BOTANICAL AND CHEMICAL COMPOSITION OF STEER DIETS ON TWO LOAMY PRAIRIE RANGE SITES AT DIFFERENT STAGES OF SUCCESSION

By

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PREFACE

Approximately fifty percent of the land in Oklahoma is classified as range and a large portion of the 5,400,000 head of cattle in the state obtain the nutrients from the plants that grow on these lands. The range presents a mixture of plant species of variable nutrient content and palatability to the animal for selection. This study was conducted to determine the botanical and nutritive content of late summer diets selected by steers grazing loamy prairie range sites in two different stages of succession in north central Oklahoma. The accurate determination of the botanical and nutritive composition of the diet of grazing livestock is essential for the proper management of grazing lands and range livestock.

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This thesis is proudly dedicated to my parents, Guillermo and Josefina Salas, for their moral and financial support.

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CHAPTER I

INTRODUCTION

There are more than 5.5 million head of cattle in the state of Oklahoma which derive some, if not all, of their nutritive requirements from the more than nine million hectares of rangeland in the state. Animal production from rangelands is determined not only by the animal's genetic potential but also by how well range forage meets the nutritive requirements of the animal in different phases of production. Range plant communities present a variety of plant species that differ in production, nutritive quality, stage of growth and palatability at any one time of the year. The extent to which available vegetation satisfies animal maintenance and production requirements depends on which plants and parts of plants the animal selects from the available herbage at different periods of the year. The consumption and nutritive value of range forage has been an area of interest and challenge to range animal nutritionists for many years. However, research in the area was largely neglected in the United States until increased grain prices and decreased feed grain availability caused a renewed concern for proper forage utilization (Cordova et al. 1978).

Accurate determination of the chemical and botanical

composition of the diet of grazing animals is essential for proper evaluation and management of grazing lands. Use of esophageal fistulated animals to collect samples and the microhistological technique for plant fragment identification are now considered by many range scientists to be the best methods of evaluating livestock diets at any season of the year. Studies of this type have been conducted on rangelands in Nebraska, New Mexico, Utah, Idaho, Louisiana, Texas and many other states. However, no studies of this type have been conducted on the rangelands of Oklahoma.

The objective of this project was to determine the botanical and chemical composition of steer diets during the late summer as selected from two loamy prairie pastures, each at a different stage of succession, in north central Oklahoma.

CHAPTER II

LITERATURE REVIEW

The accurate determination of the nutritive value, palatability, and identification of plants which contribute to the diet of grazing animals at all seasons of the year is essential for the proper management of any rangeland (Bedell 1971; Cook and Harris 1950; Harris et al. 1952; Harris et al. 1967; Holechek et al. 1982a,b; Rice et al. 1971; Rosiere et al. 1975; Theurer et al. 1976; Uresk and Rickard 1976).

Quality of the diet consumed by grazing animals is dependent upon nutritive value of the herbage available and ability of the animals to select such plants and plant parts that will satisfy their appetite. Cook and Harris (1950) pointed out that animal preference for certain forage species was an important factor affecting nutritive value of ingested forage.

The quality of forage is dependent upon the ability of plants to produce and store energy-producing nutrients which are essential to the animal body. Energy supplied by forage comes mainly from carbohydrates which comprise 60 to 80 percent of the dry matter, whereas those nutrients which are essential to the body come in the form of proteins, vitamins

and minerals (Oelberg 1956).

The forage material is arbitrarily fractionated chemically into units which are known to be either high or low in digestibility such as the cellular content and the cell wall constituents, respectively. The cellular content is composed of soluble carbohydrates (mainly sugars and starch), pectin, non-protein nitrogen, protein, lipids and other solubles. All of these are completely available and uniform to the animals as defined by the Lucas Test (Lucas et al. 1961). This test is designed to determine whether the nutritional availability of a given chemical fraction remains the same in different species of forage and in a single species through the changes caused by plant maturity (Van Soest, 1967).

There is evidence that some nitrogen (about 7 percent) is combined to the lignin fraction and is unavailable; therefore, it is not included in the cellular content. The cellular content fraction amounts to more than 60 percent of the dry matter of forage (Van Soest 1965, 1967). The cell wall constituent which is not nutritionally uniform is composed of hemicellulose, cellulose, heat damaged protein and lignin. The availability of this fraction is largely controlled by the degree to which the lignin is linked to the cellulose and to the hemicellulose.

As a forage species matures, the availability of cell wall constituents decreases and its proportion of the dry matter increases. The magnitude of these changes are

largely species oriented. In general, the grasses, as compared to legumes, are higher in hemicellulose, lower in lignin and about the same in cellulose content (Van Soest 1965). The cellulose in alfalfa is more digestible than that of the grasses of the same cellulose content (Gaillard 1962). Raymond (1969), therefore, included feed intake as an integral component of nutritive value.

Van Soest (1965) separated the relationship between feed intake and digestibility into three categories: 1. Those factors which reduce intake, but have no direct effect on digestibility, such as high-moisture content, toxic materials and palatability of forage. All these greatly reduce intake regardless of their nutritive constituents; 2. Those factors which promote a positive relationship between intake and digestibility, such as forage maturity or feed texture (ground vs. whole), which affect the time of passage through the gastrointestinal tract; and 3. Those factors which promote a negative relationship between digestibility and intake, such as the level of organic acid and glucose in the bloodstream, which controls the appetite, and the animal requirements when fed a high quality feed in which the fiber fraction is small and does not affect intake; the animal then has to consume more volume to meet the energy requirements.

Factors influencing the nutritive value of range forage are many, and the degree to which they interact varies from

one area to another. Oelberg (1956) considered stage of maturity, edaphic influences, plant species, climate, animal class, and range condition as being the most important factors influencing nutritive value of range plants.

Numerous studies indicate that digestibility and nutritive value of range forage decreases as the plant matures (Kamstra 1973; Powell et al. 1982; Rosiere et al. 1975; Scales et al. 1971; Smith et al. 1968; Streeter et al. 1968). The decrease in digestibility and nutritive value is caused by the increase of the fibrous fraction and lignification of range plants as they mature (Van Soest 1967). However, the most highly lignified forage is not always the least digestible, as there are other factors influencing digestibility which were discussed previously (Kamstra 1973; Van Soest 1965).

The decrease in nutritive content intake and digestibility of forage as the growing season progresses is a reflection of the accumulation of dead forage and stem material in the available vegetation (Beaty and Engel 1980). The proportion of live and dead material in the available vegetation also influences selectivity, as livestock prefer those plants and plant parts which are green (Laycock and Price 1970).

Harris et al. (1967) stated that differences in botanical or chemical composition between forage ingested and that of the available vegetation is an indication of selective grazing. Rosiere et al. (1975) stated that

preference alone did not always account for proportions of species in the diet because availability was a major factor influencing diet. As the availability of a given plant species decreased, so did the proportion of that plant species in the diet. Van Dyne and Heady (1965) concluded that less abundant species usually were either highly selected or rejected, while abundant ones furnished the bulk of the diet and appeared to be neither preferred nor avoided.

Numerous studies show that grasses are the most important components of cattle diets (Beck 1975; Cook et al. 1958; Cook et al. 1965; Durham and Kothmann 1977; Rosiere et al. 1975; Van Dyne and Heady 1965). Rosiere et al. (1975) reported that grass content of diets was highest in summer and lowest in spring on New Mexico desert range. The forb fraction changed little between seasons but was highest during winter. Holechek et al. (1982a) concluded that cattle diets shifted toward more grass and less forbs as the grazing period progressed on northeastern Oregon grassland. Forbs were highly preferred over grass when found at early stages of growth.

To determine which animal species to use and the time to graze a rangeland one must know the range condition at the time of making decisions. It is generally believed that as compared to higher condition range, lower condition range produces less forage and this forage is composed of lower

quality plants which may reduce the quality and quantity of intake by grazing animals, thereby affecting their performance (Cook et al. 1962; Goebel and Cook 1960; Powell et al. 1982). However, Cook et al. (1965) found no difference in nutritive content between diets collected on good and poor condition ranges when grazed to a comparable degree of utilization. Stuth and Kirby (1979) concluded that under similar amount of available herbage a plant community in a higher successional stage provided diets higher in quality throughout the winter months and furnished critical nutrients earlier in late winter and spring, than a plant community in a lower successional stage.

Lewis et al. (1977) concluded that under proper use excellent condition range produced more gain per ha (13.2 kg) but intermediate gain per day (0.77 kg). Good condition range was intermediate in gain per ha (11.8 kg) and excellent in gain per day (0.81 kg). Fair condition range was lowest in gain per ha (11.3 kg) and average in gain per day (0.72 kg). Powell et al. (1982) found that gain per day was the same in both good-excellent and low-good condition ranges. However, at 75 and 58 percent of potential climax, these pastures would not be sufficiently different in botanical composition to affect animal selectivity depending on stocking pressure.

Several methods have been used to determine the degree of selective grazing. Pickford and Reid (1948) studied the diets of grazing cattle by measuring the utilization of

plant species and comparing it with ungrazed samples. Campbell and Cassady (1951) and Reppert (1960) used close observation of grazing animals to identify the kind and amounts of plants consumed. Beck (1975) studied steer diets by counting the number of steer bites a steer ate of each plant species. Uresk and Rickard (1976) determined steer diets using finely ground fecal samples viewed through a microscope. Rice et al. (1971) used the ruminal evacuation technique. Lesperance et al. (1960b) measured selective grazing using ruminal and esophageal methods as compared to hand clipped samples.

Numerous workers have used the esophageal fistula technique to evaluate the nutritive difference between diets and the available vegetation (Durham and Kothmann 1977; Holechek et al. 1982a,b; Rosiere et al. 1975; Stuth and Kirby 1979). Anderson (1972) noted that nutritive value alone does not describe the diet because of the evidence of selective grazing. Some unpalatable plant species are as high in nutrient content as the grazed plant species. Other investigators have combined the esophageal fistula technique and the microhistological technique to determine the botanical composition of the diet (Johnson and Pearson 1981; Rice et al. 1971; Rosiere et al. 1975; Sidahmed et al. 1981; Thetford et al. 1971).

The most successful means of evaluating the forage consumed by grazing livestock is through the use of

esophageal fistulated animals (Cook et al. 1958; Harris et al. 1967; Lesperance et al. 1960a; Rice et al. 1971). Development and use of the esophageal fistula has been reviewed by Van Dyne and Torell (1964) and Harris et al. (1967). Factors affecting the chemical composition of esophageal collected samples have been reviewed by Lesperance et al. (1974), and those factors affecting the botanical composition of these samples have been reviewed by Theurer et al. (1976).

CHAPTER III

DESCRIPTION OF THE AREA

The study area is located in the north central region of Oklahoma. The land resource area is the Reddish Prairie which covers 3,902,727 ha with smooth to gently rolling hills over clays, sandstones and shales. The rock formations were developed during the Permian age. This area is also referred to as the Western Prairie Plains and extends throughout the center of the state. The Reddish Prairie soils are characterized mainly by loamy surface soils 20 to 80 cm thick, and reddish loamy to clayey subsoils. These soils vary considerably in nutrient content, from high to low phosphate and from moderate to low nitrogen. The mixed grass prairie fuses with the Cross Timbers to the east and short grass prairie to the west (Gray and Galloway 1959).

The climate of the area is continental with long, hot days during the summer, and long, cold nights during the winter. The annual rainfall of the Reddish Prairie ranges from 88 cm in the east to 71 cm in the west, which occurs within the Subhumid climate regime. The growing season ranges from 200 days in the northern parts to 225 days in the south (Gray and Galloway 1959).

The vegetation of the immediate study area could be classified as tall grass prairie at different stages of succession (Broyles 1978), or as a mixed grass prairie (Gray and Galloway 1959).

Bruner (1931) documented the vegetation of Oklahoma. Most of the area which covers the mixed grass prairie has been plowed for crop production and the remaining is used for intensive grazing. As a result, the vegetation has been modified by the reduction of the tall grass species. Therefore, the boundaries of the mixed prairie become difficult to establish because of the broad ecotones with which it is in contact. The mixed grass prairie is composed of a mixture of the tall grasses and short grasses, together with other societies which form prevernal, vernal, estival and serotial aspects, due to the long growing season which characterizes the area.

Within the mixed grass prairie, big bluestem (*Andropogon gerardi* Vitman) is found in slightly depressed areas where the soil-water content is higher, and it is frequently associated with Indiangrass [*Sorghastrum nutans* (L.) Nash]. Little bluestem (*Schizachyrium scoparium* Nash) is the dominant grass in the drier, more exposed portions of the subclimax prairie. The ecological requirements of silver beardgrass (*Andropogon saccharoides* Swartz) approach those of little bluestem, but is found on slightly disturbed areas. Blue grama [*Bouteloua gracilis* (H.B.K.) Lag. ex Steud.] is found on overgrazed tall grass sites.

The study was conducted on the Stillwater Creek Experimental Range Area which is located about 26 km west and 7 km north of Stillwater, Oklahoma. The legal description is E 1/2 Sec. 3 and the SW 1/4 Sec. 4. T. 19 N., R1W. This area has been devoted mainly to the study of improvements, management, and utilization of native pastures for the past 40 years (Gray and Nance 1978).

The study area was divided in two pastures. Pasture 1 was located on a south facing, 1 to 5 percent slope, and contained 9.7 ha. This land was cultivated and terraced at one time and abandoned. The returning vegetation was later overgrazed.

The area has been classified as a Loamy Prairie range site, having Zaneis Loam (1 to 3 percent slope) and Norge loam (3 to 5 percent slope) on the uplands, Kirkland silt loam (1 to 3 percent slope) and eroded land on the middle slopes, and Norge loam on the bottom land (Gray and Nance 1978). (See Appendix B for soil descriptions.)

Pasture 1 was classified as being in fair range condition (Broyles 1978). The vegetation was that of the typical mixed grass prairie, having little bluestem as a dominant grass species with Scribner's panicum (*Panicum scribnerianum* Nash), silver beardgrass, blue grama, sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.], big bluestem and Indiangrass as minor but important grass species. The most common forbs found were heath aster (*Aster ericoides*

L.), sagewort (*Artemisia ludoviciana* Nutt.), and western ragweed (*Ambrosia psilostachya* DC.).

Pasture 2 was located on an east-facing, 1 to 5 percent slope, containing 4.8 ha. This pasture was used historically for late-summer native hay. This pasture was not nearly as abused as Pasture 1, and there were no visible signs of erosion.

The range site for this area has also been classified as a Loamy Prairie. The upland was more or less equally divided among the Zaneis (3 to 5 percent slopes), Norge loam (3 to 5 percent slopes), Lucien loam (3 to 5 percent slopes), and Grainola silt loam (3 to 5 percent slopes) soil series. Norge loam (1 to 3 percent slopes) constituted all of the bottom land in Pasture 2 (Gray and Nance 1973). This area was classified as being in good range condition (Broyles 1978). Big bluestem and little bluestem were the main grass species, and heath aster and western ragweed were less common in this pasture, than in Pasture 1.

The average date of first frost is October 28 and the average date of last frost is April 4, giving an average of 207 frost-free days. The average annual precipitation of 86 cm is distributed throughout the year, with 36 percent falling during the spring and 28, 20 and 16 percent during the summer, fall and winter, respectively.

In 1980, the annual precipitation was 86 cm, of which 44 percent fell during the spring, with 34, 10 and 12 percent during the summer, fall and winter, respectively.

The July precipitation (0.1 cm) was unusually low for the time of year (Figure 1). The 8.8 cm in August was above average, but 5.5 cm fell in only one day. September, with 3.5 cm, was also lower than the average for that month.

The temperature for 1980 was close to the average for the past ten years (Myers 1976) (Figure 1).

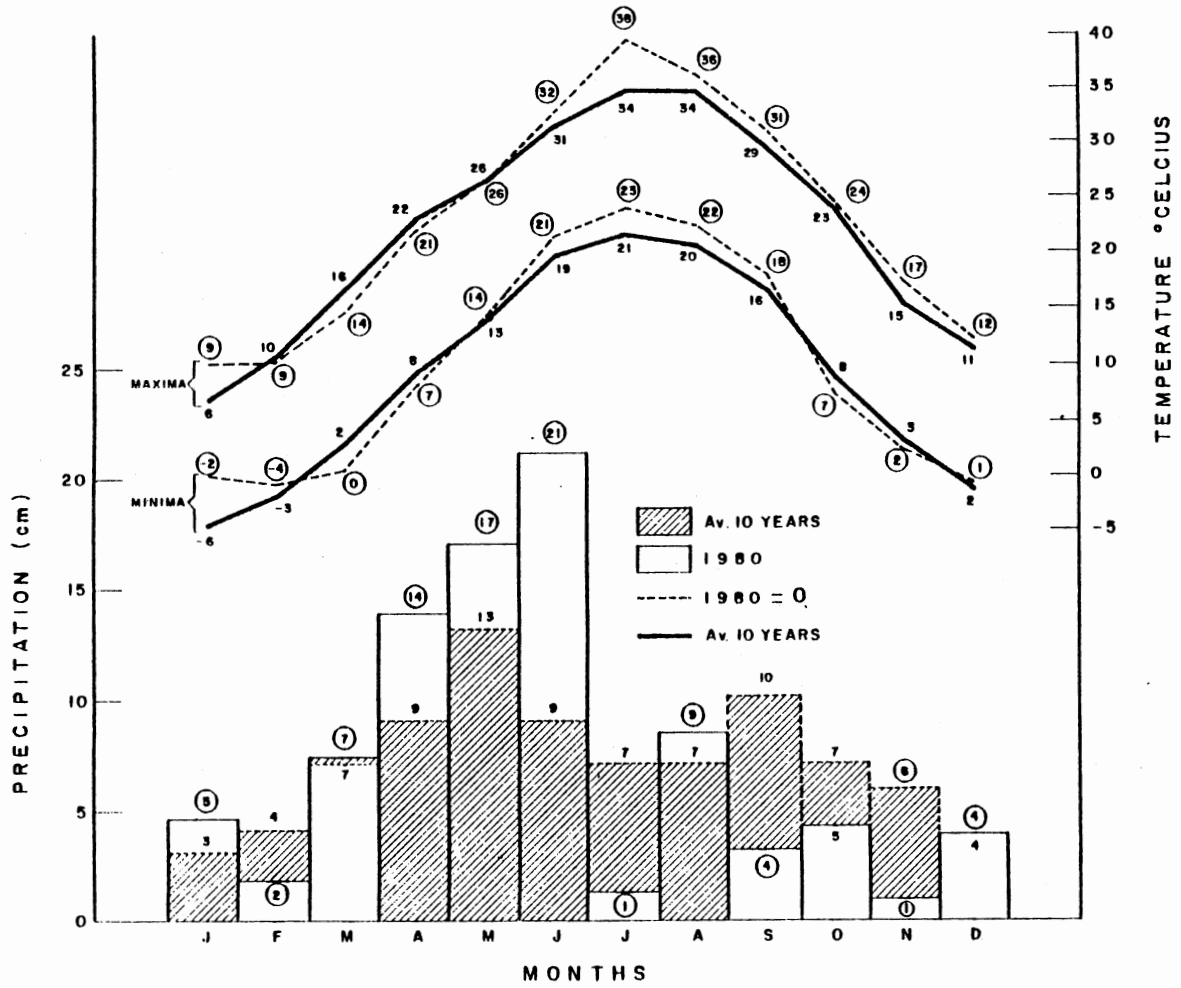

Fig. 1. Monthly temperature (^{o}C) and precipitation (cm) on 10 years average and for 1980, Stillwater, Oklahoma.

CHAPTER IV

METHODS AND PROCEDURES

The plant species composition of the area was determined approximately one week after each monthly collection period for the esophageal fistulated steers, in July, August and September of 1980. The double-sampling technique was used as described by Wilm et al. (1944). Six 20 m transects with four quadrats per transect were used in Pasture 1, while four 20 m transects with four quadrats per transect were used in Pasture 2. The direction and location of the transect and the location of the quadrat within the transect were chosen at random. The following data were obtained: total standing vegetation, standing live vegetation, standing dead vegetation, ground litter, floristic composition and the individual plant weight. One quadrat within a transect was clipped at ground level, dried in an oven at 50 C for 48 hours, ground through a 20 mesh screen in a Wiley mill and stored for later laboratory analyses.

Two esophageal fistulated steers fitted with screen bottom collection bags were used to obtain diet samples from the study area. The collection periods were carried out on three consecutive days for each pasture, with two days rest

between each pasture in July, August and September, 1980. Three holstein steers grazed all pastures (4) of the area throughout the year until the study. The five steers were allowed to graze both pastures one week prior to the collection dates. At other times the steers were maintained on the other two pastures. The study pastures were lightly grazed and had ample vegetation available for the steers to exhibit maximum selectivity during all sampling periods. The steers were fasted overnight before collection time, which was at sunrise. Immediately after collection, the samples were mixed and placed in plastic bags with the proper identification until taken to the laboratory. These samples were oven dried at 50 C for 48 hours, ground through a 20 mesh screen in a Wiley mill and stored for further analyses.

Individual plant species growing in the study area were collected, identified and ground through a 20 mesh screen. For each plant species collected, two or more reference slides were made. Preparation of the reference slides, as well as those for the esophageal samples were carried out as described by Hansen et al. (1971).

The method used to read the slides was the same as described by Sparks and Malechek (1968). The frequency of a given plant species was obtained by observing the presence or absence of that species in 100 fields per sample. The percent frequency was then converted to density using tables developed by Fracker and Brischle (1944).

Samples collected for determination of plant species composition and production, as well as for those of the fistulated animals, were processed in triplicate by the procedure described by Tilley and Terry (1963) for *in vitro* dry matter digestibility (IVDMD). The rumen fluid was obtained from a rumen fistulated steer maintained on a diet of native hay. Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) were carried out in duplicate, following the procedure described by Goering and Van Soest (1968). Nitrogen was determined in duplicate using the micro-Kjeldahl procedure (A.O.A.C. 1970).

Data collected were processed statistically using SAS (Barr et al. 1979). An analysis of variance for each phase of the experiment was used, except for that of total production of the available vegetation in which the SAS General Lineal Model was used. Duncan's Multiple Range Test was used to test those means which were significant in the analyses of variance (Barr et al. 1979).

CHAPTER V

RESULTS AND DISCUSSION

Forage Production

Figure 2 presents the trends of the available vegetation in Pasture 1 (in fair range condition) and Pasture 2 (in good range condition) during the study period (see Appendix C, Table 10). There were no significant differences between pasture means for total standing vegetation, standing live vegetation, and ground litter. The standing dead vegetation was significantly ($P<.05$) less in Pasture 1 than on Pasture 2 (Appendix C, Table 11).

A significant ($P<.05$) decline in the total standing vegetation was observed from July to September (Appendix C, Table 12). This decline was presumably caused by advancing plant phenology, forage removed by the steers and lack of available soil water during the study period. The largest decline in total standing vegetation in Pasture 1 was observed from August to September. In Pasture 2, the largest decline was from July to August. By the end of the study period, both pastures supplied about the same quantity of total standing vegetation (Figure 2).

The means of the standing live vegetation were

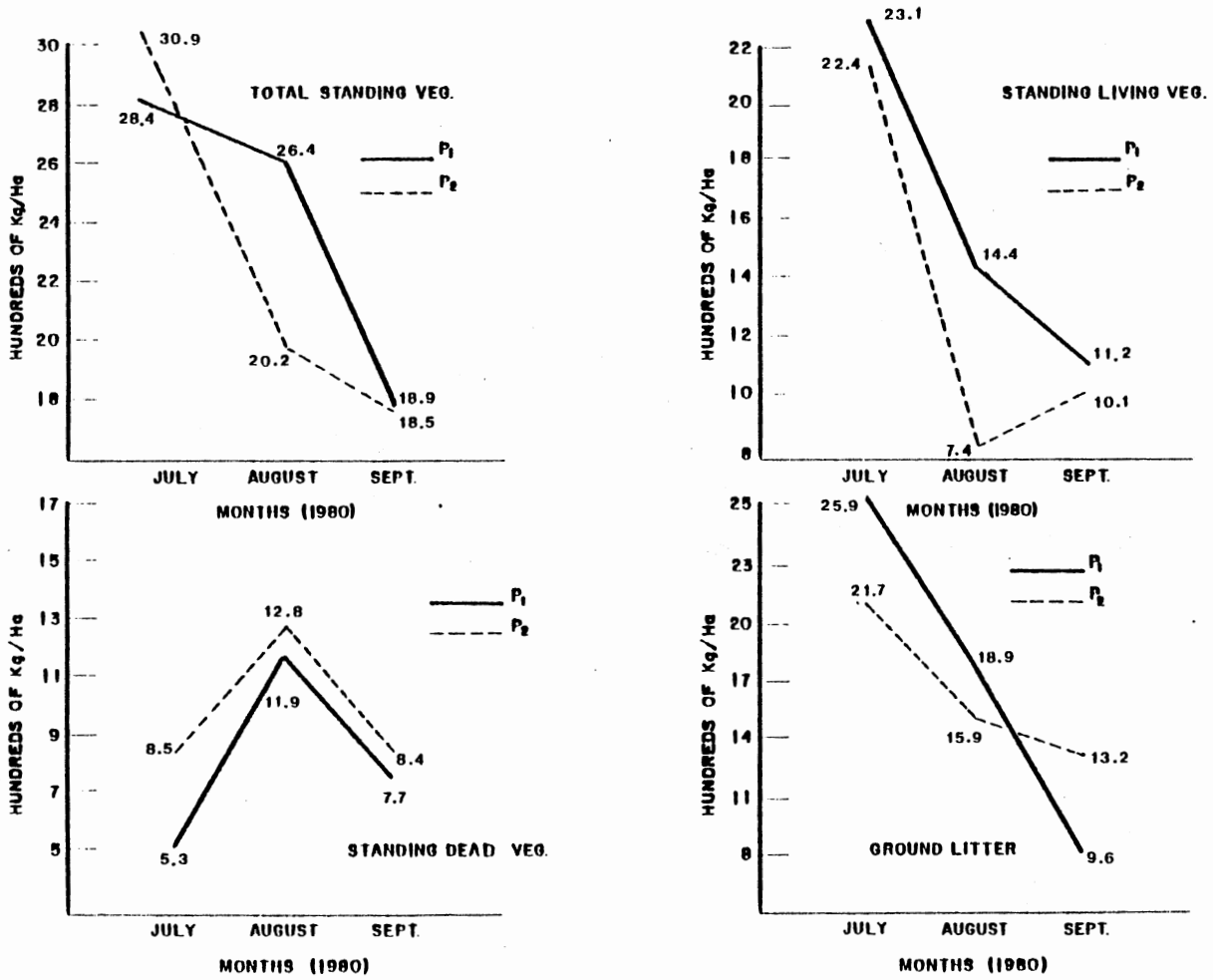

Fig. 2. Average total vegetation (kg/ha dry weight) for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

significantly ($P<.05$) higher in July than in August and September (Appendix C, Table 12). The standing live vegetation in Pasture 1 decreased throughout the study period, but in Pasture 2 it declined from July to August, and increased somewhat from August to September (Figure 2).

Dee et al. (1966), Meeuwig (1970), and Rauzi and Smith (1973) agreed that standing vegetation and ground litter have a pronounced effect on infiltration. In August, it rained 8.8 cm, of which 5.5 cm fell in one day. It is believed that in Pasture 2 water infiltrated with less evaporation and was available to the vegetation. As a result, an increase in standing live vegetation was observed in September (Figure 2).

The standing dead vegetation increased in both pastures from July to August and later decreased throughout September (Figure 2). The pooled means of the standing dead vegetation in August were found to be significantly larger ($P<.05$) than that of July and September (Appendix C, Table 12). The decrease in standing dead vegetation from August to September may be attributed to the lack of rainfall, consumption by the steers and incorporation into the ground litter.

The ground litter decreased in both pastures throughout the study period. The decrease in Pasture 1 was greater than that in Pasture 2, although these differences were non-significant (Figure 2; Appendix C, Tables 10, 11 and 12). The greater decline in Pasture 1 may be a reflection of the

condition of the pasture (fair range condition). Although it was not quantified, Pasture 1 had considerably more bare ground as observed by personal inspection. Therefore it is believed that the intensity of rainfall and density of the vegetation in Pasture 1 were important factors in determining these differences. If true that some of the standing dead vegetation was incorporated into the ground litter, then an increase in ground litter would be expected as the season advanced. At the present time, there is no explanation of the trends of ground litter during this short study period.

Grasses comprised the major portion of the available vegetation (Table 1). Grasses in Pasture 1 contributed 76, 90 and 86 percent to the total standing vegetation in July, August and September respectively. Forbs comprised 24, 10 and 14 percent in July, August and September, respectively. In Pasture 2, grasses contributed 80, 90 and 92 percent to the total standing vegetation in July, August and September, respectively. Forbs contributed 20, 10 and 8 percent in July, August and September, respectively. No significant differences were found for the pooled means of grasses and forbs between pastures nor among months.

The increase in grass composition in Pasture 1 from July to August may explain the different patterns in the total standing vegetation in Pasture 1 and Pasture 2, although there are not enough data to explain these trends (Appendix C, Figure 7).

Table 1. Percent (dry weight) grasses and forbs in the total standing vegetation on the study area.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Grasses	76.5	90.1	86.0	79.6	89.7	92.4
Forbs	23.5	9.9	14.0	20.3	10.3	7.6

A disadvantage of using the weight of a plant in estimating the botanical composition of an area, especially when comparing two areas in different range conditions, is that those plant species in areas in better condition may weigh more than those of the same species in the poorest condition, regardless of their density. Field observation suggested considerably more forbs per unit of area in Pasture 1, although data show no significant differences between pastures.

Little bluestem, the main grass species on Pasture 1, contributed 67, 71 and 53 percent in July, August and September, respectively, to the total standing vegetation. In Pasture 2, little bluestem contributed 39, 25 and 21 percent to the total standing vegetation in July, August and September, respectively. Little bluestem followed the same pattern as did the total standing vegetation on both

pastures (Table 2; Appendix C, Figure 8).

Big bluestem, the main grass component in Pasture 2, comprised 86, 58 and 60 percent of the available vegetation in July, August and September, respectively. In Pasture 1, it was sampled only on the bottom land in July, contributing 0.5 percent to the total standing vegetation (Table 2).

Scribner's panicum was evenly distributed in both pastures. Indiangrass was sampled only on very localized areas of the bottom lands in Pasture 1 and Pasture 2. Silver beardgrass and threeawn were sampled only on Pasture 1, whereas the gramas were more evident on Pasture 2. Heath aster, western ragweed and sagewort were also evenly distributed on both pastures, although sagewort was sampled only in July and August.

The plant species composition on Pasture 1 and 2 corresonds to the description of the mixed grass prairie by Bruner (1931) with respect to the big bluestem, little bluestem, Indiangrass, silver beardgrass and threeawn.

Botanical Composition of Steer Diets

The percentage of grasses and forbs in steer diets were constant throughout the study period for both pastures (Table 3). The grass content of diets from Pasture 1 was 60, 54 and 66 percent, while forbs constituted 26, 26 and 15 percent in July, August and September, respectively. In Pasture 2, grasses made up 59, 61 and 66 percent and forbs 26, 23 and 23 percent of the diet in July, August and

Table 2. Percent (dry weight) of selected[1/] plant species growing on study area.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Big blue-stem	0.5	-	-	35.7	57.8	60.2
Indiangrass	-	3.8	7.3	-	-	5.8
Little bluestem	67.3	70.9	52.7	39.1	24.8	21.2
Scribner's panicum	2.0	3.1	2.7	3.1	3.7	2.2
Sideoats grama	-	-	3.4	1.0	3.3	7.6
Silver beardgrass	1.6	0.9	1.1	-	-	-
Threeawn	-	2.8	16.7	-	-	-
Heath aster	5.4	1.0	0.5	5.5	2.7	2.6
Western ragweed	8.7	3.9	11.5	14.1	5.2	5.2
Sagewort	2.8	4.7	-	0.3	1.8	-

1/ Only those plant species which make up more than one percent of the dry weight composition at any of the sampling periods are shown in table. (See Appendix A for a list of plant species found on study area.)

September, respectively. No statistical significances between months nor between pasture means for either grasses or forbs were found in steer diets.

Table 3. Percent grasses, forbs and unidentified fragments of steer diets as observed through a microscope.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Grasses	60.3	54.4	66.5	59.2	61.3	66.4
Forbs	26.0	26.5	15.0	26.5	23.4	23.9
Unidentified[1/]	13.7	19.1	18.5	14.3	15.3	9.7

1/ Unidentified Fragments - Those fragments which were unable to be identified as grasses or forbs when viewed through a microscope.

Seventeen different grasses and thirteen forbs were identified in the diet, of which nine grass and six forb species constituted one percent or more of the diet at least once in a given month (Appendix D, Table 13).

In Pasture 1, little bluestem was the main grass species in diets of all months (Table 4). It accounted for 37, 30 and 31 percent of the diet in July, August and

Table 4. Percent composition of steer diets and available vegetation from two loamy prairie range pastures.

	July				August				September			
	Past. 1		Past. 2		Past. 1		Past. 2		Past. 1		Past. 2	
	Diet	Avail.	Diet	Avail.	Diet	Avail.	Diet	Avail.	Diet	Avail.	Diet	Avail.
Grasses												
Big bluestem	9.5	0.5	33.9	35.7	9.7	NS	25.8	57.8	1.0	NS	34.1	60.2
Indiangrass	2.1	NS[2/]	10.7	NS	3.8	3.8	2.8	1.3	2.8	7.3	1.6	5.8
Little bluestem	36.7	67.3	7.4	39.1	30.4	70.9	12.4	24.8	31.1	52.7	2.6	21.2
Scribner's panicum	2.7	2.0	T	3.1	T	3.1	1.6	3.7	6.7	2.7	20.1	2.2
Sideoats grama	T[1/]	NS	3.9	1.0	12.7	NS	3.7	3.3	1.4	3.4	T	7.6
Silver beardgrass	1.8	1.6	8.9	4.5	2.4	0.9	4.5	NS	3.6	NS	T	T
Threeawn	5.6	NS	0.5	NS	2.9	2.8	3.5	NS	12.1	16.7	1.3	NS
Forbs												
Daisy fleabane	1.1	NS	0.5	NS	0.2	NS	0.3	NS	2.2	NS	10.6	NS
Sagewort	NS	2.7	5.6	0.3	2.0	4.7	19.1	1.8	1.8	NS	7.2	NS
Western ragweed	4.1	8.7	2.8	14.1	1.9	3.9	3.0	5.2	4.5	11.5	1.5	5.2

[1/] T = trace amounts

[2/] NS = not sampled

September, respectively. Other plant species contributed lesser amounts to the diets. In July, big bluestem contributed 9.5 percent to the diet, blue grama 6.0 percent and threeawn 5.6 percent. In August, sideoats grama (12.7 percent) became the second most important constituent of diets, followed by big bluestem (9.7 percent) and blue grama (8.1 percent). By September, plains lovegrass, threeawn, Scribner's panicum and blue grama contributed 13.8, 12.1, 6.7 and 5.0 percent, respectively, to the diet (Appendix D, Table 13).

In Pasture 2, big bluestem contributed 34, 26 and 34 percent to diets in July, August and September, respectively (Table 4). Other important plant species were Indiangrass (10.7 percent), silver beardgrass (8.9 percent), little bluestem (7.4 percent) and Louisiana sagewort (5.6 percent) in July. In August, Louisiana sagewort (19.1 percent) was the second most important component of steer diets, followed by blue grama (15.4 percent), little bluestem (12.4 percent) and silver beardgrass (4.5 percent). In September, Scribner's panicum contributed 20.1 percent, daisy fleabane 9.3 percent, blue grama 9.3 percent and Louisiana sagewort 7.2 percent to steer diets (Appendix D, Table 13).

Preference of steers for individual plant species was calculated using the formula described by Krueger (1972).

$$\text{RPI} = \frac{\text{\% Diet composition}}{\text{\% Plant species composition}}$$

Big bluestem, with a Relative Preference Index (RPI) of 19, was the most preferred plant species in July diets for Pasture 1, followed by Scribner's panicum (RPI = 1.4), silver beardgrass (RPI = 1.1), little bluestem (RPI = 0.5), and daisy fleabane (RPI = 0.5). In August, however, silver beardgrass ((RPI = 2.7) was the most preferred plant species, followed by Indiangrass (RPI = 1.0) and threeawn (RPI = 1.0). In September, sideoats grama (RPI = 2.5) was the most preferred plant species, followed by threeawn (RPI = 0.7) and Scribner's panicum (RPI = 0.6) (Appendix D, Table 16).

In Pasture 2 in July, Louisiana sagewort (RPI = 18.7) was the most selected plant, followed by sideoats grama (RPI = 3.9) and silver beardgrass (RPI = 2.0). In August, Louisiana sagewort (RPI = 10.6) and Indiangrass (RPI = 2.2) were the two most selected plant species. However, in September Scribner's panicum (RPI = 9.1) and big bluestem (RPI = 0.6) were highest in preference. Preference Indices were not calculated for some plant species because of sampling error in the available vegetation (Table 4).

Availability of plant species to grazing cattle is an important factor contributing to botanical composition of livestock diets (Rosiere et al. 1975). In this study, little bluestem was the most abundant plant species in diets as well as in the available vegetation for Pasture 1, while big bluestem was the most important plant species in diets

as well as in the available vegetation for Pasture 2. The Relative Preference Index showed that these two plant species were neither selected for or against (Van Dyne and Heady 1965) (Appendix D, Table 16).

The importance of availability of plant species in diets of steers, especially at different phenological stages, is reflected in the chemical composition of diets. This might be the case for threeawn and Scribner's panicum in September for Pasture 1, where their availability increased and they were in early stages of phenology. This was reflected in the crude protein content and in the IVDMD of steer diets.

When given the choice, the steers preferred big bluestem over little bluestem. On Pasture 2 in July, little bluestem was available in about the same amounts as big bluestem. However, little bluestem constituted 7.4 percent of the steer diet, whereas big bluestem comprised 33.9 percent of the diet. The Relative Preference Index for big bluestem was higher in July and September than for August (Table 4; Appendix D, Table 16).

Chemical Composition of Available Vegetation

Data on the chemical composition of the available vegetation showed no significant difference between the means for crude protein, acid detergent fiber (ADF), acid detergent lignin (ADL) and *in vitro* dry matter digestibility

(IVDMD) between Pasture 1, and Pasture 2, (Table 5, Appendix E, Table 17).

Protein in the available vegetation in Pasture 1 increased as the season progressed, from 3.7 percent in July to 4.0 and 4.2 percent in August and September, respectively. In Pasture 2, the mean crude protein content of the available vegetation was 3.7, 3.8 and 4.1 percent in July, August and September, respectively (Table 5). The crude protein content was significantly higher ($P<.05$) in September than in July (Appendix E, Table 18). This increase in crude protein content could be attributed to the increase in annual grasses, especially in September in Pasture 1. The Pasture x Month interaction was found to be non-significant.

ADF content of the available vegetation was greater in Pasture 1 than that from Pasture 2 for July and August, but in September both pastures were about the same (Table 5). These differences and Pasture x Month interaction were non-significant (Appendix E, Tables 17 and 18).

ADL content of the available vegetation from Pasture 1 increased from 6.7 percent in July to 8.3 and 8.7 percent in August and September, respectively. The ADL in Pasture 2 increased gradually throughout the sampling period, from 6.8 in July to 7.4 and 8.4 percent in August and September, respectively (Table 5).

The mean ADL contents of the available vegetation for

Table 5. Nutritive value of available vegetation on study area (percent dry weight).

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
% Crude Protein	3.7 ± 0.7[1/]	4.0 ± 0.8	4.2 ± 1.8	3.7 ± 0.5	3.8 ± 1.1	4.1 ± 0.2
% ADF[2/]	47.6 ± 3.2	47.7 ± 4.5	48.3 ± 4.2	45.3 ± 1.6	45.8 ± 1.7	48.2 ± 0.7
% ADL[3/]	6.7 ± 1.4	8.3 ± 1.3	8.7 ± 1.0	6.8 ± 0.5	7.9 ± 2.2	8.4 ± 0.7
% Digestibility	47.3 ± 3.0	41.8 ± 4.4	32.4 ± 4.9	51.4 ± 3.2	39.7 ± 4.7	34.1 ± 2.8

1/ Standard deviation from the mean

2/ Acid Detergent Fiber

3/ Acid Detergent Lignin

July and August were significantly lower ($P<0.5$) than those of the September samples. The Pasture x Month interaction was non-significant (Appendix E, Tables 17 and 18). The increase in ADL throughout the sampling period was expected because as the plant matures, lignification increases within the plant (Van Soest 1967).

The IVDMD of the available vegetation from Pasture 1 was 47 percent in July, 42 in August, and 32 in September. The vegetation from Pasture 2 was 51, 40 and 34 percent digestible in July, August and September, respectively (Table 5). The total decrease in digestibility on Pasture 1 was 14.9 percent, while on Pasture 2 the total decrease was 17.3 percent. Pasture 2 was higher in IVDMD in July and September than in August. IVDMD decreased significantly ($P<0.5$) each month of the study period (Appendix E, Table 18). The Pasture x Month interaction was non-significant. The IVDMD decreased, possibly due to the increase in lignification of plant material as the season progressed (Van Soest 1965).

Chemical Composition of Steer Diets

The percent crude protein of steer diets in Pasture 1 was greater than that of Pasture 2 in July and August, but not in September (Table 6; Figure 3). The difference between pasture means pooled across months was non-significant (Appendix F, Table 19).

On Pasture 1, the percent crude protein was relatively

Table 6. Nutritive value of steer diets on study area (percent dry weight).

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
% Crude Protein	5.7 ± 0.7[3/]	5.4 ± 1.5	5.6 ± 1.2	5.2 ± 0.2	4.6 ± 1.0	5.9 ± 1.4
% ADF[1/]	49.4 ± 3.0	47.8 ± 2.9	45.7 ± 2.5	48.7 ± 2.1	45.3 ± 4.4	43.4 ± 4.1
% ADL[2/]	9.0 ± 1.9	10.1 ± 2.2	10.6 ± 3.5	10.6 ± 1.3	9.2 ± 1.4	9.9 ± 2.6
% Digestibility	56.2 ± 3.2	42.5 ± 5.8	45.2 ± 4.3	62.5 ± 8.2	53.0 ± 7.3	59.3 ± 6.9

1/ Acid Detergent Fiber

2/ Acid Detergent Lignin

3/ Standard deviation from the mean

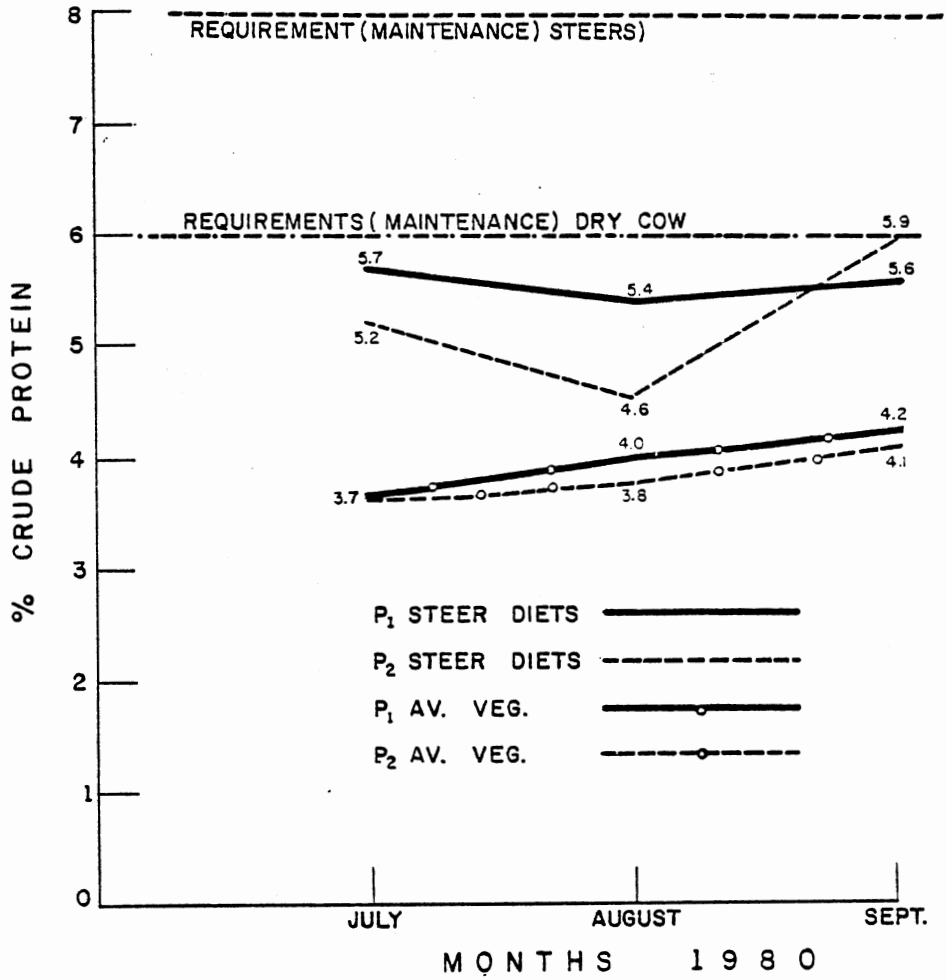

Fig. 3. Percent crude protein (dry weight) of steer diets and available vegetation for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

constant throughout the sampling period. In Pasture 2, a slight decrease was observed from July to August (from 5.2 percent to 4.6 percent). Then it increased to 5.9 percent in September. The increase in crude protein content of steer diets in Pasture 2 in September could be attributed to the decrease of little bluestem and the increase of Scribner's panicum (at a lower phenological stage) in the diet (Table 4). Those differences, as well as the Pasture x Month interaction, were non-significant (Appendix F, Table 20). Animal selected diets from Pasture 1 and Pasture 2 did not meet maintenance requirements for crude protein for dry cows in any of the months sampled (Figure 3), although Pasture 2 came close in September.

The ADF of steer diets in Pasture 2 was higher throughout the sampling period than that of Pasture 1 (Table 6; Figure 4). The difference between the pasture means was non-significant. On Pasture 1, the ADF of the steer diets decreased gradually from 49.4 percent in July to 47.8 and 45.7 percent in August and September, respectively. For Pasture 2 a larger decline in the percent ADF was observed from July to August (from 48.7 percent to 45.3 percent), dropping further to 43.4 percent in September. The difference between months and the Pasture x Month interaction were non-significant (Appendix F, Table 20).

The ADF of steer diets was greater than that of the available vegetation in July. In August, the means of steer diets and those of the available vegetation were about the

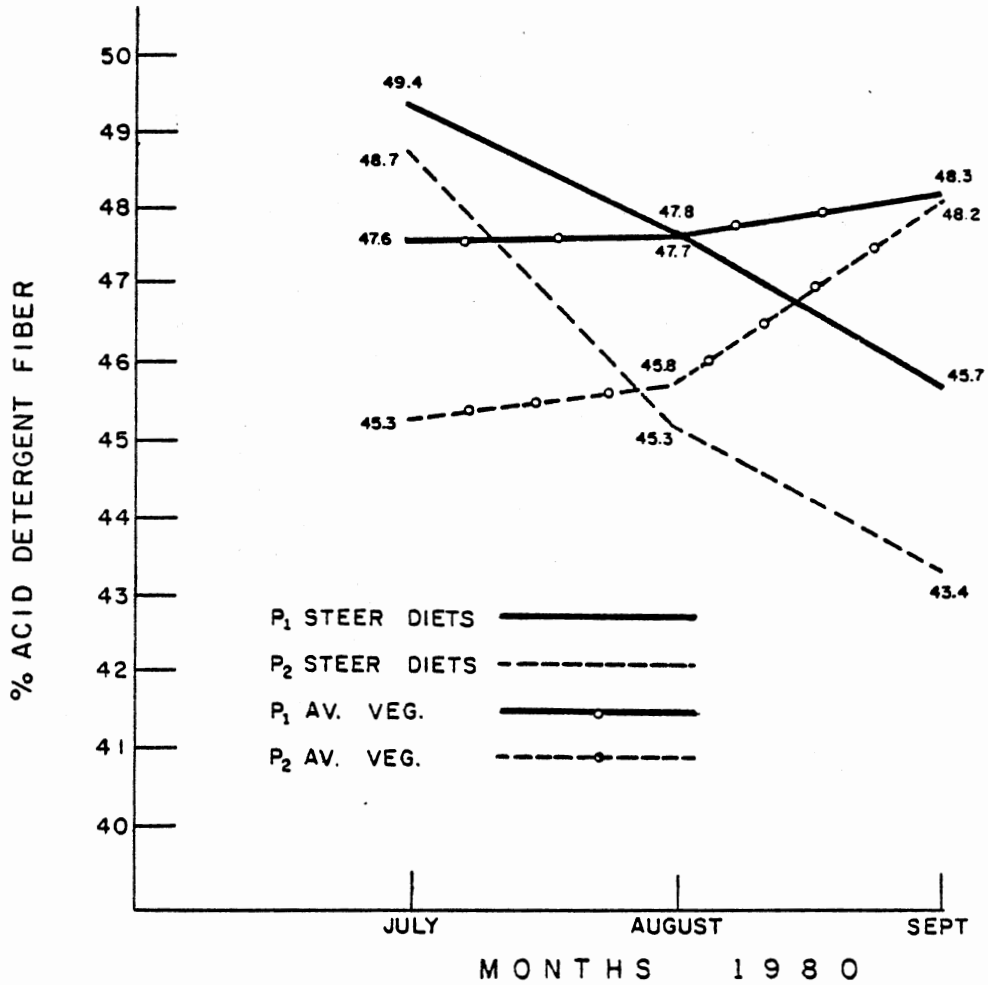

Fig. 4. Percent acid detergent fiber (dry weight) of steer diets and available vegetation for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

same. But in September, the ADF for steer diets was considerably lower than the ADF in the available vegetation (Figure 4).

In July, when the greatest difference of ADF in the available vegetation between pastures was observed, the difference between steer diets in each pasture was small; the reverse was observed in September, when the difference in ADF in the available vegetation between pastures was small, the difference in steer diets was at its greatest. The decrease in the ADF content in steer diets, as compared to the increase from that of the available vegetation samples, is an indication of selectivity.

The percent ADL in Pasture 1 diets decreased from 10.6 percent in July to 9.2 percent in August (Table 6; Figure 5). In Pasture 2 the ADL content increased from 9.0 percent in July to 10.1 percent in August. The percent ADL of steer diets in September increased to 10.6 percent in Pasture 1 diets and 9.9 percent in Pasture 2 diets. Differences among mean ADL between pastures and among months, as well as for the Pasture x Month interaction, were non-significant (Appendix F, Tables 19 and 20). The ADL content of steer diets was greater than that of the available vegetation in both pastures throughout the study (Figure 6). The diets varied from 1.3 percent higher in Pasture 2 in August to 3.8 percent higher in July in Pasture 2 than the ADL content of the available vegetation.

The IVDMD of steer diets in Pasture 2 was higher than

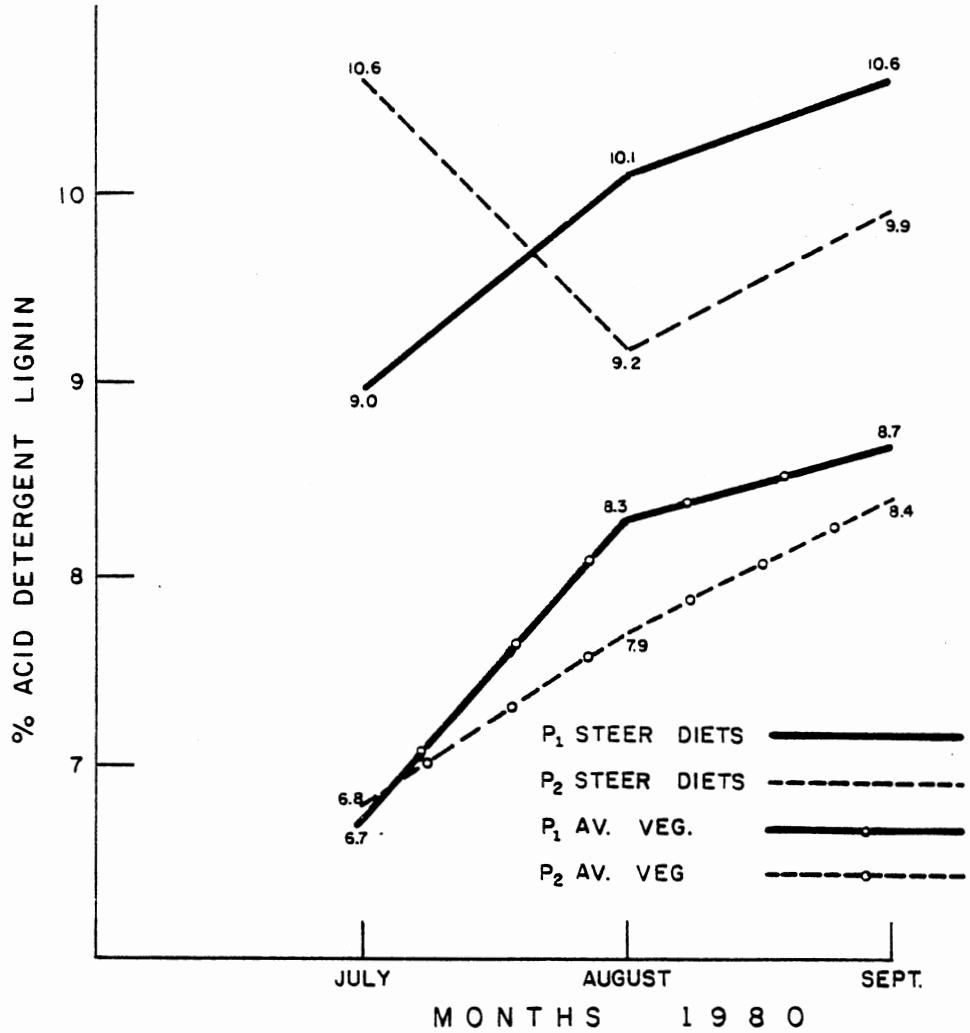

Fig. 5. Percent acid detergent lignin (dry weight) of steer diets and available vegetation for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

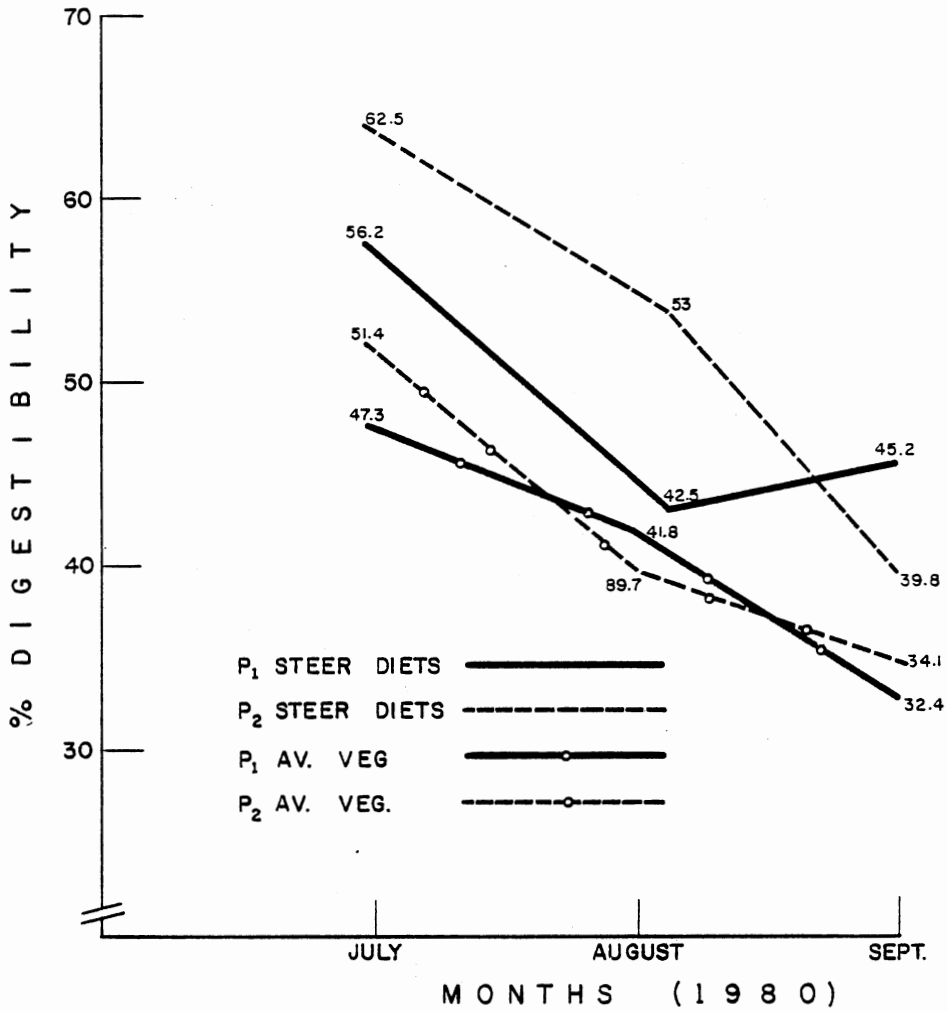

Fig. 6. Percent IVDMD (dry weight) of steer diets and available vegetation for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

that of Pasture 1 in July and August, but not during September. In this case, the difference of the pooled means between pastures was significant ($P<.05$). The IVDMD of Pasture 1 diets decreased from 56.2 percent in July to 42.5 percent in August, and increased to 45.2 percent in September. In Pasture 2, the percent digestibility of steer diets decreased throughout the sampling period, from 62.5 percent in July to 53.0 and 39.8 percent in August and September, respectively (Table 6).

The IVDMD means between months pooled across pastures were found to be significant ($P<.05$) and the Pasture x Month and Pasture x Steers interactions were also significant ($P<.05$). The Pasture x Month interaction could be explained because of the significance of the Pasture x Steers interaction. This means that each steer was consuming plants with different digestibility on each pasture (Appendix F, Table 19).

The increase (from 42.5 percent to 45.2 percent from August to September) in percent IVDMD in Pasture 1 diets may be attributed to the high percentage of green annual threeawn in the diet of this period. No increase in the IVDMD was observed in Pasture 2 diets, although an increase in protein content was observed during September. This increase was attributed to the higher percentage of Scribner's panicum (at an early stage of phenology) in the diet. The IVDMD of the diets was higher than that of the available vegetation throughout the study (Figure 6).

Any difference between the nutritive content of the available vegetation and that of the steer diets shows selectivity for plants or plant parts higher in nutritive value than the average of that available (Harris et al. 1967).

In this study, the percent crude protein, ADL and IVDMD of steer diets were found to be higher than those obtained from the available vegetation (Figures 3, 5 and 6) while ADF was lower (Figure 4).

Conclusion

It is believed that grasslands in lower successional stages are composed of more plant species with lower nutritive value (Powell et al. 1982). In this study, however, no significant differences in total herbage production and in the quality of the forage available were found between Pasture 1 (in fair range condition) and Pasture 2 (in good range condition). A significant difference was found in the floristic composition between the two pastures.

The botanical composition of steer diets was mainly grasses, which agrees with those findings by other workers, including that of Rosiere et al. (1975). Forbs constituted over 20 percent of steer diets (except for Pasture 1 in September when it was 15 percent).

Definite evidence of forage selectivity was observed in

this study. Little bluestem and big bluestem were the main grass components of steer diets in every month sampled for Pasture 1 and Pasture 2. Big bluestem was highly preferred by steers over little bluestem when both were present in the same area. Big bluestem's Relative Preference Index was higher than that of little bluestem in July and September, but not in August for Pasture 2, possibly because greater availability of other plant species on the range was an important factor for determining Relative Preference Index (Rosiere et al. 1975). Other plant species, Scribner's panicum, sideoats grama, Indiangrass, silver beardgrass, threeawn, Louisiana sagewort and western ragweed, were highly selected for at least one time during the sampling period.

The crude protein, ADL and IVDMD of steer diets were higher than those samples of the available vegetation. However, there were no significant differences in diet quality between pastures due to differences in range condition. The crude protein content of the available vegetation or the diet did not meet the protein requirements for dry cows in any of the months sampled and protein supplementation should be considered in late summer.

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APPENDIX A

A PARTIAL LIST OF SPECIES ON STUDY AREA

Table 7. Some plant species composition on study area.

Common Name	Scientific Name
Grasses and Grasslike	
Big Bluestem	*Andropogon gerardi* Vitman
Silver Beardgrass	*Andropogon saccharoides* Swartz
Splitbeard Bluestem	*Andropogon ternarius* Michx.
Broomsedge Bluestem	*Andropogon virginicus* L.
Threeawn spp	*Aristida* spp
Sideoats Grama	*Bouteloua curtipendula* (Michx.)Torr.
Blue Grama	*Bouteloua gracilis* (H.B.K.) Lag. ex. Steud.
Japanese Brome	*Bromus japonicus* Thunb.
Buffalograss	*Buchloe dactyloides* (Nutt.) Engelm.
Sedges	*Carex* spp
Windmillgrass	*Chloris verticillata* Nutt.
Plains Lovegrass	*Eragrostis intermedia* Hitchc.
Virginia Wildrye	*Elymus virginicus* L.
Scribner's Panicum	*Panicum scribnerianum* Nash.
Switchgrass	*Panicum virgatum* L.
Tumblegrass	*Schedonnardus paniculatus* (Nutt.) Trel.
Little Bluestem	*Schizachyrium scoparium* Nash.
Bristly Foxtail	*Setaria verticillata* (L.) Beauv.
Indiangrass	*Sorghastrum nutans* (L.) Nash.
Tall Dropseed	*Sporobolus asper* (Michx.) Kunth.

Table 7. Continued.

Common Name	Scientific Name
Sand Dropseed	*Sporobolus cryptandrus* (Torr.) A. Gray
Purpletop	*Tridens flavus* (L.) Hitchc.
Forbs and Shrubs	
Western Yarrow	*Achillea lanulosa* (Nutt.)
Western Ragweed	*Ambrosia psilostachya* DC.
Louisiana Sagewort	*Artemisia ludoviciana* Nutt.
Heath Aster	*Aster ericoides* L.
Wild Indigo	*Baptisia* spp
Showy Partridgepea	*Cassia fasciculata* Michx.
Texas Croton	*Croton texensis* (Klotzsh) Muell.
Sessile Tickclover	*Desmodium sessilifolium*
Daisy Fleabane	*Erigeron strigosus* Muhl.
Annual Broomweed	*Gutierrezia dracunculoides* (DC.) Blake
Lespedeza	*Lespedeza* spp
Dotted Gayfeather	*Liatris punctata* Hook.
Wooly Plantain	*Plantago purshii* R. and S.
Wild Alfalfa	*Psoralea tenuiflora* Pursh
Sumac	*Rhus* spp
Silverleaf Nightshade	*Solanum elaeagnifolium* Cav.
Buckbrush	*Symphoricarpos orbiculatus* Moench.
Ironweed	*Vernonia baldwini* Torr.

APPENDIX B

CLASSIFICATION OF SOIL ON STUDY AREA

Table 8. Soils of the study area.

Location	Topography		Soil Series	% Slope
Pasture 1	Upland	1.	Norge Loam	3 to 5
		2.	Zaneis Loam	3 to 5
		3.	Eroded Land	2 to 5
	Bottom Land	1.	Norge Loam	3 to 5
		4.	Kirkland Silt Loam[2/]	1 to 3
		3.	Eroded Land	2 to 3
Pasture 2	Upland	5.	Grainola Silt Loam[1/]	3 to 5
		6.	Lucien Loam[3/]	3 to 5
		7.	Grainola-Lucien Complex[1/]	5 to 20
		8.	Zaneis Loam	1 to 3
		1.	Norge Loam	3 to 5
	Bottom Land	1.	Norge Loam	

1/ Grainola soils are taxadjunks between the Ap or A1 and B1 horizons are noncalcareous silt Loam.

2/ Kirkland silt Loam. Typically moderately well drained.

3/ These soils typically lack a mollic epipedon and are outside the Lucien soils.

Table 9. Classification of soil series.

Soil Series	Family	Sub group	Order
Norge[1/]	Fine - silty, mixed, Thermic	Udic Argiustolls	Mollisols
Zaneis[2/]	Fine - Loamy, mixed, Thermic	Udic Haplustalls	Alfisols
Kirkland	Fine, mixed, Thermic	Uderfic Paleustolls	Mollisols
Grainola	Fine, mixed, Thermic	Typic Nastrustolls	Mollisols
Lucien[3/]	Loamy, mixed, Thermic, shallow	Udic Ustochrepts	Inceptisols

1/ Norge soils are normally classified Udic Paleustolls.

2/ Zaneis soils are normally classified Udic Argiustolls, Mollisols.

3/ Lucien soils are normally classified Mollic Xlatrostolls, Mollisols.

APPENDIX C

HERBAGE PRODUCTION AND GROUND COVER ON THE STILLWATER CREEK EXPERIMENTAL RANGE AREA. PAYNE COUNTY, OKLAHOMA 1980

Table 10. Estimated total production (kg/ha dry weight) of two loamy prairie range pastures at different stages of succession.

	Pasture 1			Pasture 2		
	July	August	Sept	July	August	Sept
Total standing vegetation	2842	2637	1887	3088	2023	1849
Standing live vegetation	2311	1443	1117	2238	742	1012
Standing dead vegetation	531	1194	770	850	1280	837
Ground litter	2594	1890	958	2168	1595	1310

Table 11. Estimated total production: pooled means across months (kg/ha dry weight).

	Pasture 1	Pasture 2
Total Standing Veg.	2455a[1/]	2320a
Standing Live Veg.	1623a	1331a
Standing Dead Veg.	832a	1019b
Ground Litter	1814a	1694a

[1/] Means with the same letters in rows are not significantly different (P<.05).

Table 12. Estimated total production: pooled means across pastures (kg/ha dry weight).

	July	August	September
Total Standing Veg.	2965a[1/]	2380ab	1868b
Standing Live Veg.	2274a	1092b	1064b
Standing Dead Veg.	690a	1237b	803a
Ground Litter	2381a	1743a	1139a

[1/] Means with the same letters in rows are not significantly different (P<.05).

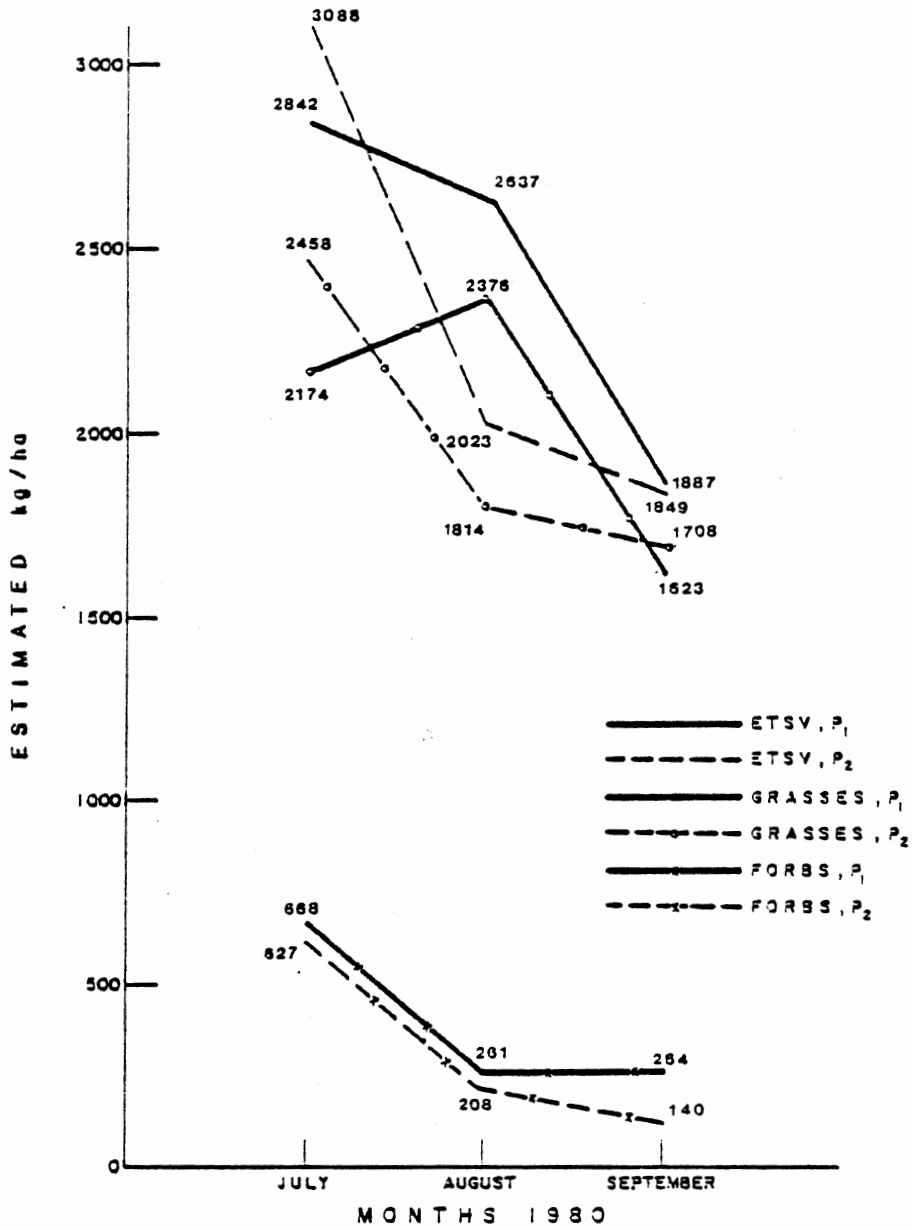

Fig. 7. Total standing vegetation, grasses and forbs for Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

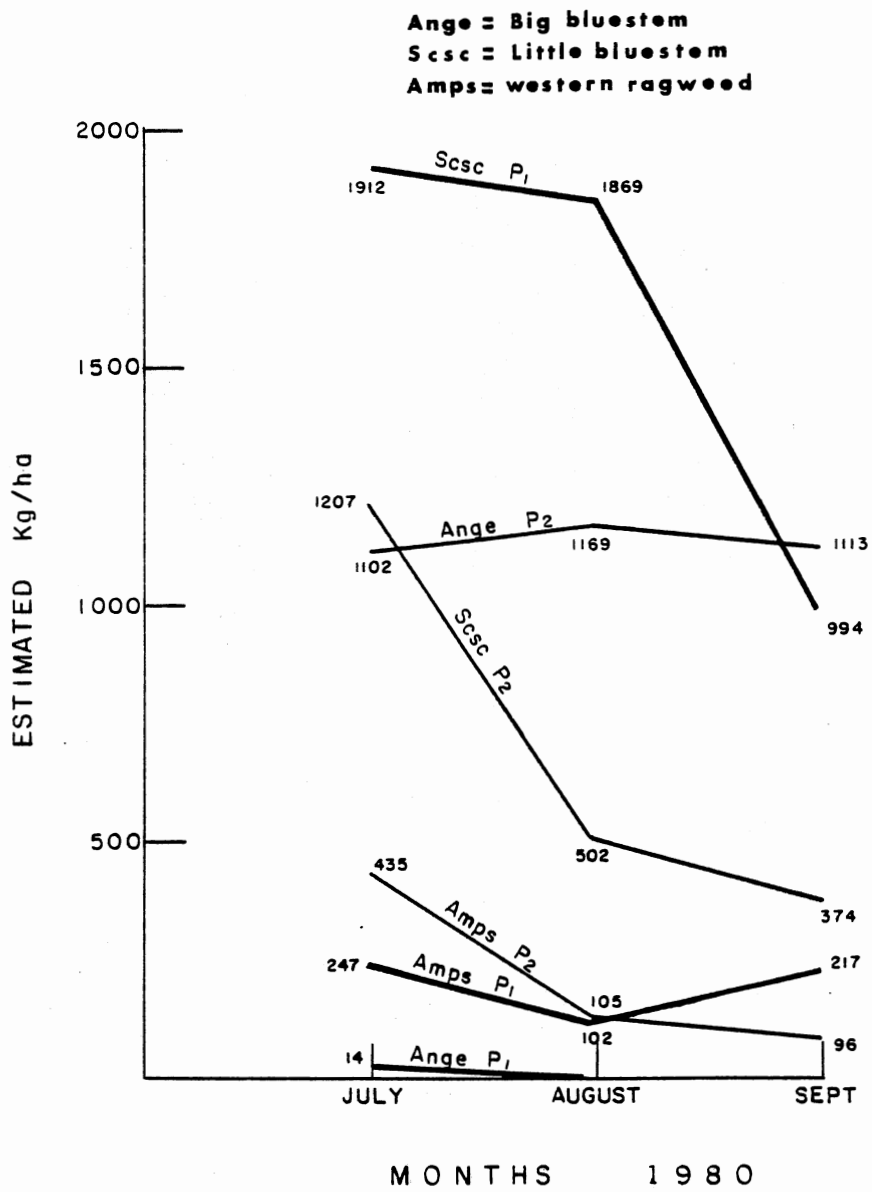

Fig. 8. Total production (kg/ha dry weight) of selected plant species of Pasture 1 (P_1) and Pasture 2 (P_2) in study area, Payne Co., Oklahoma 1980.

APPENDIX D

BOTANICAL COMPOSITION OF STEER DIETS

Table 13. Percent plant species composition of steer diets grazing two loamy prairie range sites at different stages of succession.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Grasses						
Big bluestem	9.5	9.7	1.0	33.9	25.8	34.1
Blue grama	6.0	8.1	5.0	4.9	15.4	9.3
Bristle foxtail	1.6	NS[1/]	NS	0.5	NS	NS
Buffalograss	2.3	NS	NS	1.5	NS	NS
Indiangrass	2.1	3.8	2.8	10.7	2.8	1.6
Japanese brome	1.9	NS	0.6	NS	0.6	NS
Little bluestem	36.7	30.4	31.1	7.4	12.4	2.6
Plains lovegrass	2.5	NS	13.8	0.2	NS	NS
Purple top	0.5	NS	NS	0.2	NS	2.1
Sand dropseed	NS	NS	NS	NS	NS	0.1
Scribner's panicum	2.7	0.4	6.7	0.2	1.6	20.1
Sideoats grama	0.4	12.7	1.4	3.9	3.7	0.4
Silver beardgrass	1.8	2.4	3.6	8.9	4.5	0.4
Switchgrass	3.1	0.8	2.1	1.7	0.3	0.3

Table 13. Continued.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Tall dropseed	0.9	0.2	0.5	0.6	0.4	2.5
Threeawn	5.6	2.9	12.1	0.5	3.5	1.3
Windmill-grass	NS	NS	NS	NS	NS	1.3
Forbs						
Croton	1.6	0.7	NS	1.0	NS	NS
Daisy fleabane	1.1	0.2	2.2	0.5	0.3	10.6
Dotted gayfeather	0.4	0.1	NS	1.0	NS	NS
Heath aster	NS	0.2	NS	4.2	0.9	NS
Ironweed	1.7	1.4	4.0	2.3	1.5	4.3
Lespedesa spp.	3.0	1.6	NS	1.2	NS	NS
Louisiana sagewort	NS	2.0	1.8	5.6	19.1	7.2
Showy partridgepea	3.6	NS	NS	1.9	1.2	NS
Silverleaf nightshade	3.3	4.7	4.0	2.5	2.6	NS
Tick clover	0.5	10.9	0.8	-	0.5	NS
Western ragweed	4.1	1.9	4.5	2.8	3.0	1.5
Western yarrow	0.7	0.2	NS	NS	NS	NS

Table 13. Continued.

	Pasture 1			Pasture 2		
	July	August	September	July	August	September
Wild alfalfa	0.4	1.3	0.2	0.6	NS	NS

1/ NS = not sampled

Table 14. Botanical composition of steer diets: pooled means across months (percent in diet).

	Pasture 1	Pasture 2
Grasses		
Big bluestem	6.8a[1/]	31.6b
Blue grama	6.4a	9.6a
Indiangrass	2.9a	5.2a
Little bluestem	32.7a	7.2b
Plains lovegrass	5.5a	0.1b
Scribner's panicum	3.3a	7.7a
Sideoats grama	4.8a	2.6a
Silver beardgrass	2.6a	4.6a
Threeawn	6.9a	1.7b
Forbs		
Daisy fleabane	1.2a	4.0b
Ironweed	2.3a	2.8b
Western ragweed	3.5a	2.4a
Sagewort	1.3a	10.1b
Silver nightshade	4.0a	1.7a
Tick clover	4.0a	0.1a

1/ Means with the same letter in rows are not significantly different ($P<.05$).

Table 15. Botanical composition of steer diets: pooled means across pastures (percent in diets).

	July	August	September
Grasses			
Big bluestem	21.7a[1/]	17.1a	17.6a
Blue grama	5.5a	11.4a	7.2a
Indiangrass	6.4a	3.3ab	2.2b
Little bluestem	22.0a	22.2a	16.9a
Plains lovegrass	1.4ab	0.0b	6.9a
Scribner's panicum	1.5a	0.9b	13.4b
Sideoats grama	2.2a	8.6b	0.8a
Silver beardgrass	5.6a	3.4ab	2.0b
Threeawn	3.1a	3.2a	6.7a
Forbs			
Daisy fleabane	0.8a	0.3a	6.4b
Ironweed	2.0a	1.4a	4.1a
Western ragweed	3.4a	2.4a	3.0a
Sagewort	2.8a	9.8a	4.5a
Silver nightshade	2.9a	8.8a	2.0a
Tick clover	0.2a	6.1b	0.4ab

1/ Means with the same letter in rows are not significantly different ($P<.05$).

Table 16. Relative preference indices[1/] of steer diets on two loamy prairie range sites at different stages of succession.

	Pasture 1			Pasture 2		
	July	August	Sept	July	August	Sept
Grasses						
Big bluestem	1.9	-	-	0.9	0.4	0.6
Indiangrass	-	1.0	-	-	2.2	0.3
Little bluestem	0.5	0.4	0.4	0.2	0.5	0.1
Scribner's panicum	1.4	0.1	0.6	0.1	0.4	9.1
Sideoats grama	-	-	2.5	3.9	1.1	-
Silver beardgrass	1.1	2.7	0.4	2.0	-	-
Threeawn	-	1.0	0.7	-	-	-
Forbs						
Louisiana sagewort	-	0.4	-	18.7	10.6	-
Western ragweed	0.5	0.5	0.4	0.2	0.6	0.3

1/ Relative Preference Index = $\frac{\text{\% Diet composition}}{\text{\% Range composition}}$

(Krueger 1972)

APPENDIX E

NUTRITIVE VALUE OF AVAILABLE VEGETATION ON STUDY AREA

Table 17. Nutritive value of available vegetation: pooled means across months (percent dry weight).

	Pasture 1	Pasture 2
Crude Protein	4.0a[1/]	3.9a
Acid Detergent Fiber	47.9a	46.4a
Acid Detergent Lignin	7.9a	7.6a
Digestibility	40.5a	41.8a

1/ Means with the same letter in rows are not significantly different (P<.05).

Table 18. Nutritive value of available vegetation: pooled means across pastures (percent dry weight).

	July	August	September
Crude Protein	3.7a[1/]	3.9b	4.2b
Acid Detergent Fiber	46.4a	46.7a	48.3a
Acid Detergent Lignin	6.8a	7.9a	8.5b
Digestibility	49.4a	40.8b	33.3c

1/ Means with the same letter in rows are not significantly different (P<.05).

APPENDIX F

NUTRITIVE VALUE OF STEER DIETS

Table 19. Nutritive value of steer diets: pooled means across months (percent dry weight).

	Pasture 1	Pasture 2
Crude Protein	5.6a[1/]	5.3a
Acid Detergent Fiber	47.6a	45.8a
Acid Detergent Lignin	9.9a	9.8a
Digestibility	48.1a	51.7b

1/ Means with the same letters in rows are not significantly different (P<.05).

Table 20. Nutritive value of steer diets: pooled means across pastures (percent dry weight).

	July	August	September
Crude Protein	5.5a[1/]	5.1a	5.8a
Acid Detergent Fiber	48.8a	46.6a	44.7a
Acid Detergent Lignin	9.7a	9.6a	10.2a
Digestibility	59.7a	47.6b	42.5c

1/ Means with the same letters in rows are not significantly different (P<.05).

VITA

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Master of Science

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