Some Effects of Different Intensities of Grazing on Mixed Prairies near Hays, Kansas

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SOME sites on mixed prairies near Hays, Kansas are dominated by short grasses while others may be controlled by mid or tall grasses depending upon some combination of variations in topography, soil type, soil moisture, and degree of utilization. However, short, mid and tall grasses often form an upper and lower story on the same site.

The purpose of this investigation was to determine the effect of different grazing intensities during past years on cover, composition and yield of vegetation on three sites. These sites were all on shallow soils and have been designated as ridgeline, hillside and rocky break, according to their topographical location. This basic information may be helpful in classifying range condition in this part of the mixed prairie.

METHODS OF STUDY

Three pastures were selected for study. Since all study areas were less than one-half mile apart and on similar soils and topography, the environmental factors, with the exception of grazing pressure, were assumed to be equal. The history of grazing intensities for each pasture was well known for many years. One pasture had been stocked very heavily, one moderately and the third had never been more than lightly used since the days of the buffalo. Three sites were selected in each pasture which differed in their topographical location (ridgeline, hillside and break) but were similar in slope, soil and parent material. The soil, which is dark gray, immature, granular and porous, differs in depth and stoniness. The soil on the hillside was a few inches to two feet deep and contained many fragments of limestone. The ridgeline soil was slightly deeper and somewhat less rocky but those of the breaks consisted mainly of rock fragments with a thin filler of partially-formed soil. The underlying limestone, however, contained many large fissures and crevices filled with clay which were occupied by numerous roots (Albertson 1937).

The vegetation on all three pastures was sampled in 100 square-foot plots on each site which were distributed along lines marked out in such a manner that they crossed the site many times and in all directions. Basal area was estimated at a height of 1.5 inches above the soil. Species composition was also determined by estimating the percentage of the total vegetation represented by each species. The apparatus and method of sampling have been described in detail by Voigt and Weaver (1951).

Seasonal yields of forage were computed for the nongrazed and heavily grazed pastures. These were secured at the end of the growing season by removing the vegetation one inch above the soil from 30 randomly located meter-square quadrats. The forage thus removed was air-dried, weighed, and converted to pounds per acre.

Mulch was collected from square meter quadrats randomly placed in each of the three pastures. The mulch was assumed

to be all the plant material, besides the current seasonal yield, on top of the mineral soil.

The vigor maintained by the individual plants in a pasture is very important not only from the standpoint of forage production but also in their ability to withstand climatic and biotic hardships. It was apparent from casual observation that the plants showed a marked difference in stature in relation to the intensity of use. In addition to observations numerous measurements of individual plants were made at random to obtain quantitative data on these differences. The number of stems produced by various plants was determined by making stem counts along the hillsides of each pasture on the inside of a sampling ring four inches in diameter. The ring was randomly placed on 50 plants of each of the five dominants.

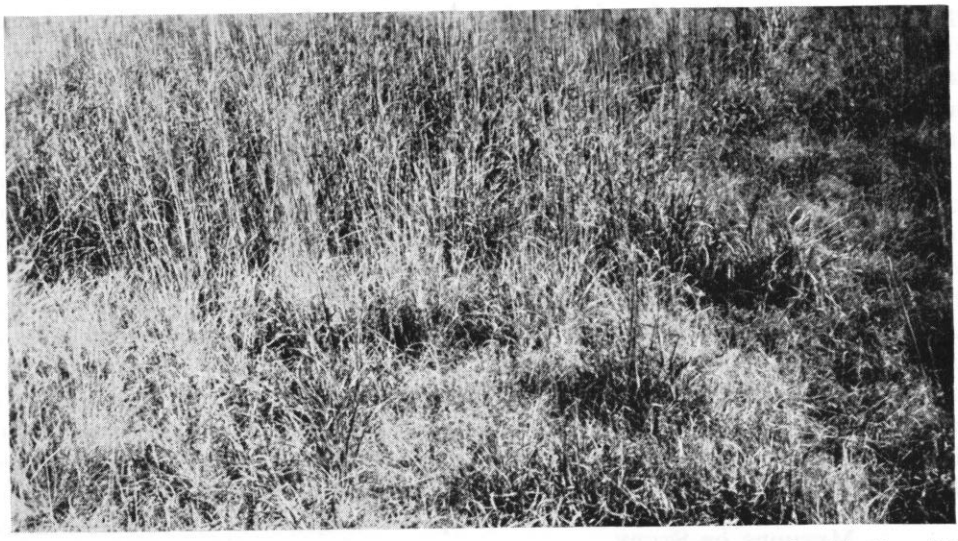

FIGURE 1. Big bluestem advancing from a pure stand into short grass on the ridgeline of the nongrazed area.

COMPOSITION AND COVER

The drought of 1933 to 1940 brought about tremendous changes in the vegetation which are apparent even after eleven years of good rainfall (Albertson, et al., 1953). General appearance of the vegetation in the fall of 1951 resembled that found before the drought but the composition was quite different. Tall grasses, especially big bluestem (*Andropogon gerardi*), had taken over large areas formerly occupied by mid grasses [little bluestem (*Andropogon scoparius*) and side-oats grama (*Bouteloua curtipendula*)] and short grasses (Fig. 1). Big bluestem had become the most abundant grass on both hillsides and ridgelines where the soil was shallow and rocky. Little bluestem had maintained its dominance on the rocky breaks. Recovery of the preferred bluestems had been hampered in various degrees depending upon the intensity of livestock use.

Ungrazed Prairie

This relict area was dominated by tall grasses which furnished 66.1 percent of the vegetation on the ridgeline, 63.0 percent on the hillside, but only 3.7 per-

TABLE 1

Percentage composition and basal cover of the principal species of grass on different sites in relation to intensity of grazing

	RIDGELINE			HILLSIDE			ROCKY BREAK		
	Non-grazed	Mod. grazed	Heavy grazed	Non-grazed	Mod. grazed	Heavy grazed	Non-grazed	Mod. grazed	Heavy grazed
Tall grasses	66.1	12.8	1.4	63.0	14.8	7.8	3.7	—	1.0
Big bluestem	64.2	12.8	1.0	60.3	14.8	7.4	3.7	—	1.0
Indian grass	1.9	—	0.4	2.4	—	—	—	—	—
Switch grass	—	—	—	0.3	—	0.4	—	—	—
Mid grasses	29.6	68.1	25.2	36.7	65.9	52.3	96.3	95.8	90.0
Little bluestem	8.6	7.1	—	26.6	9.2	2.6	81.6	67.1	45.5
Side-oats grama	17.6	59.2	23.1	9.4	56.1	48.9	14.7	28.7	43.5
Hairy dropseed	1.4	0.1	0.2	0.7	0.1	0.3	—	—	1.0
Western wheatgrass	—	—	1.7	—	—	0.1	—	—	—
Three-awn grasses	2.0	1.7	0.2	—	0.5	0.2	—	—	—
Sand dropseed	—	—	—	—	—	0.2	—	—	—
Short grasses	4.3	19.1	73.4	0.3	19.3	39.9	—	4.2	9.0
Blue grama	4.2	13.5	23.7	0.3	10.4	2.9	—	—	—
Hairy grama	—	2.7	17.3	—	7.9	22.6	—	4.2	9.0
Buffalo grass	0.1	2.9	32.4	—	1.0	14.4	—	—	—
Total composition	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Basal cover	14.4	26.4	34.5	14.0	33.1	44.8	11.2	4.1	8.4

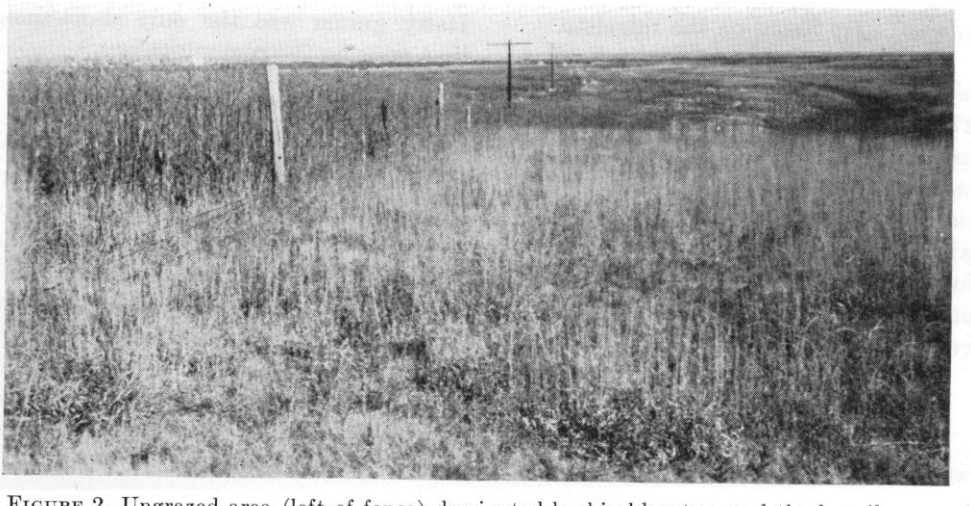

FIGURE 2. Ungrazed area (left of fence) dominated by big bluestem and the heavily grazed location (right of fence) composed mostly of side-oats grama and short grasses. Rocky breaks shown in background.

cent on the comparatively small, rocky break sites (Table 1).

Big bluestem was by far the most important tall grass due to its rapid spread following the great drought (Fig. 2). It alone composed 64.2, 60.3 and 3.7 percent of the vegetation on the sites in the order mentioned above. Indian grass

(*Sorghastrum nutans*) occurred in small amounts on the ridgeline and hillside and switch grass (*Panicum virgatum*) was found infrequently on the hillside.

Next in importance were the mid grasses which made up 29.6, 36.7 and 96.3 percent of the cover on the ridgeline, hillside and rocky break sites, respectively. Most of this cover was composed of two dominants, little bluestem and side-oats grama. On the more xeric ridgeline side-oats grama occurred in small, pure stands and was found more frequently than little bluestem (17.6 and 8.6 percent, respectively), but on the hillside little bluestem was nearly three times as plentiful. The rocky break habitat is a favorite one for little bluestem and here it comprised 81.6 percent while side-oats grama, the only other mid grass found made up 14.7 percent of the vegetative cover. Scattered plants of the three-awn grasses (*Aristida purpurea* and *A. longiseta*) and hairy dropseed (*Sporobolus pilosus*) were found on the ridgeline.

The short grasses formed a minor part of the vegetation on this ungrazed prairie. They were not present on the rocky breaks and composed only 0.3 percent on the hillside and 4.2 percent on the ridge. Blue grama (*Bouteloua gracilis*) with one exception, was the only one found. Buffalo grass (*Buchloe dactyloides*) made up a meager 0.1 percent of the vegetation on the ridges.

Moderately Grazed Pasture

Under moderate use the tall grasses were largely replaced by mid and short grasses and furnished only 12.8 percent of the vegetation on the ridgeline, 14.8 percent on the hillside but were absent entirely on the rocky breaks (Table 1). Big bluestem was the only one found in sufficient abundance to be recorded in the sampling.

The major portion of the vegetation on this moderately grazed range was furnished by mid grasses, the most important of which were side-oats grama and little bluestem. On the ridgeline and hillside sites side-oats grama made up more than half the cover (59.2 and 56.1 percent, respectively). Little bluestem was much less abundant on these two sites but comprised 67.1 percent of the vegetation on the rocky breaks. There were a few scattered plants of hairy dropseed and the three-awn grasses.

Under the influence of moderate grazing short grasses became a rather important part of the vegetation. The three short grasses, blue grama, hairy grama (*Bouteloua hirsuta*) and buffalo grass, together furnished 19.1 percent of the cover on the ridgeline, 19.3 percent on the hillside but only 4.2 percent on the rocky breaks. Blue grama was the most plentiful of the three on the ridgeline and hillside followed in order of abundance by hairy grama and buffalo grass. Hairy grama was the only short grass that grew on the rocky breaks.

Heavily Grazed Pasture

Under heavy utilization tall grasses had practically disappeared and furnished only 1.4, 7.8 and 1.0 percent of the cover on the ridgeline, hillside and rocky break sites, respectively (Table 1). Big bluestem again formed the bulk of the tall grass population but occurred only as small, scattered plants about 2 inches in diameter. Isolated and dwarfed plants of Indian grass and switch grass were occasionally found.

Even the relative amount of mid grasses decreased as the grazing pressure became heavier. They furnished about one-fourth (25.2 percent) of the vegetation on the ridgeline, one-half (52.3 percent) on the hillside but nearly all of it (90 percent) on the breaks. Side-oats grama was more abundant than little bluestem on all

sites in this heavily utilized range. Over much of the area side-oats grama occurred in pure stands 6 to 10 feet in diameter but in other areas it was rather sparse with an understory of short grasses. Degenerate clumps of little bluestem were thinly scattered throughout the pasture except on the rocky breaks where they still furnished one-half the cover. Other mid grasses of minor importance found here were hairy dropseed, western wheatgrass (*Agropyron smithii*), sand dropseed (*Sporobolus cryptandrus*) and the three-awn grasses.

The decrease in the relative amounts of tall and mid grasses under heavy utilization was accompanied by a proportionate increase in the short grasses. On the ridgeline 73.4 percent of the basal cover was furnished by the three short grasses, blue grama (23.7), hairy grama (17.3) and buffalo grass (32.4). The more mesic hillside was still dominated (over 60 percent) by tall and mid grasses with only 39.9 percent short grass. A small amount of hairy grama was the only short grass found on the rocky breaks.

Basal Cover

Total basal cover of the vegetation increased with an increase in grazing pressure on all sites except the rocky break (Table 1). On the ridgeline it was 14.4, 26.4 and 34.5 percent on the non-, moderately and heavily grazed areas, respectively. In the same sequence on the hillside it was 14.0, 33.0 and 44.8 percent. On the rocky breaks cover decreased with moderate use but increased again under more pressure. The increase in the amount of short grass under greater grazing pressures on all three sites accounted for the general increase in basal cover.

Yields and Mulch

Slightly over a ton of forage was produced on the nongrazed pasture but only a little more than one-half ton was harvested from the heavily grazed location (Table 2). Not only do these yields reflect the difference in species composition in the pastures but they also indicate variations in the vigor of the grasses.

TABLE 2

Forage yield and amount of mulch on the ground in pounds per acre in the fall of 1951

	NONGRAZED	MODERATELY GRAZED	HEAVILY GRAZED
Yield	2,296	—	1,323
Mulch	6,207	3,252	913

The amount of mulch blanketing the soil surface is often used as an indicator of range condition and past usage. Its value in protecting the soil from erosive action of raindrops and the loss of water by evaporation is well known. Too much mulch in an area can, however, reduce the forage yield (Weaver and Tomanek 1951). The nongrazed area was protected by nearly seven times as much mulch as the heavily grazed location (Table 2).

The presence of too much old vegetation seemed to limit the production of flower stalks. Many areas, especially in pure stands of big bluestem where the mulch was heavy, did not produce flower stalks while nearby pure stands of the same species without as much mulch were prolific (Fig. 3).

Height and Number of Stems

There was a noticeable variation in the height of certain species of grass found in all three pastures. With but one exception the five species studied attained a greater height under increased protection. It was particularly apparent among the tall grasses where, for example, switch grass in the non-grazed pasture averaged nearly twice the stature of the same species in the heavily grazed location (Table 3).

The number of stems counted per unit area was also greater in the pasture that had not been grazed. They became less abundant as the intensity of grazing increased. In all five species studied at least twice as many stems per unit area were counted under protection as were found in plants most heavily used (Table 4).

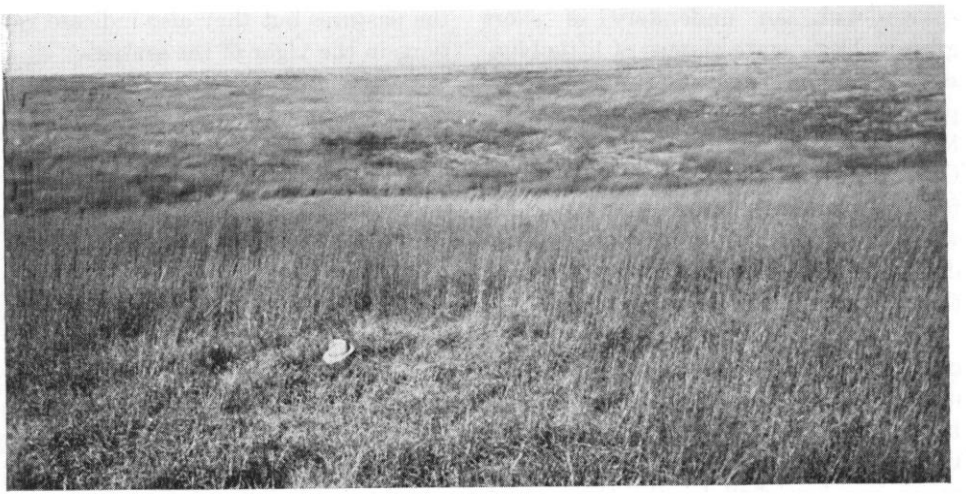

FIGURE 3. An area (hat) of big bluestem which had a heavy mulch and no flower stalks. This was bordered by a pure stand with less mulch and many flower stalks.

TABLE 3

Average height in inches of flower stalks of the principal grasses found under different intensities of grazing at the end of the growing season

	UNGRAZED	MODERATELY GRAZED	HEAVILY GRAZED
Big bluestem	54.2	42.3	39.2
Little bluestem	30.1	27.2	26.0
Side-oats grama	32.7	23.3	28.2
Indian grass	55.5	—	45.0
Switch grass	53.1	—	29.8

TABLE 4

Average number of stems of the principal grasses found in a circle 4 inches in diameter

	UNGRAZED	MODERATELY GRAZED	HEAVILY GRAZED
Big bluestem	6.0	4.6	3.3
Little bluestem	50.0	32.3	19.9
Side-oats grama	17.6	9.2	8.7
Indian grass	6.2	—	3.6
Switch grass	7.0	—	2.7

DISCUSSION

Range condition has been classified by different criteria. Density, percentage composition, yields, degree of erosion, plant vigor and litter are the ones used most frequently (Costello and Turner, 1944; Humphrey, 1949; Gilbert, 1948; Chohlis and Tinsman, 1948; Pickford and Reid, 1942; Beetle, 1950; Ellison, et al., 1951).

In their study of the true prairie, Weaver and Hansen (1941) listed the plants that decreased, increased and invaded in response to grazing. A similar ecological classification of species was used by Dyksterhuis (1949) to provide a quantitative system of range classification. His system of range condition classification has been widely applied but many more basic studies are needed to

supply detailed information on the reaction of forage plants on various locations to different intensities of livestock use.

Table 1 reveals how the principal grasses responded to grazing on different sites. However, more data on many separate areas need to be secured before a classification can be safely advanced. Big bluestem and little bluestem both decreased in abundance on all sites with an increase in utilization whereas all three short grasses increased in importance. In fact, buffalo grass occurred in such small amounts in the climax on these sites that it could almost be classed as an invader. The cover in the heavily grazed area had not been sufficiently disturbed to allow invasion of exotic plants. Side-oats grama reacted like both a decreaser and an increaser. On the hillsides and ridges it became more abundant with moderate use but as the pressure became greater it decreased. On the rocky breaks, however, it increased steadily with greater utilization. These grasses are the key species for use in determining the effects of grazing upon these sites in native pastures of this area.

Excessive utilization of range plants has a tendency to reduce their vigor. Vigor has long been one of those immeasurable criteria used in judging range condition and trend. Many things indicate variations in vigor. The differences in the vigor of plants under the three intensities of grazing are rather clearly shown by a comparison of yields, growth in height and the number of stems or tillers produced per unit area. The greater growth and more numerous stems of plants under nongrazing is reflected by the good yield in that pasture.

Summary

Three pastures were studied near Hays, Kansas to determine the effects of different grazing intensities upon the vegetation. Three sites which are common in this area were studied in nongrazed, moderately grazed and heavily grazed locations. All three sites had shallow immature soils. The rocky breaks were comprised of mostly rock fragments with only a thin filler of soil and even the soils on the hillside were very shallow and contained many small fragments of rock. The soils of the ridgeline were somewhat deeper and less rocky.

The differences in basal ground cover and species composition were determined by sampling the vegetation with numerous square-foot quadrats. Tall grasses, especially big bluestem, were dominant on the ridgeline and hillside sites in the nongrazed pasture. Mid grasses were most prevalent on these two sites in the moderately grazed areas while the bulk of the vegetation on the heavily grazed pasture was made up of short grasses. The rocky break sites were dominated by the two common mid grasses, little bluestem and side-oats grama. However, the proportionate amount of little bluestem decreased and that of side-oats grama increased with greater grazing pressures.

The basal ground cover of the vegetation was found to be greatest on the heavily grazed pasture and least on the nongrazed area. The greater amount of short grass found at the former location probably accounts for this variation.

The nongrazed pasture produced 2,296 pounds of forage per acre as compared to 1,323 pounds for the heavily grazed location.

Over three tons of mulch per acre were collected from the relict area as compared to one and one-half tons on the one moderately used, and less than one-half ton on the heavily grazed location.

Variations in vigor of the plants subjected to different intensities of use were readily shown by differences in height

and number of stems per unit area. The plants from the area which had been heavily used in past years were much shorter and had only about one-half as many stems per unit area as did those of the ungrazed pasture.

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