Botanical Composition of Central Texas Rangeland Influences Quality of Winter Cow Diets

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Abstract

Winter diets of dry, pregnant cows were investigated on a Blackland range site in mid- and high-poor condition. Under similar amounts of available forage, an advanced successional stage, i.e. change in species composition within a range condition class, resulted in increased dietary protein (CP), digestible organic matter (DOM) and phosphorus (P). A slightly larger abundance of cool-season grasses on the pasture in higher poor condition allowed the animals to select a diet adequate in CP, DOM and P approximately 3 weeks earlier in spring than on the mid-poor condition pasture.

The typical wintering program of Central Texas producers involves concentration of livestock in rangeland pastures that have good winter accessibility. Stocking pressure is high and the animals derive most of their required nutrients from hay, protein supplement, and free choice minerals. The result is a severely overgrazed and trampled pasture in poor range condition. The severity of this problem can be lessened with minor changes in successional status of the rangeland pasture.

The complex relationships between range condition and animal nutrition must be recognized by the range manager interested in animal production (Gates 1972). Range condition is defined as the current productivity of a range relative to what a particular range is naturally capable of producing (Kothmann 1974). Gates (1972) has noted that ambiguities can arise when using the term in reference to vegetation quality or quantity. Changes in ecological condition of rangelands represent changes in both species present and/or biomass produced. An increase in range condition generally represents an increase in quantity and/or quality of forage available to the grazing animals. Studies have shown that levels of biomass can mask the affect of species composition on dietary quality due to greater animal selectivity of plant parts (Goebel and Cook 1960; Cook et al. 1965; Kothmann 1968). However, Goebel and Cook (1960) found diets to vary between condition classes. Demarchi (1973) noted that poor condition sites tended to be higher in total protein, cellulose, and phosphorus.

Little information exists on quality differences as affected by successional status within a given condition class. Generally, when production values are similar between two areas, dietary quality is dependent upon species composition. Therefore, intra-class range condition differences due to successional status of a given range site should have some impact on diet quality of animals. It was the purpose of this paper to determine the influence of changes in species composition on winter diets of cows grazing a summer-deferred, poor condition Blackland range site (U.S. Dep. Agr. 1976) in central Texas.

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Study Area and Procedures

The study was conducted during the winter of 1976-1977 (December 17–April 1) on the Texas Agricultural Experiment Station Research Center at McGregor, Tex. Two, 44-hectare pastures with 4-hectare subdivisions in mid-poor and high-poor ecological condition were utilized as study sites. The soil series common to both pastures was a Houston black clay, which forms a Blackland range site (U.S. Dep. Agr. 1976). Average annual precipitation for the area is 83.9 cm (33 inches) (NOAA 1976). Peak rainfall occurs in May and September. Winter precipitation for the study period averages 34 cm (13.4 inches). The station recorded 46 cm (18.1 inches) during the study period.

In its pristine condition, this range site supported a true prairie vegetation. Little bluestem (*Schizachyrium scoparium*) dominates the plant community at climax with yellow indiangrass (*Sorghastrum nutans*) and big bluestem (*Andropogon gerardii*) as subdominant species. As retrogression occurs, silver bluestem (*Bothriochloa saccharoides*) and meadow dropseed (*Sporobolus asper*) are initial increasers. If continuous, heavy use occurs, buffalograss (*Buchloe dactyloides*), purple threeawn (*Aristida purpurea*), Texas grama (*Bouteloua rigidiseta*) and Halls panicum (*Panicum hallii*) will come to dominate the site (U.S. Dep. Agr. 1976).

Species composition was determined immediately after the first killing frost in late November 1976. Species composition was determined using a pace transect method (Stuth and Dahl 1974). Five, 100-point transects were randomly located in each pasture.

Both pastures were deferred during the growing season and stocked at approximately 3.25 ha/animal units (au) from December 15 to April 1. Access was provided to the subdivision in each pasture at all times except during diet collection periods. To monitor stocking pressure between subdivisions, available above-ground biomass was determined at each collection period. All vegetation within 20, 0.25-m^2 plots was clipped at ground level and dried at 100°C for 48 hours.

The dietary sampling technique was similar to that described by Cook (1964) and Van Dyne and Torell (1964). Four, esophageally cannulated cows were grazed approximately 1 hour in the early morning during six collection periods from December 17, 1976 to April 1, 1977. The cows were fasted approximately 12 hours prior to sample collections. Sample collections for the two pastures were made on consecutive days by rotating the cows. The cows were maintained throughout the study on TAM wintergreen (*Phalaris stenoptera*) and native pastures located on the McGregor Research Center.

Table 2. Mean standing crop (kg/ha) and associated confidence intervals of forage on mid-poor and high-poor condition pastures on a Blackland range site grazed during the winter.

Date	Mid-poor	C.I.	High-poor	C.I.
	Condition Class			
December 17, 1976	2030[1]	±374	2242	±318
January 11, 1977	1656	±185	1698	±272
January 28, 1977	1492	±288	1300	±191
February 18, 1977	1012	±202	1216	±255
March 14, 1977	980	±177	764	±156
April 1, 1977	628	±154	658	±161

[1] Standing crop did not differ significantly between pastures at any sampling date ($P<0.05$).

Forage Availability

To evaluate nutritional differences it was critical that stocking pressures be maintained as near equal as possible between pastures. Standing crop of forage was maintained at reasonably comparable levels throughout the study (Table 2). Thus, compositional effects on diets were reflected while biomass differences were minimal. The pattern of utilization obtained in this study is typical of utilization on ranches in central Texas.

Dietary Quality

Dietary Crude Protein

Crude protein was generally higher in the forage ingested by animals grazing the high-poor condition pasture (Table 3). If 5.9% and 9.2% crude protein are used as required levels for maintenance of a 1000-lb pregnant or lactating cow, respectively (NRC 1976), then only the period from mid-December to mid-January was deficient in the high-poor condition pasture. Deficient CP levels were extended into February on the mid-poor condition pasture. Available forage was assumed not to be limited.

A rapid increase in dietary protein was observed during February, when cool-season species began active growth. The high-poor condition pasture exhibited the response 3 weeks earlier than did the mid-poor condition pasture. Initiation of growth of cool-season species depends primarily on winter and early spring temperatures. The significantly larger percentage of both perennial and annual cool-season grasses in the high-poor condition pasture probably accounted for the earlier increase in CP observed there (Table 1). Crude protein content of the diet averaged 2.5% higher for the entire sampling period in the high-poor condition pasture as compared to the mid-poor condition pasture ($P<0.05$). All CP values were significantly different between pastures and among dates ($P<0.05$).

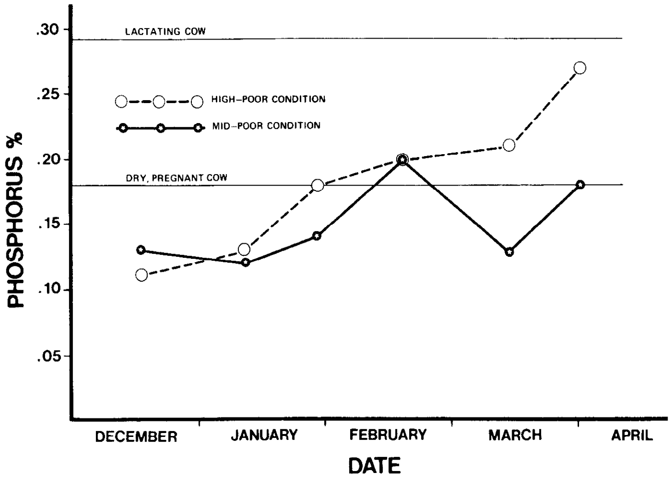

Fig. 2. *Phosphorus (%) in diets of cows on mid-poor and high-poor condition pastures of a Blackland range site grazed during the winter of 1976-77. Dietary phosphorus requirement for lactating and dry, pregnant cows is provided.*

Digestible Organic Matter

Percent DOM was generally higher in the high-poor condition pasture during mid-winter (Table 3). DOM levels were lowest in diets for both pastures in February, a period with low standing crop and little growth of cool-season plants. The greatest differences in DOM between pastures were in March and April, a period when the spring "flush" of cool-season grasses, primarily Japanese brome (*Bromus japonicus*), little barley (*Hordeum jubatum*), rescuegrass (*Bromus unioloides*) and Texas wintergrass, occurred. Average DOM was 10% higher in the high-poor condition pasture than in the mid-poor condition pasture ($P<0.05$). All DOM values were significantly different between pastures for each sampling date ($P<0.05$).

Phosphorus

Phosphorus levels were similar between pastures until mid-January (Fig. 2). After February, phosphorus content of the diets was higher in the high-poor condition pasture. Dietary phosphorus levels declined during March on the mid-poor condition pastures. It appeared that utilization of cool-season species exceeded growth, thereby, reducing their contribution to the cows' diets. Differences in dietary phosphorus were most evident in March and April.

Table 3. Percent dietary crude protein (CP) and percent digestible organic matter (DOM) of mid-poor and high-poor condition pastures on a Blackland range site grazed during the winter.

Date	CP High-poor	C.I.	CP Mid-poor	C.I.	DOM High-poor	C.I.	DOM Mid-poor	C.I.
December 17, 1976	6.07	±0.11[1,2]	4.67	±0.06	58.4cd	±0.3[1,3]	51.9f	±0.5
January 11, 1977	5.65	±0.03	6.42	±0.04	60.0c	±0.4	55.3e	±0.9
January 28, 1977	9.29	±0.06	5.28	±0.08	55.7e	±0.5	57.8d	±0.6
February 18, 1977	8.37	±0.05	8.50	±0.05	45.9g	±1.4	42.7h	±3.8
March 14, 1977	15.24	±0.04	8.77	±0.04	71.2b	±5.3	45.4g	±1.3
April 1, 1977	16.04	±0.33	11.81	±0.07	76.3a	±2.4	55.2e	±0.6
Mean	10.11		7.58		61.3		51.4	

[1] All values are significantly different between pastures ($P<0.05$).
[2] All values are significantly different among dates × pastures ($P<0.05$).
[3] DOM values followed by a common letter are not significantly different (<0.05).

Fig. 1. *Esophageally cannulated cows grazing the mid-poor condition pasture with the high-poor condition pasture in background.*

Forage samples were oven-dried at 60°C for 48 hours and ground in a Wiley mill to pass a 1-mm screen. Crude protein (CP) was determined using micro-Kjeldahl procedures as outlined by the Association of Official Agricultural Chemists (1960). Digestible organic matter (DOM) was determined using in vitro digestion followed by Neutral Detergent Fiber digestion as outlined by Ellis (1970). Phosphorus (P) content of the diet samples was determined in duplicate by the forage testing division of the Texas Agricultural Analytical Services using atomic emissions spectrophotometry (AOAC 1975). An attempt to reduce salivary P contamination of the diet samples was made by hand squeezing to remove saliva. Hoehne et al. (1967) reported P contamination nearly eliminated in squeezed samples. Phosphorus values represent averages of composited samples by date over animals analyzed in duplicate.

Chi-square analysis was used to determine significant difference in species composition between pastures. The Student's *t*-test was used to evaluate differences in available biomass between pastures. A two-way analysis of variance was used to test differences in CP and DOM ($O<0.05$). Means were compared using Duncan's multiple range test (Bruning and Kintz 1968).

Results and Discussion

Species Composition

Compositional analysis of the vegetation indicated significant species differences occurred between pastures (Table 1). However, when range condition was determined from Soil Conservation Service guides, the pastures were found to have identical scores. The determination of mid- or high-poor condition was based upon presence and amounts of dominant and subdominant species in relation to known successional stages as previously described. The high-poor condition pasture was dominated by meadow dropseed with Texas wintergrass forming a strong subdominant. Both species were significantly higher in amounts present than on the mid-poor condition pasture. Other subordinate species in the high-poor condition pasture included buffalograss, common Bermudagrass (*Cynodon dactylon*), purple threeawn, and cool-season annual grasses. Only the annual cool-season grasses had a greater abundance in the high-poor condition pasture than in the mid-poor condition pasture.

Buffalograss was the dominant species in the mid-poor community, with common Bermudagrass, Texas wintergrass, Halls panicum, meadow dropseed, and purple threeawn being important subordinants. Only purple threeawn did not differ significantly between pastures. Twenty-five percent of the composition in the high-poor condition pasture consisted of cool-season species which provided green forage during the winter while cool-season species constituted only 17% composition in the mid-poor condition pasture.

Table 1. Species composition (%) of mid-poor and high-poor condition summer deferred pastures on a Blackland range site grazed during the winter (December 17, 1976).

Species		Condition Class	
Common name	Scientific name	Mid-poor	High-poor
Buffalograss	*Buchloe dactyloides*	31	7**
Common Bermudagrass	*Cynodon dactylon*	14	4**
Texas wintergrass	*Stipa leucotricha*	13	18*
Halls panicum	*Panicum hallii*	11	1**
Meadow dropseed	*Sporobolus asper var. drummondii*	11	51**
Purple threeawn	*Aristida purpurea*	10	8ns
Silver bluestem	*Bothriochloa saccharoides*	2	1†
White tridens	*Tridens albescens*	2	4†
Windmillgrass	*Chloris verticillata*	1	3†
Texas grama	*Bouteloua rigideseta*	<1	—†
K.R. bluestem	*Bothriochloa ischaemum* var. *songaricus*	2	—†
Annual cool-season grasses		3	6*
Annual cool-season forbs		<1	1†
Total cool-season species		17	25
SCS Range Condition Score		15	15

*—P<0.05
**—P<0.01
ns—not significant
†—not analyzed (<5% composition)

Phosphorus levels were deficient for a non-lactating, pregnant cow (NRC 1976) in both pastures until late January. However, neither pasture would have met the phosphorus needs of lactating cows (0.28%) throughout the study period. By early April both pastures were providing adequate phosphorus levels for dry, pregnant cows (0.18%).

Conclusions

CP, DOM and P in diets of fistulated cows were influenced by differences in species composition on two ranges differing in condition, even though standing crop of forage was approximately the same. The 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. The important role of cool-season species was evident in these findings. A small increase (8%) in contribution of cool-season species to a plant community could mean a 3 to 4 week shorter supplementation period for protein, energy, and phosphorus. The findings would be applicable to a poor condition Blackland range site.

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