



*Activities
and
Grazing
Preferences*

**OF COWS WITH CALVES
IN NORTHERN OSAGE
COUNTY, OKLAHOMA**



DON D. DWYER

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Cattle have well-defined habits and their movements on rangeland are far from random. A knowledge of their activities and the plants they prefer provide some basis for establishing a management plan for both cattle and range.

Several workers have been concerned with the study of the activities of cattle as they graze naturally on the range (10, 11, 13, 14, 15, 16, 17, 18). It appears that such environmental factors as condition of pastures, distance to water, temperature, and wind influence the activities of cattle (1, 2, 3, 4, 5, 22). One of the earliest studies compared the activities of sheep, goats, and beef cattle (6). Another studied the activities of cattle, sheep, and deer (10).

Preferences shown by cattle for certain species are largely responsible for any changes in vegetative composition which occur in native rangelands. These preferences are influenced by such conditions as succulence of forage, appetite of the animals, season of growth, nutritive qualities, and others (7, 12, 19, 21). A portion of this study attempts to establish the relative preferences of cattle for the four important native forage species of the region throughout the growing season.

Description of the Study Area

Adams' Ranch is a 33,000 acre tract of land located in the Osage Hills of Oklahoma, an area renowned for its bluestem pastures. The Osage Hills are a continuation of the Flint Hills of eastern Kansas and the structure and composition of the vegetation are much the same.



Figure 1. General view of the loamy prairie range site in late July showing the structure of the vegetation. Flower stalks of big and little bluestems are apparent.

Gently rolling topography with many steep winding ravines is typical of most of the area. Trees and shrubs are found only in the canyons and along the steeper slopes. According to Weaver (22), this area is a part of an "enormous prairie that extends from near the Nebraska state line entirely across Kansas and into Oklahoma, where it is known as the Osage Hills." The hilly topography is most pronounced near streams, where steep breaks and escarpments occur.

The study area, a 1,500 acre pasture located on Adams' Ranch, was divided into three range sites: loamy prairie, shallow, and rocky breaks (9). Loamy prairie site represents 70 per cent of the total acreage included in the area. This site was characterized by a fertile, deep soil (greater than 36 inches) of the Labette and Summit clay loam series. These soils are nearly black, highly granular, and have chert fragments throughout and on the surface. These permeable soils rest on fragmental beds of chert or flinty limestone, and have enough clay and silt interspersed with the rock fragments to furnish good water storage capacity. The vegetation is largely a mixture of tall and mid grasses with big and little bluestem (*Andropogon gerardi* and *A. scoparius*), switchgrass

(*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*) as the predominant species (Figure 1).

On flat hilltops and ridges shallow soils of the type Sogn stony loam usually occur overlying limestone ledges. This shallow site makes up twelve percent of the total study area and has soils varying in depth from zero to 36 inches. The vegetation is primarily blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), and sideoats grama. Tall grasses often occur in the bed rock fissures of this site. Many acres of claypan soils belonging to the Parsons silt loam type are scattered in patchwork fashion over the region (Figure 2). A dense, compacted layer of clay, located from four to ten inches beneath the soil surface, sharply restricts the growth of the tall grasses. Consequently, the vegetation is very similar to that found on shallow soils overlying the escarpments. These claypan areas were included in the shallow range site for purposes of this study because of similiarity in vegetation.

Vegetation on the rocky breaks site consists mostly of tall and mid grasses in a composition much like that on the loamy prairie soils. This



Figure 2. Claypan soils occur in patchwork fashion throughout the region. Note the distinct boundary with short grasses on the left and tall grasses on the right. The conspicuous forb is antelopehorn milkweed (*Asclepias viridis*).

site comprises 18 per cent of the study area and was so designated when the slope exceeded 25 per cent. From ten to 30 per cent of the soil surface is occupied by exposed rocks and boulders, but many deep soil pockets are found interspersed among them.

Climate of the Study Area

The general climate of the region is one of dry, hot summers and wet springs and falls. Records for the United States Weather Bureau at Pawhuska, Oklahoma, a town about 20 miles southwest of the ranch, showed a mean annual precipitation of 34.55 inches with nearly three-fourths of it coming during the growing season. The month of May has the highest average precipitation with 5.11 inches and December has the lowest with 1.31 inches. Summer temperatures are usually high with frequent extremes of 100° F. The mean annual temperature is 61.0° F. with the lowest monthly average of 37.5° occurring in January and the highest, 83.7°, in July. Relative humidity was unusually high during the study period, averaging 68.3 per cent. The highest daily average was 88.9 per cent and the lowest average was 48.5 per cent.

The study period was marked with rather cool, moist weather. Rains were frequent and precipitation was well above normal. Daily fluctuations in temperature and humidity were generally gradual. The lowest temperature and the highest humidity reading occurred at day-break each day, but as the day progressed, temperature gradually increased until the high for the day was reached about 2:00 or 3:00 p.m. At this time the humidity reading was always lowest for the day. The evenings showed a very gradual decrease in temperature and an increase in humidity.

Grazing Activities

Methods and Procedures

The first of June, 1958, 20 Hereford cows with calves were cut from the herd in the pasture in which the study was conducted. Large numerals were painted on the sides of the cows and chains with plastic numbers placed on their necks so each cow could be individually identified. The animals were then returned to the herd and allowed to become dispersed in the pasture. Observations were made at three and four day intervals through the summer grazing season. Each study period was spent watching a different marked animal.

Observation of a particular cow for any given day began when she arose in the morning, usually around 4:40, and continued until she ceased grazing for the day, about 8:15 p.m. This period from rising until bedding down was called a cow-day. It was learned prior to the initiation of the study that movement of a pickup truck near the herd caused a minimum of disturbance. In fact, after the first hour of the first day the cows paid little, if any, attention to it. It was very easy to stay within 20 yards of a cow under observation, although it was not necessary to remain this close at all times. The cows would become excited and move away, however, if the observer walked more than a few yards away from the pickup.

The vegetation of the study pasture included enough climax plants to place the loamy prairie and breaks sites in the "excellent" range condition class and the shallow site in "good" condition. The yearlong stocking rate of 211 cows with calves for the entire pasture was proper under the existing conditions of vegetation and climate.

The time of day at which any change in activity occurred and the period spent in each activity were recorded for each range site. The timed activities included grazing, standing, lying, ruminating, suckling, walking, watering, and salting. All times were taken to the nearest minute. Temperature and humidity were taken each hour with a sling psychrometer. At this same time, wind direction and relative velocity and sky conditions (whether overcast, cloudy, clear, etc.) were noted. These conditions were then related to the cow's movements and activities for the cow-day. The effect of the calves on movements and grazing habits of their mothers was recorded as well as activities of the calves themselves. Binoculars proved a valuable aid in locating the cow and establishing time records.

One 24-hour period of observation was included every month and seven nighttime observations were also made of cows randomly selected from the 20 marked animals. A flashlight was used to keep the animal under observation at night. The use of a light had no noticeable effect on the activity of the cows.

Aerial photographs of the pasture were used to trace routes of the cattle and to determine travel patterns in relation to range sites, salt and watering places, and climatic factors (Figure 3). The daily distance traveled by each cow was determined from routes traced as well as by the speedometer readings of the pickup.

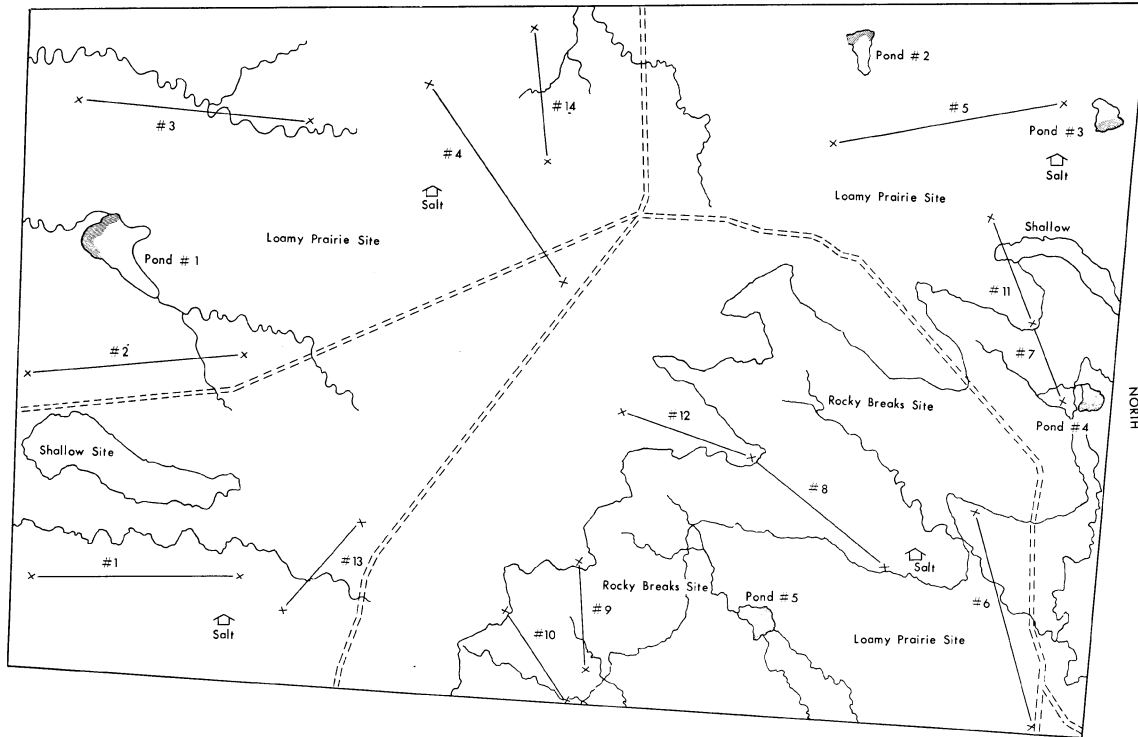


Figure 3. Drawing of the study pasture showing location of ponds, protected salt feeders, range sites, and line transects. Transects numbered 1 through 6 are located on the loamy prairie; 7 through 10 are on the breaks; and 11 through 14 are located on the shallow range site.

Activities for an Average 24-Hour Period

Activities of the range cows for a 24-hour period are presented graphically in Figure 4 as averages obtained from all observations. The cow-day began at daybreak just as the sky became bright and objects were discernible only by shadows. At this time, about 4:40 a.m., the cows arose from lying, and stretched, curling their tails over their backs

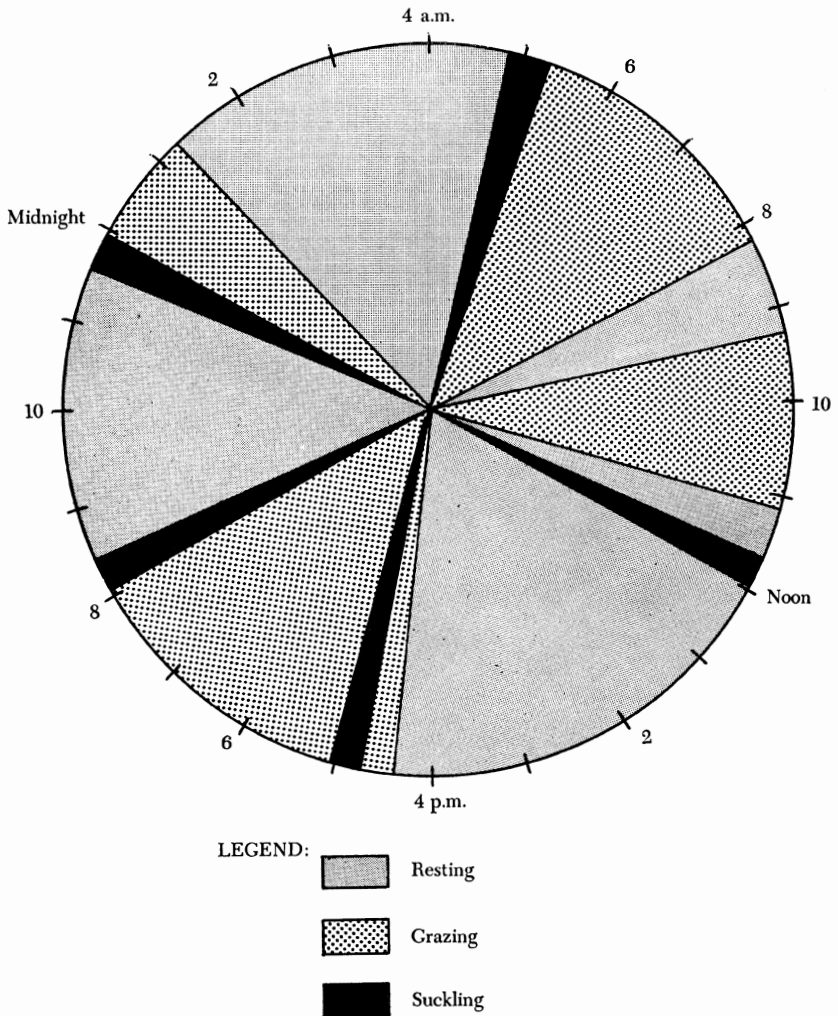


Figure 4. Average distribution and length of grazing, resting, and suckling periods for the mother cow during a 24-hour period.

and extending a hind leg. They usually stood for five or ten minutes and continued ruminating contentedly after rising. The calves generally remained lying for awhile after their mothers got up, especially when they were very young. The cows began grazing by 5:00 and very shortly the calves arose and bawled for their mothers. The first nurse period of the day was completed by 5:15.

After nursing, the calves remained close by their mothers as they grazed rather intensively in the general direction of water. In most cases this was toward a pond, but occasionally water was found in gullies. The cows arrived at the watering place for their first drink sometime between 7:00 and 8:00 a.m. Following this they continued grazing away from water until around 8:15 or 8:30. At this time, all observed cows rested for about an hour. Most of this period was spent lying down and ruminating. The cows then resumed grazing in the direction of a pond. This trip to the pond appeared to be as much for a place to cool themselves as it was for the water they drank.

Temperature dictated the time of arrival at the pond—that is, the hotter the morning, the earlier they arrived (Table 1). In general, the

Table 1. Arrival time and hours spent within a 100-yard radius of pond by observed animals in relation to temperature conditions.

Cow No.	Pond No.	Hours Spent Within 100 Yds. of Pond	Average Cow-day Temp.	Time of Arrival at Pond	Temperature on Arrival
1	1	2.4	84.1° F.	11:35 a.m.	89° F.
2	1	2.2	72.2	1:10 p.m.	75
3	1	6.5	83.7	11:46 a.m.	88
4	4	4.1	85.8	10:05 a.m.	89
5	—	—	70.1	—	—
6	1	6.3	80.1	10:13 a.m.	84
7	2	5.8	81.7	10:03 a.m.	84
8	5	6.1	78.0	12:17 p.m.	79
9	2	8.0	85.4	10:35 a.m.	88
10	1	5.1	82.8	11:53 a.m.	90
11	1 & 3	0.4	72.2	12:00 noon	79
12	1	1.4	74.1	11:20 a.m.	76
13	4	9.7	87.5	7:33 a.m.	85
14	—	—	80.6	—	—
15	1	0.5	74.6	12:43 p.m.	78
16	5	10.4	86.4	8:06 a.m.	83
17	1	2.3	74.7	7:54 a.m.	74
18	3	9.2	84.2	8:22 a.m.	81
19	1	7.8	81.4	8:48 a.m.	85
20	—	—	80.4	—	—
		Avg. 4.4 Hrs.			

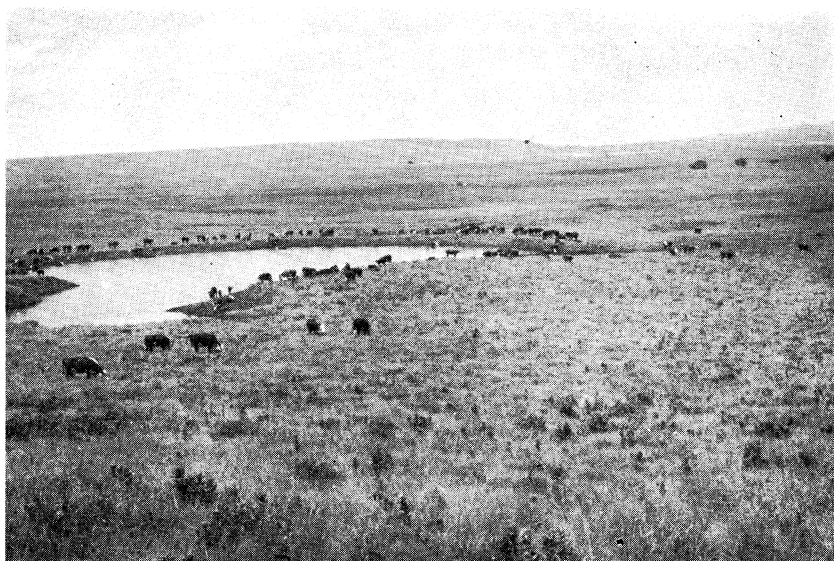


Figure 5. View of Pond No. 5 shortly after 12:00 noon showing approximately 100 head of cows and calves resting or grazing near the pond.

cattle tended to arrive at the pond when the temperature approached 85° F. The number of hours at the pond was also regulated by temperature. For example, Table 1 shows that when the average cow-day temperature was 87.5° F., the hours spent at the pond were 9.7, and when the temperature average was 72.2° F. this time was only 0.4 hours. By 11:00 a.m. most of the animals had reached the pond. Shortly after arrival, the calves nursed for the second time. The cows then spent the next four to five hours alternately standing on the shore, dam, or in the water; lying, or occasionally grazing a short distance from the pond and back again. Much of this mid-day rest period was spent in rumination. Generally, the herd remained idle and congregated around the ponds from nearly noon until around 4:00 p.m. (Figure 5).

With cooler temperatures in late afternoon, around 4:00 or 5:00, the cows, after drinking, gradually drifted away from the pond, singly or in small groups, and began the evening period of grazing. The cows usually searched out their calves, if they were not with them, and nursed them. This nurse period occurred either just before the cows began grazing or soon after. Following this, both the cows and their calves grazed very intently in the direction of a bedding ground which was generally located on hilltops and ridges. Salting was accomplished

during this late evening grazing period or during the early morning period of grazing between 5:00 and 8:00 a.m.

As the time approached for bedding down, the cows always tried to have their calves by side. By 6:00 or 6:30 p.m., the cow without her calf began looking and calling for it. She continued to graze, but nervously looked up and called frequently. When the calf answered, she kept on calling until it came into view, then she stopped calling and stood, waiting for the calf to come to her. It either nursed upon reaching its mother or at the bedding grounds. If the bedding grounds were not reached by dark while grazing, the cows trailed in single file the remaining distance. They spent the nights in relatively large groups, and small groups often walked considerable distance so they would be with the larger body.

Grazing usually ceased by 8:30 p.m. and the cows were soon contentedly chewing their cuds. Many of the calves would nurse again at this time. By 9:15 the herd was generally lying down. They remained resting in this position or alternately standing and lying until around midnight. At this time the herd would, one by one, begin grazing. They did not drift far from the immediate area because their calves usually remained bedded down. However, when the calves became older they would arise with their mothers and nurse as well as graze. This grazing period rarely exceeded two hours and the herd was again resting peacefully by 2:00 a.m. The remainder of the night was spent resting and ruminating until the early morning dawn initiated another cow-day.

General Activities of Range Cows

Grazing

The total time spent grazing included the travel necessary in this activity. There were two intense periods of grazing for each day. These were between 5:00 and 8:00 in the morning and from 5:00 to 8:00 in the evening. Culley (8) working in Arizona also reported that "Cattle have rather definite grazing periods." During these periods the animals ate almost frantically and were not easily distracted (Figure 6). During the morning and evening periods of grazing, several bites of forage were consumed between each step, while during other grazing periods the cows walked several steps between bites and were easily disturbed.

The animals often sniffed the forage plants before eating them. This action appeared to be a critical test to determine whether or not



Figure 6. Cow No. 8 during the morning grazing period. Note the painted numeral on the side, which is partially gone due to shedding of hair coat, and the neck chain which aided in identifying the animal.

a particular plant part would be consumed. Often a plant would be rejected after smelling, even though the same species had been grazed immediately before. Variety of species seemed to be quite important in range cows' diets. The animals depended on three or four species of grass for the major portion of their food but continuously grazed many different grasses, forbs, and shrubs. Certain areas were regrazed several times during the summer while others were grazed only once. The cattle always preferred the tender new growth of grazed plants over the more mature vegetation.

Animals ordinarily grazed in groups of 20 to 30, each cow following in the general direction of the group, but still exercising a great deal of individuality. On the breaks site the groups were noticeably smaller and tended to follow the easiest topography—grazing around the terraces (Figure 7). When in these small groups of six to ten, each animal followed the actions of the group quite closely. There did not appear to be specific leaders in any group of animals, but some bullying was

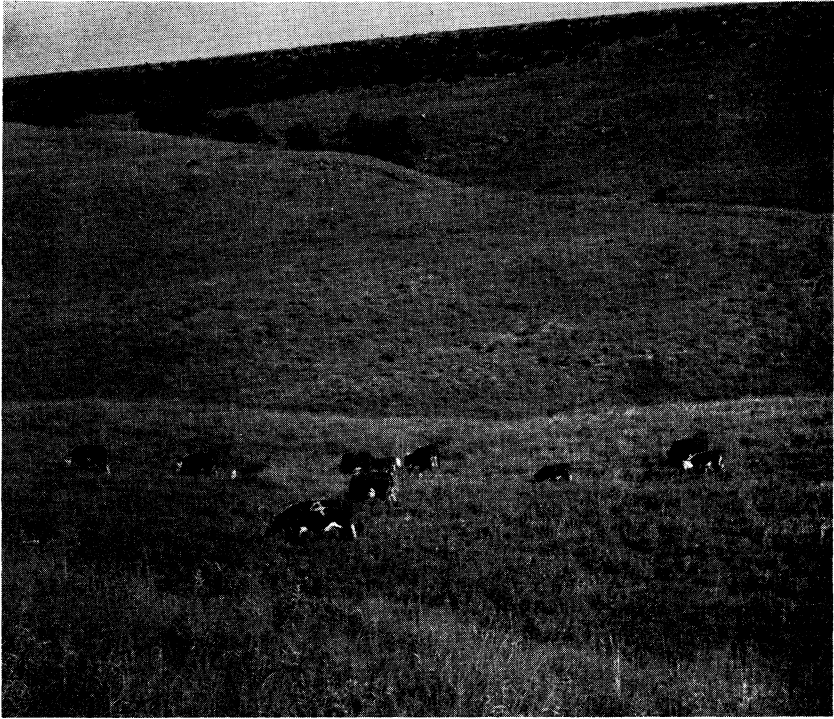


Figure 7. Cow No. 4 grazing on the level terrace benches of the rocky breaks site. Cattle usually grazed in relatively small groups of six to ten on this site. Woody vegetation occurs on the north facing slopes of the breaks site.

shown around the salt boxes. The composition of the various grazing groups constantly changed through mingling at watering and salting places or simply by one or more cows walking directly from one group to another. The only constant companion of any one cow was her offspring.

The cattle never passed up the opportunity to rub themselves whenever they came near any object that provided a rubbing surface. A large rock located near the center of the pasture bears witness to this fact. This rock projected only 18 inches from the ground and the cows had to get on their knees to rub their necks, but its surface was smooth and the surrounding area bare from the countless animals that had paused to rub themselves. Healing over of gullies was retarded because cattle continually rubbed on the sides and butted the soft earth, wearing away any vegetation present. Bulls were especially destructive to the sides

of gullies and used their horns to gouge and tear the gully walls. Almost any time during the day some bull had his white face dirtied with the soil from a gully.

Once each month the cattle were gathered in pens at the northeast corner of the pasture to be doctored and sprayed for insect control. Consequently, they were not troubled a great deal with insects, although flies usually became quite bothersome a short time before spraying. The cows were often seen swinging their heads around to knock the flies from their backs and then running a short distance in an effort to get away from them.

Effect of Temperature on Grazing

Total time spent grazing was directly affected by the temperature of the day. There was opportunity during the investigation to study the cattle during cool, moderate, and hot days. The effect of temperature on total time spent grazing is shown in Table 2. Days were designated cool when hourly temperatures from 5:00 a.m. until 8:00 p.m., inclusive, averaged less than 80° F. On a moderate day the average

Table 2. Hours spent grazing by cows during the cow-day when the hourly temperatures from 5:00 a.m. until 8:00 p.m. averaged less than 80° F., 80° to 85°, and above 85° F. and were designated cool, moderate, and hot days, respectively.

Cow No.	COOL DAY Below 80° F.	MODERATE DAY 80° to 85° F.	HOT DAY Above 85° F.
1		8.4	
2	9.1		
3		7.7	
4			8.2
5	8.0		
6		8.3	
7		8.7	
8	8.4		
9			6.5
10		6.5	
11	9.1		
12	9.3		
13			5.7
14		7.8	
15	8.4		
16			6.2
17	8.6		
18		8.4	
19		7.2	
20		8.8	
Average	8.70	7.98	6.65

temperature was between 80° and 85° F. and on a hot day the average exceeded 85° F. On a cool day the cows grazed an average of 8.70 hours, while on a moderate day this average dropped to 7.98 hours. A hot day further decreased the average time spent grazing during the cow-day to 6.65 hours.

From these data it is seen that when the temperature exceeded an average of 85° F. for the day, the cows did not spend as much time grazing as when the average temperature was lower. In fact, animals grazed 2.05 hours less on a hot day than on a cool day, or about 24 per cent less. They grazed 17 per cent less time on a hot day than on a moderate day. These trends indicate that on hot days the cows did not consume as much feed as on either moderate or cool days and, consequently, gain in body weight was less. Bonsma (3) stated that if the body temperature rises from 105° to 107° as a result of external heat, the animal consumes much less forage. Nighttime observations revealed the cows did not graze any longer on nights of hot days than on nights of cool or moderate days. Therefore, on hot days, the 24-hour period contained a smaller percentage of time spent grazing.

A correlation coefficient was obtained for average daily temperature and total time spent grazing to determine the extent of their relationship. Figure 8 shows the regression equation plotted graphically. This line was determined from the regression equation $Y = 18.12 - 0.127X$ after Snedecor (20). The correlation between temperature and total time spent grazing was $r = -0.657$ and was significant at the .01 level. The average time spent grazing for the 20 cows was 7.96 hours, representing 52 per cent of the 15.3 hour cow-day, and the average temperature for all observation days was 80.0° F. (Table 3). For every increase of one degree in average daily temperature there was a decrease of 0.13 hours spent grazing during the day.

Possibly these grazing habits partially explain the decrease in gains of cattle during July and August, even though forage may be adequate and palatable. An animal requires a certain amount of energy from feed for maintenance. The amount of feed consumed in excess of that needed for maintenance energy is the part responsible for gain in weight. If the temperature was high enough to make the cow uncomfortable, she simply grazed long enough to satisfy her requirements or possibly a little more for satisfaction, and then spent the remainder of her time resting and trying to cool herself. Only if conditions were ideal, as they appeared to be on a cool day, did she gorge herself on what may be termed luxury grazing and thus increase her body weight. On hot

days she apparently satisfied her requirements and appetite and, therefore, made no effort during the nighttime grazing period to make up for lost grazing time due to heat.

When the temperature approached or exceeded 90° F. there was a very noticeable increase in the respiration rate of the cows. This would

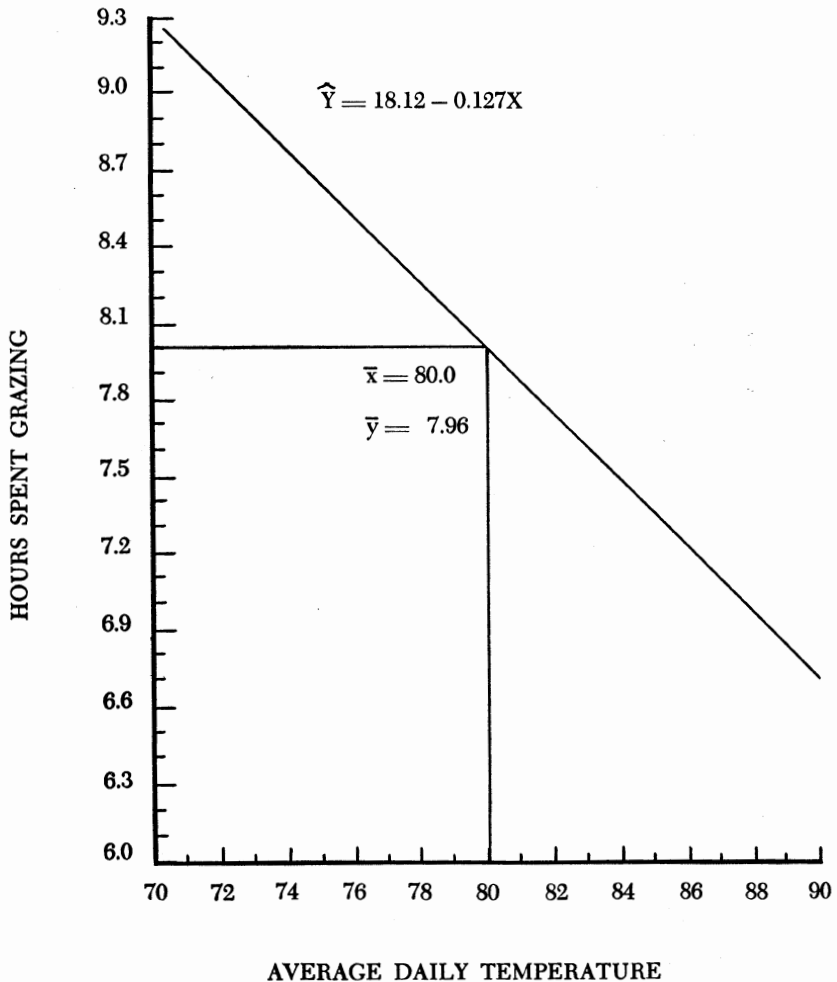


Figure 8. Regression of total time spent grazing during the cow-day on average cow-day temperature from 5:00 a.m. to 8:00 p.m. Correlation coefficient ($r = -0.657$) is significant to the 0.01 level.

Table 3. Daytime livestock and metabolic activities of 20 cows in relation to temperature and humidity conditions. Times are in hours unless otherwise specified.

Cow No.	Cow-day	Distance Traveled Miles	LIVESTOCK ACTIVITIES						
			Grazing	Standing	Lying	Total Resting	Standing	Rumination Lying	Walking
1	15.5	4.8	8.4	2.9	3.5	6.4	1.2	3.3	0.5
2	15.3	2.6	9.1	2.3	3.5	5.8	0.8	3.4	0.1
3	15.3	2.6	7.7	4.3	3.1	7.4	3.1	1.9	0.1
4	15.6	2.3	8.2	3.7	3.2	6.9	2.3	2.7	0.2
5	15.3	3.4	8.0	4.9	2.0	6.9	3.8	1.7	0.7
6	15.2	3.6	8.3	4.9	1.5	6.4	2.8	1.4	0.5
7	15.0	2.9	8.7	4.4	1.5	5.9	2.6	1.2	0.3
8	15.5	2.3	8.4	5.0	1.5	6.5	3.5	1.2	0.4
9	15.3	3.4	6.5	4.7	2.8	7.5	2.4	2.2	1.0
10	15.1	3.8	6.5	6.1	1.7	7.8	3.9	0.3	0.5
11	15.0	4.4	9.1	2.7	2.3	5.0	1.1	1.9	0.7
12	15.3	2.8	9.3	2.7	2.0	5.7	1.7	2.7	0.2
13	15.1	1.8	5.7	7.0	1.3	8.3	3.2	1.1	0.1
14	15.2	2.5	7.8	6.2	0.8	7.0	3.4	0.0	0.3
15	15.3	3.1	8.4	2.9	3.1	6.0	1.6	2.5	0.7
16	15.9	2.8	6.2	7.2	1.7	8.9	4.3	0.3	0.1
17	15.8	4.6	8.6	3.5	3.0	6.5	2.3	3.0	0.7
18	15.6	3.8	8.4	3.5	3.2	6.7	1.9	3.0	0.1
19	14.8	2.8	7.2	4.6	3.0	7.6	2.2	1.8	0.3
20	15.1	2.3	8.8	2.2	3.9	6.1	1.3	2.6	0.2
Average	15.3	3.13	7.96	4.26	2.48	6.74	2.50	1.92	0.33

Suckling	Minutes			METABOLIC ACTIVITIES				WEATHER CONDITIONS			
	Watering	Salting		No. of Times Defec.	Urin.	Rumination Mastic.	Sec.	Humidity Avg.	Hi	Temperature Avg.	Hi
0.6	5	13	--	4	4	47.0	46.1	78.1	100	84.1	91
0.4	3	--	14	6	6	51.2	52.9	82.1	90	72.2	77
0.5	3	--	12	4	4	55.6	50.5	69.9	95	83.7	93
0.7	4	12	12	4	4	46.0	37.4	59.6	86	85.8	94
0.6	2	--	11	4	4	45.2	35.5	88.9	100	70.1	81
0.3	3	--	--	5	5	48.9	45.4	64.9	84	80.1	89
0.7	5	--	14	5	5	46.9	36.2	68.1	90	81.7	92
0.7	5	5	--	4	4	46.9	37.3	74.1	90	78.0	89
0.8	5	--	--	5	5	46.8	---	61.3	90	85.4	95
0.4	3	8	11	4	4	46.5	44.2	71.4	86	82.8	94
0.4	2	4	11	5	5	49.9	45.0	63.8	94	72.2	84
0.7	6	--	10	4	4	50.0	36.1	48.5	75	74.1	76
0.5	5	--	12	5	5	50.4	53.9	64.4	95	87.5	98
0.5	5	--	--	4	4	48.3	49.9	73.4	95	80.6	89
0.6	4	5	14	4	4	47.3	37.0	75.9	95	74.6	82
0.5	3	--	--	6	6	54.3	47.0	64.7	95	86.4	96
0.7	8	10	14	5	5	58.1	49.3	59.2	68	74.7	86
0.5	4	9	--	5	5	45.3	---	67.4	90	84.2	92
0.4	3	7	12	4	4	52.8	48.6	60.8	94	81.4	96
0.6	4	--	12	6	6	48.0	40.9	68.9	85	80.4	88
0.56	4.1	8.1	12.2	4.6	4.6	49.9	44.4	68.3		80.0	

increase the energy required for respiration and decrease the net energy retained from feed, thus allowing a smaller gain in weight.

The amount of time spent grazing did not vary a great deal among the cool, moderate, or hot days during the 4:00 to 8:00 a.m. and 5:00 to 8:00 p.m. periods of grazing. On very hot days the cattle were so occupied in trying to keep comfortable between 8:00 a.m. and 5:00 p.m. that grazing was curtailed.

The direct effect of humidity on the activities of the cattle could not be ascertained. This climatic factor probably has an indirect effect which may be expressed through temperature. Cloud cover influenced the animals only as it affected temperature.

Table 4 shows that for a 24-hour period the cattle grazed an average of 9.67 hours or about 40 per cent of the time.

Table 4. Average number of hours spent in activities during the cow-night, cow-day and 24-hour period; and per cent of time spent in these activities for cow-day and 24-hours.

	Grazing	Standing	Lying	Total Resting	Rumination Standing	Lying	Walking	Suckling
Cow-night Avg.	1.71	1.80	4.86	6.66	1.47	4.58	0.10	0.17
Cow-day Avg.	7.96	4.26	2.48	6.74	2.50	1.92	0.33	0.56
% of Cow-day	52.0	27.8	16.2	44.0	16.3	12.5	2.1	3.6
24-hour Avg.	9.67	6.06	7.34	13.40	3.97	6.50	0.44	0.73
% of 24 hrs.	40.3	25.2	30.6	55.8	16.5	27.1	1.83	3.04

Nighttime Grazing

At about midnight each night the cows arose to graze. This grazing period average 1.71 hours for the seven nighttime observations made during the periods of full moon, one-half, one-quarter and no moon (Table 5). The length of this period was not affected by daytime temperatures or amount of moonlight. Grazing usually took place in the same general area as the bedding grounds. Temperatures during the night appeared to have no influence on the grazing activities of the cows.

Table 5. Nighttime livestock activities of cattle based on seven observations. Times are in hours unless otherwise specified.

Cow No.	Phase of Moon	Grazing	Standing	Lying	Total Resting	Rumination		Walking	Minutes Suckling	Minutes		Miles Traveled
						Standing	Lying			Watering	Salting	
5	Quarter	2.2	1.8	4.5	6.3	1.8	4.5	0.1	--	-	-	0.2
6	None	1.9	3.0	3.2	6.2	2.1	3.2	0.3	12	-	-	1.1
11	One-half	1.7	1.6	5.2	6.8	1.4	4.0	0.1	22 (twice)	-	9	0.8
13	Quarter	1.8	3.2	2.7	5.9	2.7	2.7	0.6	9	-	5	1.4
14	Full	1.7	0.6	6.3	6.9	0.8	6.1	--	9	1	-	0.3
16	None	1.3	1.6	5.5	7.1	0.6	5.0	--	9	-	-	0.3
20	Full	1.4	0.9	6.6	7.5	0.8	6.6	--	--	-	-	0.3
Cow-night Average		1.71	1.80	4.86	6.66	1.47	4.58	0.10	10.1	-	7	0.63

Resting

Resting includes all the time spent by the cows in lying down and standing. The average time resting was practically identical for night and day, that is, 6.66 and 6.74 hours, respectively, or a total of 13.40 hours representing 56 per cent of a 24-hour day (Table 4). The major portion of the cow-day resting time, an average of 4.4 hours each cow-day, was spent within a 100-yard radius of one of the five ponds in the pasture (Table 1). Pond number one, located close to the south fence, was used extensively during this period.

Flies caused the least trouble during the hottest part of the day if the cattle were in the sun. If the cattle rested in the shade, however, flies were quite bothersome. Bonsma (3) pointed out that in the direct rays of the sun, the cow's back may reach a temperature as high as 115° to 120° F. when the ambient temperature is 90° F. If flies were present under these conditions they were generally on the underside of the animal. This area of the body was easily protected by wading into the pond.

On the average, starting at 8:16 a.m., all observed cows rested for 66 minutes each day in areas away from the ponds. They licked their calves at various times during the different rest periods.

Standing

After rising each morning the cows stood for a few minutes before grazing began. At various times during the day, the cattle ceased other activities to rest on their feet. An average of 4.26 hours was spent standing during the cow-day which represented 27.8 per cent of the 15.3 hour cow-day (Table 4). Nighttime studies showed an average of 1.80 hours was spent standing (Table 5). For a full 24-hour period, 25.2 per cent of the time, or 6.06 hours was occupied in standing (Table 4).

On days when the temperature was extremely warm, the cattle responded by standing more than lying down, while resting during the cow-day. This was particularly emphasized during days when there was very little wind movement. The cow probably attempted to receive as much air circulation as possible around her body and also to keep off the heated surface of the ground by standing.

The cattle spent less time standing around the ponds on cool days than on hot days. When temperatures were high, the animals often waded into the pond and stood for several minutes with the water just under their chins (Figure 9). They seldom stood in the water for more than 30 minutes before coming out to stand on the shore to be cooled

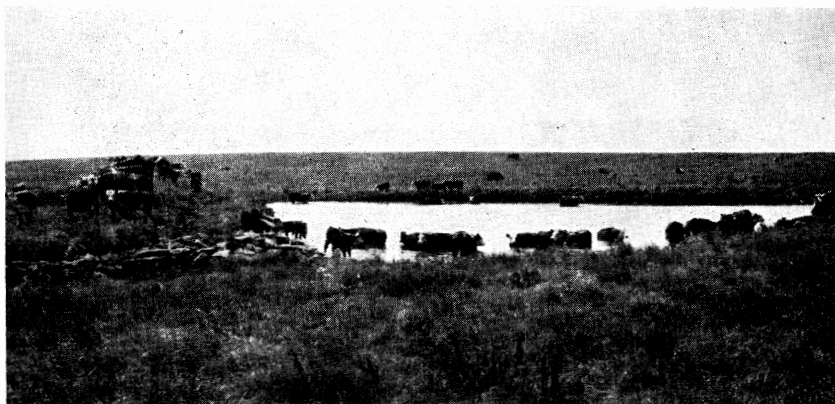


Figure 9. Cattle cooling themselves in Pond No. 3 during the mid-day rest period.

as the moisture evaporated. This procedure was usually repeated several times during rest periods at the ponds.

It was observed that the animals stood a great deal on bare areas such as roads or stomp areas along trails and around ponds.

Lying

Much of the resting time of the cattle was spent lying down. During the cow-day the cattle spent 2.48 hours lying down—a little more than half the time occupied by standing (Table 3). However, at night an additional 4.86 hours were spent lying down for a total of 7.34 hours for a 24-hour period or 30.6 per cent of the time (Table 4). Nearly twice as much time was spent lying down at night when it was cool as during the day.

The cows generally sniffed the ground before lying down but the calves did not. Although the calves were constantly up and down, they spent almost all of their resting time lying. They were easily disturbed by others in the herd, but, contrarily, once the cows laid down they were less easily aroused. There appeared to be no pattern as to which side the animals lay on. Many times the cattle were seen lying with their heads and necks curled around their bodies and appeared to be sleeping. Also, some time during the day, they usually lay completely outstretched with their necks extended and head on the ground. They never remained in this position for more than a few minutes. The cows did not lie down as much on calm, hot days, but the calves did not appear to alter the time they spent lying down on these days.



Figure 10. Cow No. 5 with her calf, ruminating while resting at a pond. Vegetation was in excellent condition near the ponds in the study pasture.

Rumination

Rumination occurred during rest periods while standing and lying down and during nursing periods (Figure 10). Occasionally the animals ruminated while walking but this was rather rare. Time expended by the cows in ruminating during the cow-day was 4.42 hours, of which 2.50 hours was while standing and 1.92 hours while lying (Table 3). During the 24-hour period, the cows ruminated for 10.47 hours, 3.97 hours or 37.9 per cent while standing and 6.50 hours or 62.1 per cent while lying down (Table 4).

Counts were made to determine the number of times the cows masticated their cuds and the number of seconds required to masticate each bolus. Ten counts were made for each of the 20 cows and 10 time measurements were taken for 18 of the 20. The mean number of mastications from counts was 49.3 and the average number of seconds required for each bolus was 44.4 seconds or slightly less than one mastication per second. Analyses of variance for mastications per cud and seconds per bolus showed highly significant differences between cows in the number

of mastications and seconds required for each bolus. This indicates that these factors are not environmentally conditioned. Bonsma (3) has shown that most cattle belonging to the European beef breeds ceased rumination when ambient temperatures rose above 90° F.

Comparable data for the calves showed that the calves chewed their cuds more times for a shorter period than the cows. The average number of mastications was 55.7 per cud for 40.0 seconds.

Suckling

The number of nursing periods during the day varied somewhat for each calf but in general there were four for the very young calves—morning, noon, afternoon, and bedding down; no nurse period occurred at night. The older calves also nursed four times daily, during morning, noon, later afternoon, and around midnight when they arose to graze. Calves younger than three or four months rarely grazed at night. Average time required for each nurse period was 9.4 minutes. The periods were consistently between eight and 11 minutes long whether the calves were very young or over four months of age. An average of 0.56 hours (Table 3) was spent suckling calves during a cow-day and 0.73 hours for a 24-hour period (Table 4) or 3.7 and 3.0 per cent of the respective periods. Suckling was generally initiated by the calves at opportune times; however, there were occasions when the cows appeared to call the calves for suckling. A cow was never observed to nurse a calf other than her own, although several calves tried. The cows never refused their own calves any time they chose to suckle. If the cow would not stand immediately for its calf, the calf ran in front of her to stop her, and then crowded its rear end against the cow's side to hold her.

As they nursed, the calves changed teats every few seconds, in a fairly regular sequence, during the entire nursing period. The end of the period was marked by the calf butting the udder each time it changed teats. The cows, without exception, began ruminating, if they were not already doing so, soon after the calves began nursing. They always stood quietly, often with eyes closed, until the calf finished (Figure 11). This often meant the cow had to remain behind to feed its calf while the rest of the herd moved on.

Walking

This activity included only the actual time used in walking directly from one place to another. Most of this travel was to water or salt, from one group of animals to another, and to the bedding grounds. The average distance traveled during the cow-day was 3.13 miles (Table



Figure 11. Cow No. 4 nursing her calf as she stands ruminating with eyes closed.

3). Cows traveled 0.63 miles at night and the total for 24 hours was 3.76 miles (Table 4). Extremes traveled by the animals during the cow-day were 4.8 and 1.8 miles. Only 2.1 per cent or 0.33 hours were spent walking directly to various areas during the day and none at night.

The distance traveled was affected by such factors as rainfall, the availability of water in gullies, and the activities of the bulls during the cows' heat periods. Very young calves usually did not travel as far as their mothers, but after about four months of age the calves traveled equally as far.

Watering

The five ponds in the pasture were located so that no part of the area was more than half a mile from water. Usually the animals made two separate trips to the ponds during the day. In the first trip, between 7:00 and 8:00 a.m., the animals drank but did not remain at the pond. The animals returned to water at about 11:00 a.m. and remained at the pond for several hours to rest and cool themselves. They usually walked directly to the pond after they had grazed within 50 or 100 yards of it. The cattle normally drank on reaching the pond each time and drank again at 4:00 or 5:00 p.m. before leaving the pond.

The amount of time spent in drinking averaged 4.1 minutes. The actual period of water ingestion consisted of two or three, 20 to 40 second periods. When water was available in gullies the cattle usually

did not travel to the ponds to drink but would go for cooling purposes. They did not stand in the water on cool days, and spent much less time concentrated around ponds. Calves were seldom seen drinking water until they were around four months old.

Conditions that appeared to influence watering and movement of the animals to the pond included temperature, availability of water in gullies, wetness of plants from dew and length of time they remained wet, and rainfall during the day.

Salting

Loose salt was placed in four weather-protected feeders in lightly grazed areas away from water. The closest distance of any salt feeder to permanent water was approximately 400 yards. The cattle salted while it was cool, either prior to 8:00 a.m. or after 5:00 p.m., and on two occasions they salted at night. Normally the animals did not go for more than about 36 hours without salting. An average of 8.1 minutes was spent at the feeders when the cows salted. Time spent actually licking salt was less than this because the cows only licked the salt for about 60 or 70 seconds at a time and then stood for a time licking their noses and slobbering. They often ceased licking salt to rub on the feeder a few minutes before returning to lick again (Figure 12).



Figure 12. Cow No. 17 rubbing on the salt feeder between periods of licking salt during late evening. Note the limited area of destruction to the vegetation and the relatively light grazing use near the feeder.

In most cases, the animals took salt while grazing and resumed grazing immediately. The cattle ceased grazing when they were about 50 yards from the feeder and walked directly to it. In only one instance the observed cow walked directly from salting to water. The feeders accommodated only two or three animals at a time; therefore, several had to wait until they could get to the feeder. This period was often spent by grazing close to the feeder or scuffling with each other. Sometimes a single cow would bully the others and not allow them to salt when she did. The young calves often tasted the salt but never appeared to crave it or consume any. When they first began tasting it, they usually coughed.

Table 6 shows the average daily salt consumption for a mature range cow weighing approximately 1000 pounds was 0.094 pounds per animal. This was determined using covered salt feeders. The amount of salt lost from an unprotected feeder due to rainfall was 137 pounds from 9.37 inches of rain (Table 7). This represents about 15 pounds of salt lost for every inch of rain. It is estimated from these figures that approximately 1800 pounds of salt would be lost each year in this pasture from four unprotected feeders. Much of the bare area around salting areas is obviously due to this large quantity of salt carried in solution to the surrounding vegetation.

Table 6. Average amount of salt consumed per day by mature range animals.

Check*	Days in Check	Total Salt Consumed (pounds)	Salt Consumed Per Day (pounds)	Salt Consumed Per Animal Per Day (pounds)
1	6	140	23.3	0.105
2	8	158	19.8	0.089
3	7	141	20.1	0.091
4	4	78	19.5	0.088
5	6	147	24.5	0.116
6	4	84	21.0	0.099
7	2	38	19.0	0.090
8	5	80	16.0	0.076
9	5	116	23.2	0.110
10	4	93	23.2	0.110
11	7	112	16.0	0.076
12	7	104	14.8	0.070
13	7	149	21.3	0.101
14	4	78	19.5	0.092
Average				0.094

*Ten bulls and 211 cows are included in checks 1 through 4 after which the bulls were withdrawn.

Table 7. Amount of salt lost due to weathering from an unprotected feeder.

Check	Amount of Salt		Amount Lost (pounds)	Rainfall (inches)
	Weigh In (pounds)	Weigh Out (pounds)		
1	50	33	17	1.23
2	50	14	36	2.15
3	50	48	2	0.17
4	50	6	44	3.32
5	50	40	10	0.57
6	50	38	12	0.81
7	50	38	12	0.84
8	50	46	4	0.28
		Total	137	9.37

The location of salt and water, as shown in Figure 3, appeared to give very good distribution of grazing over the study pasture. The only well-worn paths that occurred in the pasture were found within 50 yards of the watering and salting areas. Salt feeders were not moved during the study period. The cattle did not seem to prefer one salting area over the others, but rather, instinctively traveled to the feeder nearest them.

The cattle had no difficulty in locating the salt feeders after they were placed in the pasture at the outset of the study and generally traveled to the nearest feeder.

The northeast portion of the pasture below the rocky breaks site began to show signs of over-utilization by the middle of August as the entire herd was moved to that area each month for doctoring and spraying (Figure 3). The cattle tended to concentrate there for rather lengthy periods before dispersing again over the pasture, because both salt and water were available. To distribute the cattle to other parts of the pasture, salt was removed from the feeder in this area. In three days, 120 of 180 animals had moved from the area; and by four days, all but 13 of the cows were gone from that part of the pasture. This example illustrates the effectiveness of salt as a means of distributing cattle.

Defecation and Urination

Counts were made to determine the number of defecations and urinations that occurred during the cow-day for each animal studied. In general, defecation and urination took place within a few minutes of each other soon after arising in the morning. An average of 12.2 defecations and 4.6 urinations occurred during the cow-day (Table 3). It

Table 8. Average number of defecations and urinations occurring during grazing and resting periods of the cow-day.

Hours Spent	Number of Defecations	Hours Between Each Defecation	Number of Urinations	Hours Between Each Urination
Grazing 7.96 Hrs.	8.1	0.98	3.1	2.57
Resting 6.74 Hrs.	4.1	1.64	1.5	4.49
Total	12.2		4.6	

was difficult to obtain accurate defecation counts for each animal in the early stages of the study until it was learned that a relatively regular pattern existed. Defecations took place approximately an hour apart during grazing periods. Table 8 points out that 8.1 defecations or one defecation every 0.98 hour occurred during the 7.96 hours spent grazing and that 4.1 defecations or one defecation every 1.64 hours occurred while resting. Defecation often took place at the resting area a few minutes prior to beginning grazing or as the animals moved from resting to grazing. Defecation was also expected after an extended period of lying down. Table 8 also shows that over twice as many urinations occurred while the cows grazed as when they rested.

Behavior During Rainfall

Activities of the cows varied somewhat during periods of rainfall. On extremely damp and cool days the cattle occasionally kicked up their heels and ran for short distances. This happened just preceding a rain or when it began to sprinkle prior to the rain. As soon as rain began falling, the cattle drifted slowly with the wind, either grazing or walking and stopping once in a while to graze a few bites before drifting on. Sometimes they paused for a few minutes with head lowered and back humped. They continued to move with the wind and rain until they reached the fence and then stood clustered together, tails to the wind. If the rain continued, the animals grazed along the fence, the only apparent effect being that they did not graze into the wind and rain.

The cattle did not lay down during rain or while the grass and ground were extremely wet just after the rain ceased. Some of the calves, however, were seen lying down for brief periods during light rain. The calves remained close to their mothers throughout the course of rainfall or when something unusual occurred.

Activities of the Calves

The calves averaged about two months of age at the beginning of the study. At this age they grazed approximately four hours a day and spent the remainder of the day resting, generally lying down. They drank very little water. They never consumed salt although some tasted it when their mothers salted. The calves stayed with their mothers during the early morning grazing period but usually remained resting when their mothers resumed grazing after their 8:15 a.m. rest period. The cows returned for their calves later or found them at the pond around mid-day. Young calves grazed during the evening grazing period but did not graze at night. During the day they generally nursed four times for 9.4 minute periods. They were often seen in groups of five or six in the cool of late evening playfully scuffling or running and kicking.

As the calves grew older several noticeable changes occurred in their activities. Around the age of four to five months it was noted that the calves began to assume activities that more nearly resembled those of their mothers. The time the calves spent grazing at this age almost equalled that of the cows and they followed more closely the movements of their mothers. Water was taken at more frequent intervals than when they were younger. There were four suckling periods, each of about ten minute duration; three occurred during the cow-day, and one around midnight when they arose with their mothers to graze.

Most of the resting time of the calves was spent lying down, but they were easily disturbed and, consequently, were up and down frequently. It was quite obvious that the calves did not seek the cows, but rather the cows sought the calves. Cows and calves seemed to identify each other by smell and voice more than by sight. The cows called for their calves and the calves often answered from considerable distance, then they walked toward each other. Once the calf recognized its mother, the cow always stopped and made the calf travel the remaining distance to her.

Activities of the Bulls

It was possible to make some general observations on activities of the ten bulls which were in the pasture until July first. The bulls grazed much less time than the cows during the day because they constantly traveled from one group of cows to another. It was estimated the bulls traveled in excess of six miles each day. They often disturbed the

herd during rest periods to check the cows for heat. Many times two or three bulls were seen following a single cow for as much as half a day, with the bulls running after the cow for half a mile or more at a time.

The period of breeding for the cow was marked by considerable running and travel and little grazing. Her calf was left behind with other cows during this period. The bulls traveled a great deal at night and often caused much disturbance to the herd when a cow was in heat.

Livestock Activities on Each Range Site

The degree of use received by each range site in any pasture is determined by the length of time the livestock spend in various activities on each of these sites. The percentage of study area occupied by each site was 70.0 per cent for loamy prairie, 12.0 per cent for shallow, and 18.0 per cent for rocky breaks (Table 9). Figure 13 shows the per cent of time, by months, the observed animals spent grazing on each site.

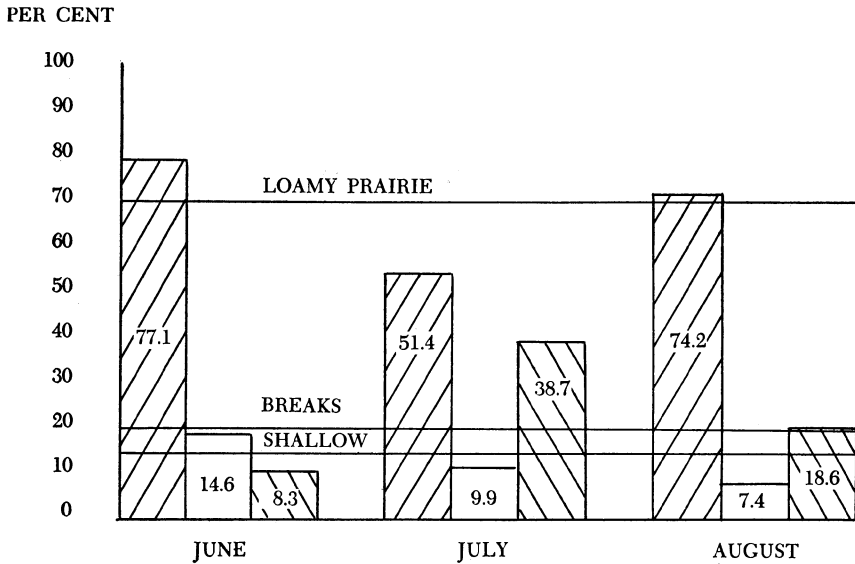
Table 9. Average per cent of time spent by study cows on each site in various activities.

Activity	RANGE SITES*		
	Loamy Prairie	Shallow	Rocky Breaks
Standing	81.4	13.6	5.0
Lying	83.0	14.4	2.6
Walking	77.7	15.8	6.5

*Of the total pasture acreage, 1050 acres, or 70% is in loamy prairie; 180 acres or 12% is in shallow; and 270 acres, or 18% is in rocky breaks.

During June, 77.1 per cent of the grazing occurred on the loamy prairie site, with 14.6 on the breaks and 8.3 per cent on the shallow site. The grazing time for July dropped to 51.4 per cent on the loamy prairie and 9.9 on the breaks; however, grazing time spent on the shallow site increased to 38.7 per cent. These changes were attributed to the abundance of lush summer annual grasses, such as common witchgrass (*Panicum capillare*), sand paspalum (*Paspalum stramineum*), and fall panicum (*Panicum dichotomiflorum*) which appeared on the shallow and claypan areas following frequent July rains.

The values for length of time spent grazing on sites during July were tested statistically by chi-square and found to be significantly different from that expected, assuming random selection of grazing sites. During August, 74.2 per cent of the grazing time was spent on the



Solid lines represent per cent each site composed of the study area.

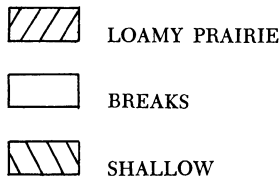


Figure 13. Per cent of time spent grazing on each range site by range cows for each month compared with the per cent area each site made up of the study pasture.

loamy prairie, 7.4 on the breaks, 18.4 per cent on the shallow site. Actual time spent on the breaks site was less for every month than the expected 18.0 per cent. Considerably more time was spent grazing on the shallow site during July and August than would be expected under random selection of grazing sites. The data indicates cattle preferred the shallow site during July and August and the loamy prairie during June and August, but did not show preference at any time for the breaks site.

Animals rested while standing 81.4 per cent of the time on loamy prairie, 13.6 on shallow, and 5.0 per cent on the breaks sites (Table 9). Respectively, the percentage of time spent resting while lying down for

each of the sites was 83.0, 14.4 and 2.6 per cent. For walking, corresponding values were 77.7 for loamy prairie, 15.8 for shallow, and 6.5 for rocky breaks sites. The percentages given for standing, lying and walking were found to be significantly different from those expected if the selection of sites were random. These figures suggest the cattle preferred the loamy prairie and shallow sites over the rocky breaks site for standing, lying, and walking.

Movement of Livestock in Relation to Wind Direction

Wind action is an important means of cooling cattle since they can not depend on evaporation of sweat for relieving heat. Circulation of air around the body removes heat radiated by the animal as well as heat absorbed from rays of the sun. Throughout the course of the study it was continually noted that the position of cattle was generally so that one side or the other of their bodies was toward the direction of the wind. Table 10 shows that while grazing, the animals spent 68.3 per

Table 10. Positions and average per cent of time cows spent in various activities in relation to direction of the wind.

Activity	Side Toward Wind	Head Downwind	Head Upwind
Grazing	68.3	20.5	11.2
Standing	73.1	16.8	10.1
Total Time*	66.5	22.9	10.6

*Includes grazing, standing, lying, suckling, and walking.

cent of the time with their sides toward the wind, 20.5 per cent with heads downwind, and 11.2 per cent with heads upwind. For standing, these percentages were 73.1, 16.8, and 10.1, respectively. The total time spent in activities related to the direction of the wind includes that spent suckling calves, lying down, walking, standing, and grazing. For the total period 66.5 per cent was spent with sides toward the wind, 22.9 per cent with heads downwind, and 10.6 with heads upwind.

With southerly winds prevailing during summer, the cattle grazed primarily east and west. The wind appeared to have no affect on the cattle while walking except during rainstorms when they always moved with the wind.

Grazing Preferences

Methods and Procedures

The relative preference of cattle for various plants was determined for each month during the summer grazing season. The study pasture was in excellent range condition so adequate number of climax species were available for differential grazing selection by the cattle.

Fourteen line transects were permanently located in the study pasture (Figure 3). Six of these transects, 660 yards long, were on the loamy prairie site and four transects varying in length from 200 to 400 yards were located on each of the rocky breaks and shallow sites. These transects were sampled for grazed plants the first week of each month from June through and including September. Samples taken during the first week of June, therefore, represented grazing by the cattle for the month of May.

A steel welding rod about three feet in length was used for sampling. Single point samples were taken at 15 pace intervals along the transects. At the final pace the point was placed at the toe of the investigator and the perennial grass nearest the point was identified and recorded as either grazed or ungrazed. Data from these samples yielded grass composition for each site, as well as the percentage of plants of various species that were grazed.

The most important grazing species of the region, known locally as the "big four", big and little bluestems, switchgrass, and Indiangrass, were used in determining volume removal or utilization. Utilization was determined each month by wrapping culms of ungrazed plants of these four species (Figures 14 and 15). They were then clipped to average grazed height for that month. The average grazed height was determined by measuring grazed heights of plants randomly over the pasture. After clipping, the two parts of the wrapped plants were weighed, and per cent or volume of the plant utilized was determined. Ten such utilization measures were made for each species every month. Preference values were obtained monthly for each of the four species by multiplying the percentage of times grazed times the per cent utilization.

Grasses other than big and little bluestem, switchgrass, and Indiangrass were recorded only as the per cent of times they were grazed. Grazing of forbs was noted and the relative degree of use was estimated on the basis of a scale ranging from one to five, number one indicating heaviest utilization. Records were made of the portion of the forb grazed and the period during which it was preferred.

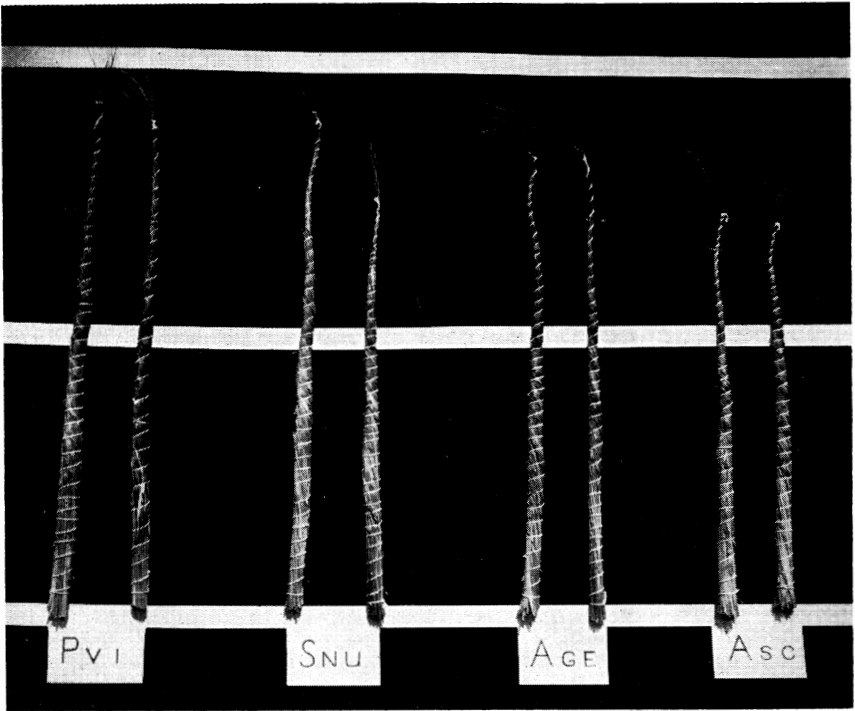


Figure 14. Wrapped plants of switchgrass (Pvi), Indiangrass (Snu), big bluestem (Age), and little bluestem (Asc) on June first, illustrating the method used for determining utilization. White lines represent one-foot intervals.

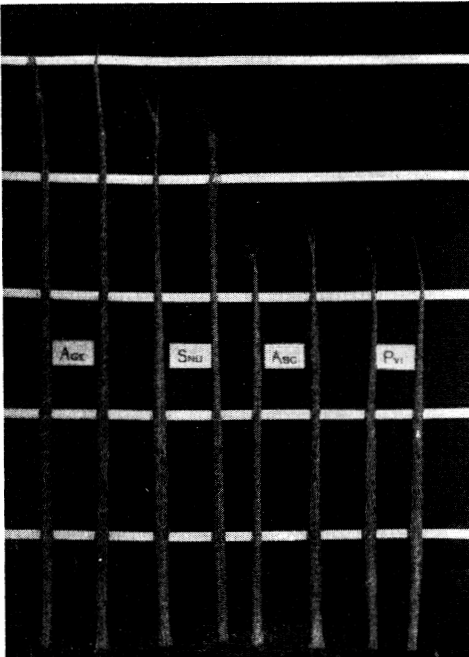


Figure 15. Wrapped plants of big bluestem (Age), Indiangrass (Snu), little bluestem (Asc), and switchgrass (Pvi) on September first. White lines represent one-foot intervals.

Botanical Composition of Grasses in Study Pasture

Loamy prairie and breaks sites were characterized by a uniform cover of true prairie species, whereas the shallow site vegetation was predominantly short grass. The composition of grasses on the loamy prairie and breaks sites was similar. Buffalograss was the dominant species on the shallow site and tall grasses played a minor role in the vegetation. Table 11 illustrates the importance of big and little bluestems, switchgrass, and Indiangrass on the loamy prairie and breaks sites. These four species made up 81.5 per cent of all perennial grasses on the loamy prairie and 70.3 per cent on the breaks site, but include only 15.9 per cent on the shallow site. The 13 species listed in Table 11 comprise over 98 per cent of the total cover of perennial grasses on the study area.

Loamy Prairie Site

Big bluestem was the major species on this site, making up 39.5 per cent of the total vegetational composition (Table 11). Little bluestem was second in abundance with 25.9 per cent and was followed by Indiangrass, 8.7, and switchgrass, 7.4 per cent. Other grasses making

Table 11. Composition of grasses on the loamy prairie, rocky breaks, and shallow range sites.

Scientific Name	Common Name	Loamy Prairie ¹ (per cent)	Breaks ² (per cent)	Shallow ³ (per cent)
<i>Andropogon gerardi</i>	Big bluestem	39.5	38.8	8.8
<i>Andropogon scoparius</i>	Little bluestem	25.9	18.2	4.1
<i>Panicum virgatum</i>	Switchgrass	7.4	7.4	2.6
<i>Sorghastrum nutans</i>	Indiangrass	8.7	5.9	0.4
<i>Buchloe dactyloides</i>	Buffalograss	6.8	5.9	57.3
<i>Bouteloua curtipendula</i>	Sidcoats grama	2.9	2.4	2.8
<i>Bouteloua gracilis</i>	Blue grama	0.1	1.0	9.7
<i>Sporobolus asper</i>	Tall dropseed	5.6	7.6	4.7
<i>Sporobolus asper hookeri</i>	Meadow dropseed	1.0	2.0	0.4
<i>Andropogon saccharoides</i>	Silver bluestem	0.5	8.1	3.0
<i>Chloris verticillata</i>	Windmillgrass	0.3	0.7	4.7
<i>Panicum scribnerianum</i>	Scribner panicum	0.5	--	0.6
<i>Tripsacum dactyloides</i>	Eastern gama	0.3	0.5	--
Other grasses		0.8	1.5	0.9
	Total	100.0	100.0	100.0

¹Based on 800 samples.

²Based on 407 samples.

³Based on 466 samples.

significant contributions to the composition were buffalograss, 6.8 per cent, tall dropseed (*Sporobolus asper*), 5.6, and sideoats grama, 2.9 per cent.

The major species were thoroughly intermingled although switchgrass was more common in areas of higher moisture. Eastern gama (*Tripsacum dactyloides*) was found in isolated patches located only in low areas where soil moisture was ample for its growth.

Rocky Breaks Site

Although the topography of the breaks site was extremely steep, soil moisture penetration was sufficient for the production of tall grasses. Big bluestem made up 38.8 per cent of the grass composition on this site, little bluestem, 18.2 per cent, switchgrass, 7.4, and Indiangrass, 5.9 per cent (Table 11). Silver bluestem (*Andropogon saccharoides*) comprised 8.1 per cent of the composition and was quite conspicuous because of its brilliant, silvery inflorescence. Silver bluestem was generally most abundant on south-facing slopes. Tall dropseed and meadow dropseed (*Sporobolus asper* var. *hookeri*) usually occurred together on the level terraces of the breaks. This area was frequently quite moist as a result of lateral seepage.

Trees and shrubs were found in the heads of the canyons, along draws, and on north-facing slopes. Some of the major tree species were white oak (*Quercus alba*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*), and common hackberry (*Celtis occidentalis*). Shrub species included roughleaved dogwood (*Cornus drummondii*), skunkbrush (*Rhus trilobata*), and coralberry (*Symphoricarpos orbiculatus*).

Shallow Site

Boundaries of the shallow site were often marked by a distinct line of vegetation, with tall grasses on one side and short grasses on the other. Due to the restriction of root development and poor soil-water-root relationships on the shallow and claypan areas, tallgrasses were excluded and shortgrasses provided the dominant vegetation. Buffalograss and blue grama predominated, comprising 57.3 and 9.7 per cent, respectively, of the vegetation (Table 11). Fissures in the bedrock of shallow areas allowed some growth of tall grasses, but the relative composition of the four important grazing species on this site dropped to 8.8 per cent for big bluestem, 4.1 for little bluestem, 2.6 for switchgrass, and 0.4 per cent for Indiangrass.

Plant Preferences Through the Summer Grazing Season

Observations and data on grazing preferences and utilization are presented for May, June, July, and August for the three range sites in the study area. Quantitative data representing grazing for the monthly periods are based on transect samples obtained the first week of the month following.

Preference and Utilization for May

Vegetative growth was initiated in the early spring, around the second or third week in March. Growth progressed slowly at first, but, with ample moisture and warm days, rapid growth began by mid-April. The early spring aspect of the prairie was dominated by forbs such as prairie scurfpea (*Psoralea floribunda*), *Baptisia* spp., and milkweed (*Asclepias*) before the warm season perennial grasses appeared. Accompanying these early forbs were the cool season annual grasses, Japanese brome (*Bromus japonicus*), little barley (*Hordeum pusillum*), and six-weeks fescue (*Festuca octoflora*).

Loamy Prairie Site

During the first half of May, there was considerable grazing on the cool season annual grasses. Japanese brome furnished the greatest amount of forage of this group and continued to provide grazing until the first part of June. Inflorescences of Japanese brome appeared in mid-May and were especially desired by the cattle. The animals were often observed to pull the plants out of the ground, chew off the seed heads, and spit out the dried lower portion of the plant.

Big bluestem was by far the most widely grazed species during May, as shown in Table 12. The per cent of big bluestem plants grazed on the loamy prairie site was 31.0 and the degree of utilization by weight was 50.2 per cent. The preference value, based on per cent of plants grazed times utilization expressed as a decimal fraction, was 15.6 and indicated a relatively high degree of preference for this grass. The average ungrazed height of big bluestem at the sampling was 17.2 inches and the average grazed height was 6.3 inches.

Preference values for the other grasses were comparatively low. Little bluestem exhibited the lowest preference rating, 2.9, of the four species. Only 8.0 per cent of the little bluestem plants were grazed during May. Switchgrass and Indiangrass had preference values of 3.5 and 3.9, respectively. By the end of May, switchgrass was the tallest

Table 12. Average ungrazed and grazed heights, per cent of plants grazed, per cent utilization, and preference value for the four important grazing species for loamy prairie, breaks, and shallow range sites.

MAY					
Grass	Avg. Ungr.* Height (inches)	Avg. Grazed* Height (inches)	Per Cent Grazed	Per Cent* Utilized	Preference** Value
LOAMY PRAIRIE					
Big bluestem	17.2	6.3	31.0	50.2	15.6
Little bluestem	15.6	7.1	8.0	36.8	2.9
Switchgrass	21.0	11.5	14.3	24.7	3.5
Indiangrass	17.2	10.0	13.3	29.3	3.9
BREAKS					
Big bluestem	17.2	6.3	23.5	50.2	11.8
Little bluestem	15.6	7.1	6.3	36.8	2.3
Switchgrass	21.0	11.5	36.4	24.7	9.0
Indiangrass	17.2	10.0	0.0	29.3	0.0
SHALLOW†					
Big bluestem	17.2	6.3	17.6	50.2	8.7
Little bluestem	15.6	7.1	0.0	36.8	0.0

*Standard error is within 10 per cent of the mean for all species.

**Preference value is the product of per cent grazed and per cent utilization using one of the values as a decimal fraction.

†Switchgrass and Indiangrass were not abundant enough on this site to determine grazing preference.

grass in the pasture and big bluestem and Indiangrass were intermediate with identical heights. Little bluestem had made the least height growth of the "big four". On the average, only 24.7 per cent utilization of switchgrass occurred due to the coarse, heavy lower culms.

Table 13. Per cent of plants grazed by monthly periods for perennial grasses present on each range site of the study area and on the study area as a whole.

Month	RANGE SITES			:	Total Study Area
	Loamy Prairie	Rocky Breaks	Shallow		
May	16.0	14.3	3.2	:	11.6
June	22.5	13.0	10.2	:	16.7
July	28.5	17.0	11.2	:	20.9
August	39.0	23.5	10.3	:	27.3

Transect measurements for May indicated that 16.0 per cent of all perennial grass plants present on the loamy prairie site were grazed (Table 13) and that 97 per cent of these grazed grasses were big and little bluestems, switchgrass, and Indiangrass. Only one other perennial species, tall dropseed, was observed grazed on the upland site transects during May.

Rocky Breaks Site

Forbs and browse were more abundant on the breaks site than on either upland or shallow sites. Cattle were observed grazing American elm and often kept individual plants in a shrubby condition by continuous browsing. All elms within reach of the cattle showed evidence of recent grazing. Hackberry was also important as a browse plant on this site. Perennial sunflowers (*Helianthus rigida*, *H. maximiliani*, and *H. hirsuta*), occurring only on the breaks, were consistently grazed.

Big bluestem was grazed 23.5 per cent of the time it was observed on the breaks site (Table 12). The preference value, 11.8, for this plant was slightly lower than that found on the loamy prairie site. Little bluestem's preference value was 2.3, similar to that for loamy prairie. Switchgrass, with a value of 9.0, however, showed a higher preference on the breaks than loamy prairie while Indiangrass was not observed to be grazed.

Transect data on the breaks site revealed that 14.3 per cent of all perennial grasses present were grazed during May. Of these grazed plants, 86.8 per cent were the "big four", 6.6 percent was sideoats grama, and 6.6 per cent was meadow dropseed.

Shallow Site

There was very little grazing of perennial grasses on the shallow site during May. Although buffalograss comprised 57.3 per cent of the vegetation on this site, no grazing was observed on the grass. Big bluestem was practically the only grass grazed during May on the shallow site. It was grazed only 17.6 per cent of the time, and its preference value was 8.7. Little bluestem was not grazed; switchgrass and Indiangrass were of such limited occurrence that grazing preference could not be determined. Only 3.2 per cent of all perennial grasses present on this site showed evidence of grazing (Table 13).

A total of 431 samples were taken on the three range sites for May, of which 51 were grazed. For the study pasture as a whole, 11.6 per cent of all perennial grasses were grazed during this month (Table 13).

Table 14. Average ungrazed and grazed heights, per cent of plants grazed, per cent utilization, and preference value for the four important grazing species for loamy prairie, breaks, and shallow range sites.

JUNE					
Grass	Avg. Ungr.* Height	Avg. Grazed* Height	Per Cent Grazed	Per Cent* Utilized	Preference** Value
LOAMY PRAIRIE					
Big bluestem	21.5	8.1	34.2	46.3	15.8
Little bluestem	18.4	7.6	9.8	39.6	3.9
Switchgrass	24.7	15.3	57.1	18.4	10.5
Indiangrass	20.7	10.6	22.2	31.3	6.9
BREAKS					
Big bluestem	21.5	8.1	23.8	46.3	11.0
Little bluestem	18.4	7.6	0.0	39.6	0.0
Switchgrass	24.7	15.3	14.3	18.4	2.6
Indiangrass	20.7	10.6	28.6	31.3	8.9
SHALLOW†					
Big bluestem	21.5	8.1	57.1	57.1	26.0
Little bluestem	18.4	7.6	25.0	25.0	9.8

*Standard error is within 10 per cent of the mean for all species.

**Preference value is a product of per cent grazed and per cent utilization using one of the values as a decimal fraction.

†Switchgrass and Indiangrass were not abundant enough on this site to determine grazing preference.

Preference and Utilization for June

Patches of switchgrass could be seen scattered over the pasture as it remained the tallest grass on the area during June, with an average ungrazed height of 24.7 inches (Table 14). At this time the lower eight to ten inches of the plant consisted of coarse hard stems with succulent leaves rather sparsely arranged on the culm. Leafiness was confined to the upper ten inches of the plant and this was the part the cattle consumed. This left an average grazed height of 15.3 inches (Figure 16). Big bluestem and Indiangrass maintained similar growth rates during June and the average ungrazed height measured 21.5 inches for big bluestem and 20.7 inches for Indiangrass. Big bluestem was grazed to a height of 8.1 inches while Indiangrass, being somewhat coarser at the base, was grazed to an average height of 10.6 inches. The average ungrazed height of little bluestem was 18.4 inches and the grazed height was 7.6 inches.



Figure 16. Close-up view of grazed switchgrass plants as they appeared in June. The coarse lower culms were not grazed by the cattle.



Figure 17. Close-up view of big bluestem plants (middle and foreground) as they appeared in June. These plants were selected by the cattle from the midst of the finer-leaved little bluestem plants.

Loamy Prairie Site

During most of June, the cattle grazed big bluestem and switchgrass almost exclusively, as evidenced by the high preference values, 15.8 for big bluestem and 10.5 for switchgrass (Table 14). Over 57 per cent of all switchgrass plants were grazed, but the amount of an individual plant utilized was limited to 18.4 per cent due to its coarse type of growth. The basal portions of the switchgrass stems were so tough and lignified that if stems happened to be taken with a mouthfull of switchgrass, the leaves were eaten and the stems often rejected. At this time, big bluestem was quite leafy and the culms were not as woody; consequently, its degree of utilization was 46.3 per cent. The per cent of big bluestem plants grazed on the loamy prairie site was 34.2 and the plants were often selected from the midst of other species (Figure 17).

Little bluestem was perhaps the leafiest plant of the "big four" during June but only 9.8 per cent of the plants were grazed. The degree of utilization was 39.6 per cent and the preference value, 3.9, was only slightly higher than for May. Indiangrass was grazed 22.2 per cent of the time with 31.3 per cent utilization. The preference value for Indiangrass increased to 6.9 for the month of June.

Data for June showed that 22.5 per cent of all perennial grasses on the loamy prairie site were grazed (Table 13), with slightly less than 98 per cent of the grazing being provided by the "big four". Eastern gama showed evidence of recent grazing at every encounter, indicating its high palatability; however, its limited occurrence did not allow it to supply much quantity in the animals' diet.

Rocky Breaks Site

Big bluestem exhibited a preference value of 11.0 on this site for June (Table 14), which was practically the same as it was for May. The per cent of big bluestem grazed, 23.8, remained low compared with the loamy prairie. The preferences for switchgrass and Indiangrass were reversed from their May values, with switchgrass dropping from 9.0 for May to 2.6 for June, and Indiangrass increasing from zero for May to 8.9 for June (Table 14). No grazing of little bluestem was observed along the transects on the rocky breaks during this month.

Total per cent of all perennial grasses grazed on the breaks site decreased slightly in June to a value of 13.0 per cent (Table 13). About nine per cent of the silver bluestem plants on this site were grazed during this month.

Shallow Site

Over 57 per cent of the big bluestem plants found on the shallow site were grazed in June, a significant increase over the value of 17.6 per cent for the preceding month. The preference value increased to 26.0 for big bluestem and 9.8 for little bluestem which indicates a very high preference for these plants on the shallow site. Of all perennial grasses on this site, 10.2 per cent were grazed.

For the month of June, a total of 408 samples were taken along the 14 transects on three range sites; 68 of the samples were grazed. As a whole, 16.7 per cent of the perennial grasses in the pasture were grazed, an increase over the 11.6 per cent value for May (Table 13).

Preference and Utilization for July

Cool weather and sufficient moisture during July allowed maximum growth of warm season grasses. Big bluestem increased to an average ungrazed height of 35.5 inches by the last of the month and was followed by switchgrass with 35.1 inches, Indiangrass, 29.5 inches, and little bluestem with 26.8 inches (Table 15). Switchgrass began flowering around the first week in July and by the third week most of the switchgrass plants were producing seed heads. The average grazed height of 20.5 inches for switchgrass was high compared with the other grasses. Although the majority of the switchgrass plants had been grazed by the last of July, the growing points of the plants were not removed and, thus, practically all produced seed heads.

Seed stalks from a few plants of big and little bluestem appeared about mid-July but inflorescences were not seen during the month. Average grazed heights for big and little bluestems and Indiangrass were 14.0, 10.1, and 15.0 inches, respectively. Summer annual grasses made tremendous growth during July and the cattle spent considerable time grazing in areas where these grasses were accessible.

Loamy Prairie Site

Big bluestem remained the most highly preferred species on the loamy prairie site during July, as pointed out in Table 15. The preference value of 10.0 for little bluestem showed a significant increase over the June value, indicating an increased desire for this plant by the cattle. The per cent of little bluestem plants grazed increased from 9.8 in June to 21.6 per cent for July. Switchgrass remained the species with the largest per cent of plants grazed, although this value decreased somewhat from its June rating. The preference value likewise decreased

Table 15. Average ungrazed and grazed heights, per cent of plants grazed, per cent utilization, and preference value for the four important grazing species for loamy prairie, breaks, and shallow range sites.

JULY					
Grass	Avg. Ungr.* Height	Avg. Grazed* Height	Per Cent Grazed	Per Cent* Utilized	Preference** Value
LOAMY PRAIRIE					
Big bluestem	35.5	14.0	40.0	45.0	18.0
Little bluestem	26.8	10.1	21.6	46.3	10.0
Switchgrass	35.1	20.5	43.7	22.2	9.7
Indiangrass	29.5	15.0	23.5	37.4	8.8
BREAKS					
Big bluestem	35.5	14.0	27.8	45.0	12.5
Little bluestem	26.8	10.1	10.5	46.3	4.9
Switchgrass	35.1	20.5	33.3	22.2	7.4
Indiangrass	29.5	15.0	20.0	37.4	7.5
SHALLOW†					
Big bluestem	35.5	14.0	60.0	45.0	27.0
Little bluestem	26.8	10.1	40.0	46.3	18.5

*Standard error is within 10 per cent of the mean for all species.

**Preference value is the product of per cent grazed and per cent utilization using one of the values as a decimal fraction.

†Switchgrass and Indiangrass were not abundant enough on this site to determine grazing preference.

for switchgrass from 10.5 in June to 9.7 in July. Indiangrass was grazed 23.5 per cent of the times it was observed and had a utilization of 37.4 per cent. Its preference value increased from the previous month to 8.8 for July.

The cattle consistently grazed the flower stalks produced by big and little bluestems, which contained the immature inflorescences of the plants. The animals did not graze the flower stalks or seed heads of switchgrass, however.

The total per cent of grazed perennial grasses on the loamy prairie site was 28.5 per cent for July, an increase of six per cent over the June figure (Table 13).

Rocky Breaks Site

The preference value for big bluestem was 12.5 on this site for July, with 27.8 per cent of the plants being grazed (Table 15). Little bluestem was grazed 10.5 per cent of the time and the preference value

increased from the previous month to 4.9 for July. The cattle showed about equal preference for switchgrass and Indiangrass on the breaks site during July.

For July, 17.0 per cent of all perennial grasses were grazed on the rocky breaks (Table 13). Grazing was observed on silver bluestem and eastern gama grass in addition to the four species investigated.

Shallow Site

A high degree of preference was shown for big and little bluestems on the shallow site for July (Table 15). These grasses were rather limited on this site and 60.0 per cent of the big bluestem and 40 per cent of the little bluestem plants occurring there were grazed. Other grasses grazed during July on the shallow site were silver bluestem and windmillgrass.

As was pointed out earlier, the cattle spent a considerable portion of their grazing time on shallow and claypan sites during July (Figure 13). The abundance of summer annuals in these areas provided tender forage which the cattle relished. Two grasses, generally associated with shallow and disturbed areas, tumblegrass (*Schedonnardus paniculatus*) and windmillgrass, were grazed extensively. The data revealed that 11.2 per cent of all perennial grasses were grazed on the shallow site for July.

Samples totalling 416 for all transects on three sites were observed with 87 of them being grazed. Of all perennial grasses in the pasture, 20.9 per cent showed evidence of grazing during the month of July (Table 13).

Preference and Utilization for August

Big bluestem was the tallest grass on the prairie by the last of August with an average ungrazed height of 51.5 inches (Table 16). At this time some inflorescence racemes were appearing on the upper four or five nodes of the flower stalks, but it was apparent growth was not complete. Indiangrass was 41.9 inches in height and was the slowest maturing of the "big four". Inflorescences of Indiangrass were barely evident the last of the month. By the first of September almost all the little bluestem plants had produced inflorescence and the average ungrazed height of the mature plant was 37.5 inches. Switchgrass reached maturity around the first week of August when the average height measured 39.3 inches. The seed heads of big and little bluestems were continually sought for grazing by the cattle but the seed heads of switchgrass were rejected.

Table 16. Average ungrazed and grazed heights, per cent of plants grazed, per cent utilization, and preference value for the four important grazing species for loamy prairie, breaks, and shallow range sites.

AUGUST

Grass	Avg. Ungr.* Height	Avg. Grazed* Height	Per Cent Grazed	Per Cent* Utilized	Preference** Value
LOAMY PRAIRIE					
Big bluestem	51.5	13.2	50.0	58.1	29.1
Little bluestem	37.5	9.9	36.4	60.0	21.8
Switchgrass	39.3	14.0	13.3	43.9	5.8
Indiangrass	41.9	13.7	55.0	54.2	29.8
BREAKS					
Big bluestem	51.5	13.2	30.4	58.1	17.7
Little bluestem	37.5	9.9	15.0	60.0	9.0
Switchgrass	39.3	14.0	0.0	43.9	0.0
Indiangrass	41.9	13.7	33.3	54.2	18.0
SHALLOW†					
Big bluestem	51.5	13.2	71.4	58.1	41.5
Little bluestem	37.5	9.9	60.0	60.0	36.0

*Standard error is within 10 per cent of the mean for all species.

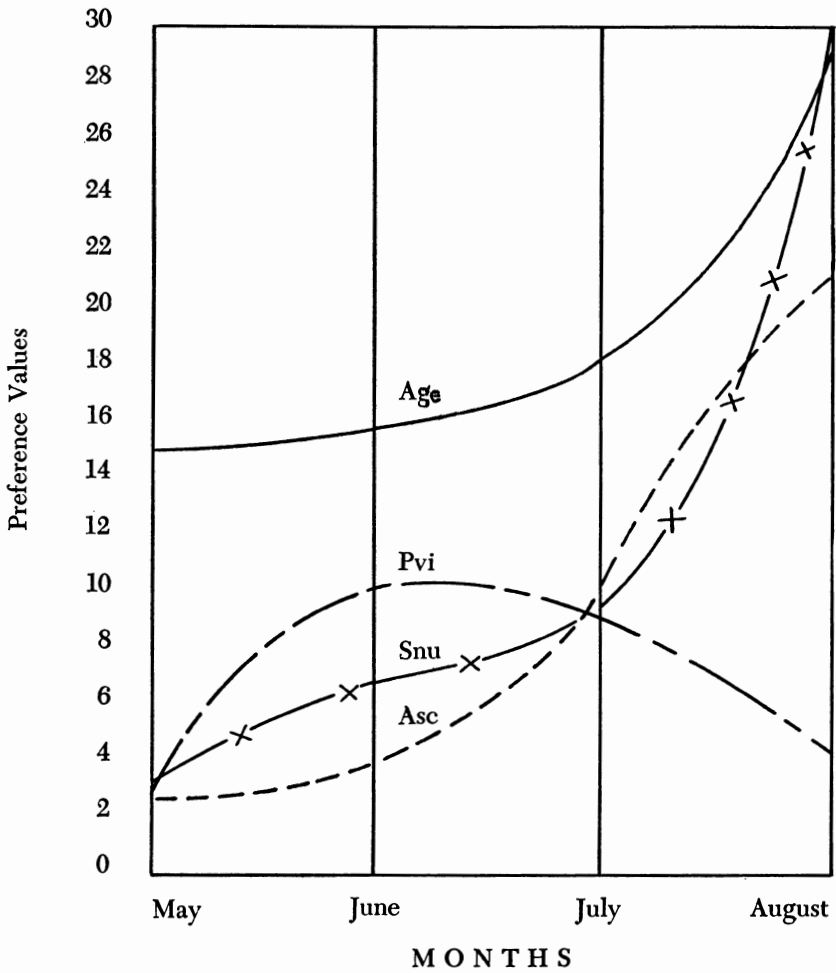
**Preference value is the product of per cent grazed and per cent utilization using one value as a decimal fraction.

†Switchgrass and Indiangrass were not abundant enough on this site to determine grazing preference.

Although significant increases in plant heights were shown for August, there was little change in the average grazed heights of the four species. The general trend during the previous months was an increase in average grazed heights from one month to the next; however, the average grazed height for August for each of the four grasses was less than it was for July. The average grazed height for switchgrass decreased from 20.5 inches in July to 14.0 inches for August. This was attributed to the refusal by the cattle of mature switchgrass plants and their continual regrowth of new growth produced by plants previously grazed.

Loamy Prairie Site

Significant increases were found in preference for big bluestem, little bluestem, and Indiangrass for August. The preference rating for switchgrass dropped from 9.7 in July to 5.8 for August (Table 16). The preference value for Indiangrass showed the greatest increase, from 8.8 in July to 29.8 in August. This was the only value that ever approached or exceeded the value for big bluestem on the loamy prairie site. The preference for little bluestem more than doubled and Table 16 shows that 60.0 per cent utilization of the plant occurred with 36.4 per cent of the plants being grazed.



Age – Big bluestem

Pvi – Switchgrass

Snu – Indiangrass

Asc – Little bluestem

Figure 18. Relative preferences by months of the four important grazing species on the loamy prairie range site.

Figure 18 presents the preference values for the four important grazing species as found on the loamy prairie site for the summer grazing season. Big bluestem showed a gradual rise in preference rating from May through July with a substantial increase in August. Greatest selection of big bluestem over the other grasses was exercised by the cattle during June and big bluestem continued to remain the most highly desired grass throughout the summer. Switchgrass, Indiangrass, and little bluestem had similar preference ratings in May. Switchgrass displayed an increased rating in June when it was second to big bluestem in being selected by the animals. After June, switchgrass declined steadily in preference and was scarcely being grazed in August.

Little bluestem demonstrated a continual increase in preference value and more than doubled the value of the previous month in both July and August. The most marked advance was illustrated by Indiangrass when its preference rating increased from 8.8 in July to 29.8 in August, raising it from fourth to first in selection by the cattle.

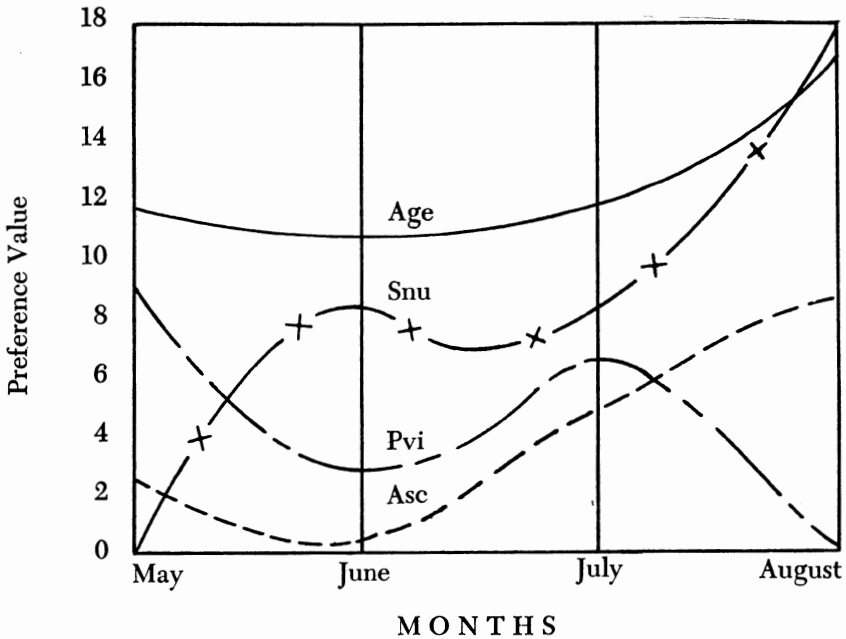
The number of grazed perennial grasses on the loamy prairie site showed a consistent increase throughout the study period with 16.0 per cent found grazed in June and 39.0 per cent grazed in August (Table 13). Very limited grazing was observed on grasses other than the four that were studied. Samples representing the loamy prairie site revealed that only 1.9 per cent of the buffalograss plants present on this site were grazed during the summer, 4.4 per cent of the tall dropseed plants, and 100 per cent of the eastern gama grass plants were grazed.

Rocky Breaks Site

Results of grazing preference investigations for the breaks site in August were similar to those on the loamy prairie for the same month. Switchgrass was the only species that decreased in preference rating. Big bluestem and Indiangrass had similar preference ratings in August (Table 16).

Figure 19 shows that switchgrass and little bluestem declined in grazing preference from May to June while preference by the cattle for Indiangrass increased; however, the reverse of this was true in July. By the end of August the preference values for the four main grasses on the breaks site were in the same order that was observed on the loamy prairie; that is, Indiangrass and big bluestem with the highest value, followed by little bluestem with an intermediate value, and switchgrass with the lowest preference value.

The per cent of perennial grasses grazed on this site was 23.5 for



Age – Big bluestem

Pvi – Switchgrass

Snu – Indiangrass

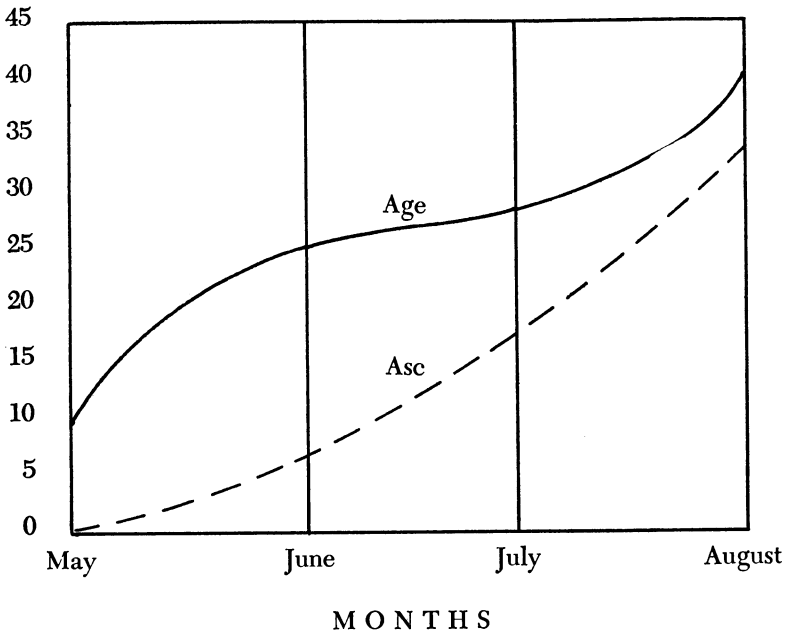
Asc – Little bluestem

Figure 19. Relative preferences by months of the four important grazing species on the rocky breaks site.

August (Table 13). Transect data for all monthly periods showed that 3.2 per cent of the tall dropseed plants on the breaks site were grazed, 10.0 per cent of the sideoats grama, 10.1 per cent of the silver bluestem, and 100 per cent of the eastern gama plants were grazed.

Shallow Site

The paucity of tall grasses on the shallow and claypan areas apparently made those present very desirable. Table 16 shows that the preference values for big and little bluestems on the shallow site greatly exceeded comparable values on the loamy prairie site. Over 70 per cent



Age — Big bluestem

Asc — Little bluestem

Figure 20. Relative preferences by months of big and little bluestems on shallow site. Switchgrass and Indiangrass were not abundant enough on this site to determine grazing preferences.

of the big bluestem plants and 60 per cent of the little bluestem plants present on the shallow site were grazed.

For August, 418 samples were taken on all three range sites of which 114 were grazed. This indicated 27.3 per cent of the perennial grasses in the study pasture were grazed (Table 13).

Cattle grazing preference for big and little bluestems increased quite markedly on the shallow site throughout the summer (Figure 20). Little bluestem was always less preferred than big bluestem. Other perennial grasses selected by the cattle for grazing on this site were 4.8 per

Table 17. Estimated degree of use by cattle of various forbs on the study area and plant part consumed, period when each forb was desired, and range site where each forb was found.

Scientific Name	Common Name	Degree* of use	Plant Part Grazed	Period Grazed	Site**
<i>Ambrosia psilostachya</i>	Western ragweed	5	Upper leaves	Je-Jy	L-B-S
<i>Amorpha canescens</i>	Leadplant	1	Upper stem and leaves	Je-Jy	L-B
<i>Apocynum cannabinum</i>	Hemp dogbane	5	Upper leaves	Je	L-B
<i>Asclepias tuberosa</i>	Butterfly milkweed	3	Flower	Je	L
<i>Asclepias verticillata</i>	Whorled milkweed	2	Upper half	My-Je	L-B
<i>Aster ericoides</i>	Heath aster	2	Stem tips	Je-Jy	L
<i>Ceanothus ovatus</i>	Inland ceanothus	3	Upper stem and leaves	Je	L-B
<i>Deiphinium virescens</i>	Plains larkspur	4	Lower leaves	My-Je	L
<i>Desmanthus illinoensis</i>	Illinois bundle flower	3	Upper stem and leaves	Je-Jy	L
<i>Eryngium yuccifolium</i>	Yuccaleaf eryngo	1	Upper half	Je	L
<i>Euphorbia corollata</i>	Flowering spurge	2	Flowers and Upper leaves	Je-Jy	L
<i>Helianthus hirsutus</i>	Hairy sunflower	3	Upper half	Je-Jy	B
<i>Helianthus maximiliani</i>	Maximilian sunflower	2	Upper half	Je-Jy	B
<i>Helianthus rigidus</i>	Stiff sunflower	2	Upper half	Je-Jy	B
<i>Justicia americana</i>	Water willow	1	Upper half	Je-Jy	L
<i>Kuhnia eupatorioides</i>	False boneset	4	Upper stem and leaves	Je-Jy	L
<i>Lespedeza capitata</i>	Roundhead lespedeza	4	Upper leaves	Je-Jy	B
<i>Lespedeza violacea</i>	Trailing lespedeza	2	Upper half	Je-Jy	B
<i>Liatris punctata</i>	Dotted gayfeather	5	Upper half	Ag	S
<i>Penstemon cobaea</i>	Cobaea penstemon	3	Upper half	Je	S
<i>Petalostemum candidum</i>	White prairie clover	2	Upper half	Je-Jy	L
<i>Petalostemum purpureum</i>	Purple prairie clover	2	Upper half	Je-Jy	L-B
<i>Psoralea argophylla</i>	Silver scurfpea	3	Upper stem and leaves	Je-Jy	B
<i>Psoralea floribunda</i>	Prairie scurfpea	4	Upper stem and leaves	Je-Jy	L
<i>Ratibida columnifera</i>	Prairie coneflower	3	Flower	Je	L
<i>Ruellia ciliosa</i>	Fringeleaf ruellia	1	Upper half	Je-Jy	L
<i>Salvia pitcheri</i>	Pitcher's sage	2	Upper half	Jy-Ag	L
<i>Schrankia uncinata</i>	Catclaw sensitive briar	3	Upper half	Je-Jy	L
<i>Solidago altissima</i>	Tall goldenrod	4	Upper leaves	Je-Jy	L
<i>Silphium integrifolium</i>	Entireleaf rosinweed	3	All parts	Je-Jy	L
<i>Silphium laciniatum</i>	Compass plant	1	All parts	Je-Ag	L
<i>Strophostyles leiosperma</i>	Trailing wildbean	3	Upper half	Je-Jy	L
<i>Thelesperma trifida</i>	Plains green- thread	3	Flower	Je-Jy	S
<i>Xanthium pennsylvanicum</i>	Cocklebur	3	Upper leaves	Jy-Ag	L

*Based on visual estimation with five indicating the least use.

**L—Loamy prairie; B—Breaks;—S—Shal'ow

cent of the buffalograss plants, 6.2 per cent of the blue grama, 7.1 per cent of the silver bluestem and tall dropseed, 7.7 per cent of the sideoats grama, and 18.2 per cent of the windmillgrass plants.

Grazing Preference of Cattle for Forbs

The cattle showed definite degrees of selection in grazing forbs and in many cases certain portions of individual plants were preferred. Table 17 summarizes the forbs of the study area that were grazed and the degree of use of each species. Western ragweed was the most abundant perennial forb in the pasture and was present on all range sites but was very rarely grazed by the cattle. According to Weaver (22), leadplant is a conspicuous half-shrub of the deep soils of the ungrazed upland; however, it rarely occurred in the study pasture. This was due to its being highly preferred by livestock, and, consequently, it was removed by continuous grazing. The leadplant that was present was maintained by grazing at a level much below that of the grasses.

On some plants, butterfly milkweed, prairie coneflower, and plains greenthread, only flowers were grazed and on others only the upper stem and leaves were consumed. All of the perennial sunflowers were preferred by the cattle, as were the related *Silphium* species.

Many plants considered to be poisonous, hemp dogbane, whorled milkweed, plains larkspur, flowering spurge, and cocklebur, were grazed but appeared to offer no serious threat to livestock since an abundance of nutritious forage was always present.

As a plant family, the legumes were the most highly desired, although only one received a degree of use rating of "one," which indicated the greatest use. Of the 34 forb species listed in Table 17, five received an estimated degree of use rating of "one." During June and July the cattle utilized the forbs to the greatest extent. This period coincided with the time the majority of the forbs were most actively growing.

Discussion and Summary

Osage County, Oklahoma, is a part of one of the most valuable and productive cattle-producing areas of North America. During years of normal rainfall the native vegetation which is in excellent condition will easily support a cow and her calf year-long on ten acres, with the only supplemental feed necessary being protein during winter. The grazing history of the region has allowed the vegetation to remain in good condition. For many decades the land has been leased for grazing

to cattlemen of the Southwest who have used it to fatten steers before shipping them to market. This grazing practice permitted some deferment and the grasses were able to recuperate from grazing from year to year.

The present study was carried out in a 1,500 acre pasture in excellent range condition located in northern Osage County. Three major range sites, loamy prairie, rocky breaks, and shallow, were found in the pasture in roughly the same proportion as they occurred over the general region. The animals studied had free choice of all important climax species associated with the true prairie.

Long and careful observations of Hereford cows with calves, under natural range environment, were made to determine amount of time spent in various grazing activities and plants preferred by the animals.

An individual cow was observed from the time she arose in the morning, usually around 4:40, and continued until she ceased grazing for the day, about 8:15 p.m. This period of rising until bedding down was designated as a cow-day. Nighttime observations were also included and every month one 24-hour observation was made.

The herd generally arose about 4:40 a.m., and, after standing for a few minutes, soon began grazing. Grazing continued until around 8:15 a.m. when the animals halted grazing and rested for about an hour. This morning rest period was observed in all study animals. The cattle made their way to the ponds by 11:00 a.m. and usually spent the hours between 11:00 a.m. and around 4:00 or 5:00 p.m. alternately standing on the shore, dam, or in the water; or lying or occasionally grazing a short distance from the pond. With cooler temperatures in late afternoon, the animals gradually drifted away from the pond and began grazing. The major part of the grazing occurred between 5:00 and 8:00 p.m. Grazing usually ceased by 8:30 p.m. and by 9:15 the majority of the herd was lying down. They rested quietly until around midnight when the herd arose, one by one, to graze for about 1.7 hours. The calves nursed four times throughout the cow-day at fairly regular intervals.

The cow-day averaged 15.3 hours in length with 7.96 hours or 52 per cent spent in grazing, and 6.74 hours or 44 per cent spent resting. The cows rested while standing almost twice as long on the average as when lying down. The cows grazed an average of 9.67 hours each 24-hour period, 7.96 during the day and 1.71 hours at night. For a 24-hour period, the study animals rested a total of 13.40 hours, half of which occurred during the cow-day and half during the cow-night. The cattle ruminated 6.05 hours at night and 4.42 hours while resting during the

day. Rumination occurred 6.50 hours while lying and 3.97 hours while standing, during rest periods of a 24-hour day. A little over half an hour each cow-day was spent suckling the calves.

The temperature of the day exerted considerable influence on the animals' activities. The cows did not graze as many hours on hot days as they did on moderate or cool days. Nighttime studies showed the cows did not graze any longer on nights of hot days than on nights of cool or moderate days. Hot days were also marked by the animals' spending more time cooling at the ponds during mid-day. While resting on hot days, the cows did not lie down as much as on cooler days, as they apparently sought to take full advantage of air circulation to cool their bodies.

The average daily distance of 3.13 miles traveled by the animals was surprisingly far considering the excellent condition of the vegetation and the closeness of salt and water to all parts of the pasture. The cattle normally watered three or four times each day and usually went no longer than 36 hours without taking salt. Salting was accomplished during the cool of early morning or late evening. Salt was generally taken while the animals were grazing, and grazing was resumed soon after.

An average of 12.2 defecations and 4.6 urinations occurred for each cow during the cow-day. These metabolic functions took place about twice as often while animals grazed as when they rested.

Counts were made to determine the number of times the cows masticated their cuds and the number of seconds required to complete the mastication. The mean number of mastications for the study animals was 49.3 and the average number of seconds required for each bolus was 44.4. Analyses of variance for number of mastications and seconds per cud showed highly significant differences between cows. Comparable data for the calves revealed that calves chewed their cuds more times for a shorter period than the cows. The average number of mastications was 55.7 per cud for 40.0 seconds.

Conspicuous changes occurred in the activities of the calves as they reached the age of four to five months. Their activities closely resembled those of their mothers, and they spent almost as much time grazing as their mothers did. At this age the calves were frequently tasting salt but did not appear to consume any. They also took water more often than when they were younger. The number of nursing periods for the calves each 24-hour period did not change during the study; however, the length of the periods between nursings became greater as the calves grew older. They did not graze at night when very young but at the age

of four or five months, the calves arose to graze with their mothers. The calves also nursed at this time.

The bulls which were in the pasture were observed throughout the breeding season. It was noted that they grazed considerably less time during the day and traveled much greater distances than the cows due to their activities in checking cows for heat.

Kind of vegetation present on each range site was important in determining the amount of time the cattle spent grazing there. The cattle spent a significantly greater proportion of their grazing time on the shallow range site during July than would be expected with random selection of grazing sites. This was because of the animals' preference for the lush summer annual grasses that came with July rains. Results also showed that the cattle preferred the loamy prairie range site over shallow and rocky breaks sites for standing, lying and walking.

Grazing preferences of cattle were determined during the summer grazing season by means of examining plants along line transects located on each of three range sites. Preference values were determined every month for each of the four most important grazing species of the region, namely, big and little bluestems, switchgrass, and Indiangrass. Results showed that big bluestem was the most highly preferred of all species on all range sites during the entire grazing period which included the months of May, June, July, and August. Little bluestem was not selected by the cattle to any great extent until July and August. Preference values for switchgrass were highest during June when this species was selected over all others except big bluestem. As switchgrass matured, grazing was limited only to the new growth of switchgrass plants previously grazed. Indiangrass showed a gradual increase in grazing preference from May through July, and during August its preference value was equal to that of big bluestem. Even though buffalograss made up over 57 per cent of the vegetative composition on the shallow site, it was very rarely grazed. The animals showed less selectivity for plants when they were wet from rainfall or dew and during the morning and evening periods of intense grazing.

It was apparent that the cattle grazed a variety of species and that this variety was important in their diets, but it was also obvious that the great majority of the forage consumed was furnished by the four species discussed above. The percentage of perennial grasses grazed increased progressively each month on each range site.

Grazing was observed on many different forb species found in the pasture. Some of the most highly preferred forbs were lead plant, yucca-leaf eryngo, water willow, fringleaf ruellia, and compass plant.

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