.D.A., Forest Service Misc. Pub. No. 940.

SOIL CONSERVATION SERVICE. 1962. Range site technical descriptions and range condition guides. Albuquerque, New Mexico.

VOGEL, W. G., AND G. M. VAN DYNE. 1966. Vegetation responses to grazing management on a foothill sheep range. J. Range Manage. 19:80–85.