Effect of Grazing Intensity on Plant Composition, Vigor, and Production[1]

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Highlight

Two loamy prairie pastures were studied to determine the effect of different grazing intensities on botanical composition, herbage production, and plant vigor. Indications are that heavy grazing causes a decrease in range condition, an increase in undesirable grasses and forbs, and a decrease in vigor. Heavy grazing did not affect basal density.

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The Osage rangeland of Oklahoma, an area of gently rolling hills, is world renowned for its grass-fattened cattle. The region lies at the southern end of one of the last large segments of true prairie in the United States. The northern portion of this segment is known as the Kansas Flint Hills (Anderson, 1953). The general regional climate is one of hot summers with wet springs and falls. The mean annual precipitation is 32.81 inches with about three-fourths during the growing season.

The principle range site, loamy prairie, is characterized by fertile, deep, upland clay loam soils (Gray and Galloway, 1959). These soils are nearly black, highly granular, and permit good root penetration. Low permeability and rolling topography with many steep, winding ravines make cultivation difficult, therefore, native grass is the most practical vegetation. Many acres of claypan soils of the Parsons silt loam type also occur throughout the area in patchwork fashion, and were described in an earlier publication (Hazell, 1965).

Four important grass species (hereafter referred to as the big four), big bluestem (*Andropogon gerardi* Vitman), little bluestem (*A. scoparius* Michx.), indiangrass (*Sorghastrum nutans* (L.) (Nash), and switchgrass (*Panicum virgatum* L.) are the principle dominants on the loamy prairie site.

Overstocking is a major problem of the region. The purpose of this study was to compare the effect of two different grazing intensities on botanical composition, forage production, and plant vigor.

FIG. 1. General view of the moderately grazed pasture in excellent range condition June 1, 1962. Note vigorous growth of grasses and general absence of forbs.

FIG. 2. General view of the heavily grazed pasture in poor range condition June 1, 1962. Forbs were abundant and density of desirable grasses was low.

Study Areas and Methods

Area 1 (Fig. 1), a loamy prairie pasture in excellent condition, was grazed only during calving periods (October 15 to December 1, and February 15 to May 1). Area 2, a loamy prairie pasture in poor range condition, was grazed heavily year round (Fig. 2). It affords an excellent comparison to Area 1 in that heavy grazing has caused marked differences in botanical composition, plant vigor, and herbage production.

The point intercept method (Levy and Madden, 1933) was used to determine basal cover and species composition of the grasses of each study area. Two hundred samples, 2,000 points, were taken along pace transects in each pasture. The abundance and species of forbs were determined by the square-foot method. One hundred square-foot samples were taken in each study area at regular intervals.

Herbaceous forage production was determined by clippings from twenty 11.5 x 24-inch quadrats. Each sample was then oven-dried and the weight recorded in grams. Pounds per acre were calculated by multiplying the average weights in grams by the factor 50.

Vigor of the important grass species was determined by measuring maximum height, average height, leaf length, leaf width, and number of leaves. To obtain length and width, the third leaf from the base of the culm was measured at the widest point on ten random plants. On forbs, ten randomly located leaves from ten plants were measured from petiole to tip.

Results

Sixteen grass species were recorded in the study areas (Table 1). The big four were predominant in Area 1, with little bluestem the most abundant. These four alone comprised an average of 92.5% of the total vegetation.

The big four were sparse in Area 2 (Table 1). Indiangrass, in particular, was widely scat-

Table 1. Percent grass composition on the two study areas for the summers of 1961 and 1962.

Species	Area 1		Area 2	
	1961	1962	1961	1962
Little bluesteam	69.1	74.1	4.7	6.1
Big bluestem	12.5	13.5	4.7	6.1
Indiangrass	7.3	4.8	—	—
Switchgrass	2.0	1.6	1.1	—
Buffalograss	3.0	1.6	25.0	21.6
Tall dropseed	1.1	0.4	21.0	23.4
Silver bluestem	0.4	—	11.5	12.9
Sideoats grama	2.0	1.6	3.9	4.0
Sand dropseed *Bouteloua curtipendula*	—	0.4	14.1	8.3
Scribner panicum *Panicum scribnerianum*	1.4	0.4	3.4	2.6
Blue grama *Bouteloua gracilis*	—	0.4	1.5	2.9
Purple Lovegrass *Eragrostis spectabilis*	—	0.4	—	—
Sand paspalum *Paspalum ciliatifolium*	0.4	0.4	—	2.0
Windmillgrass *Chloris verticillata*	0.8	—	5.8	6.1
Tumblegrass *Schedonnardus paniculatus*	—	—	3.5	0.9
Sedges *Carex* spp.	—	0.4	—	3.0

tered, and though it was present, it did not occur either year in the point quadrat samples. Sims and Dwyer (1965) in a study concerning retrogression on the loamy prairie site near Stillwater, Oklahoma, found that these decreasers declined from 93% in excellent condition pastures to zero in extremely poor condition pastures. The main grasses in Area 2 were buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.), tall dropseed (*Sporobolus asper* (Michx.) Kunth), sand dropseed (*S. cryptandrus* (Torr.) Gray), and silver bluestem (*Andropogen saccharoides* Sw.). These four species alone made up 69.0% of the total vegetation in Area 2.

There was no significant difference in basal density between the two areas. Area 1 had a density of 11.4% while Area 2 had a density of 10.4%. It seems that due to the abundance of the sod-forming short grasses that density would be higher in Area 2. According to Tomanek and Albertson (1953), basal cover increases as overgrazing occurs, when the increasing species are sod-formers. The plants in Area 2 were grazed to such an extreme that they were very low in vigor and this was not the case. The results indicate that grazing intensity affects range condition, but not necessarily basal density.

Although the same forbs occurred in both study areas, the composition and abundance were strikingly different (Table 2). Area 1 produced an average of 56,319 forbs/acre and Area 2 had 229,775. It appears in this study that grazing intensity affects both composition and production of forbs (Fig. 1 and 2).

Forage production in the two areas was somewhat comparable, with Area 1 producing an average of 3,767 lb/acre of dry forage and Area 2 an average of 3,172 lb. The big four contributed 1,730 lb/acre in Area 1 but only 439 lb in Area 2. This is shown in Table 3, with all differences being significant at the .01 level (Steel and Torrie 1960).

Buffalograss, tall dropseed, sand dropseed, silver bluestem, and forbs were the main forage producers in Area 2. These four grasses produced 989 lb and the forbs 1,973 lb; together they contributed 2,062 lb of the total of 3,172 lb. Forb production in Area 1 was only 46 lb/acre.

Forage production decreased from 1961 to 1962, possibly because rainfall in May, 1961, was 5.66 inches and in May, 1962, only 1.86 inches.

The grass species in Area 1 had a significantly greater maximum height, average height, and leaf length than the same species in Area 2 (Table 4). Leaf height seemed to be the most consistent indicator of plant vigor. These

Table 3. Differences in production of grasses on study areas 1 and 2. Figures represent production of Area 2 subtracted from Area 1 (lb/acre).

Species	1961	1962
Little bluestem	1759**	1666**
Big bluestem	1213**	479**
Indiangrass	304**	256**
Switchgrass	296**	111**

**Significant at .01 level

Table 2. Average numbers per acre of the five principal forbs on the two areas for summers of 1961 and 1962.

Species	Area 1 (Moderate Grazing) 1961	Area 1 (Moderate Grazing) 1962	Area 2 (Heavy Grazing) 1961	Area 2 (Heavy Grazing) 1962
Western ragweed *Ambrosia psilostachya*	16,988	17,860	192,040	118,919
Heath aster *Aster ericoides*	13,504	15,682	43,068	61,150
False prairie boneset *Kuhnia eupatorioides*	11,246	9,614	28,019	38,352
Blue salvia *Salvia azurea*	5,227	4,356	17,424	12,632
Baldwin ironweed *Vernonia baldwinii*	4,712	2,614	24,848	22,197
Others	6,916	3,920	17,505	23,396
Total	58,593	54,046	322,904	276,646

Table 4. Average differences in cm for vigor of grasses[1] found on study area 1 and study area 2. Figures represent measurements of area 2 subtracted from area 1.

Species	Maximum Ht. June/61	Maximum Ht. June/62	Average Ht. June/61	Average Ht. June/62	Leaf Length June/61	Leaf Length June/62
Asc	-2.0	16.1**	-12.0**	11.2**	-2.5	1.0
Age	-5.8	17.0**	-7.0**	16.1**	-0.6	8.8**
Snu	4.9	7.7**	9.5**	14.4**	7.7**	9.0**
Pvi	4.3	28.4**	-10.5**	30.7**	9.2**	15.8**
	July/61	July/62	July/61	July/62	July/61	July/62
Asc	15.0**	9.9**	13.8**	6.7**	1.7	8.3+
Age	11.0**	3.7	12.7**	9.8**	3.0	4.7
Snu	11.0**	14.0**	7.0**	7.5**	7.4	8.9**
Pvi	14.5**	41.3**	13.3**	30.6**	3.0	5.0**
	Aug./61	Aug./62	Aug./61	Aug./62	Aug./61	Aug./62
Asc	-2.4	-17.0**	9.0*	5.2+	10.0**	21.6**
Age	-16.0**	-9.5**	-7.8+	10.6**	-1.8	15.4**
Snu	1.0	13.7**	6.0	2.4	1.5	6.9*
Pvi	0.7	29.6**	-2.8	30.6**	2.4	5.9**

[1] Asc=*Andropogon scoparius*, Age=*Andropogon gerardi*, Snu=*Sorghastrum nutans*, Pvi=*Panicum virgatum*.

* Significant at .05 level; ** Significant at .01 level; + Significant at .1 level.

results are in agreement with those of Johnson (1956), but in contrast with those of Blaisdell and Pechanec (1949). Differences in leaf width and number of leaves were not statistically significant even at the .1 level.

Even though the desirable grasses exhibited very low vigor in Area 2, they would probably recover rapidly if given a chance. According to Humphrey (1949), grasses in low vigor usually will show good to excellent vigor within a period of only one or two years, if the cause (overgrazing) is corrected.

Summary and Conclusions

Two loamy prairie pastures were studied during the summer months of 1961 and 1962 in northern Osage County, Oklahoma. One was grazed heavily year round; the other was grazed moderately for only about four months per year. An attempt was made to determine the effect of different grazing intensities on botanical composition, forage production, and plant vigor.

Sixteen grass species were recorded in the study areas. Little bluestem was by far the most abundant in the moderately grazed pasture while buffalograss and tall dropseed were the most abundant in the heavily grazed pasture. Silver bluestem was also abundant in this pasture, indicating that these invader plants increase under heavy stocking. The big four in the moderately grazed pasture were sparse in the heavily grazed pasture. Indications are that indiangrass was one of the least resistant to top removal, as it was not sampled either year by the point quadrat. According to Harlan (1960) part of the differential response of these grasses to top removal is due to differences in the position of shoot apices and dormant buds. With indiangrass, the severity of top removal probably depended greatly on the timing of the treatment with respect to the position of the shoot apices.

No correlation was noted between grazing intensity and basal cover. Grazing intensity did affect forb production. Western ragweed, heath aster, and false prairie boneset, respectively, were the most abundant forbs in each area, but their number in the heavily grazed pasture was tremendous.

Forage yields of around 3,400 lb/acre of dry matter per season were produced on each area. However, the species making up this production were entirely different in the two areas. Big bluestem, little bluestem, switchgrass, and indiangrass were the major forage producers in the moderately grazed pasture; while buffalograss, tall dropseed, sand dropseed, and silver bluestem were the main producers in the heavily grazed pasture.

Leaf height was one of the most consistent indicators of plant vigor. The grasses in the moderately grazed pasture produced a greater maximum height, average height, and leaf length than the same species in the heavily grazed pasture. Leaf width and number of leaves, however, were not correlated with vigor.

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