Botanical Composition of Summer Cattle Diets on the Wyoming High Plains

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Abstract

Botanical composition of the summer diet was determined for cattle grazing semiarid grassland in southeastern Wyoming. Diet samples from beef cattle with esophageal fistulas were examined using a microscope technique. Western wheatgrass was the most abundant single species. Western wheatgrass, blue grama, sedges, and needleandthread made up 70% of the diet. Western wheatgrass and needleandthread were found in the diet at proportions greater than the relative amount available; conversely, blue grama was found at proportions less than the relative amount available.

In recent years many studies have been conducted on the diets of domestic and wild animals. Theurer et al. (1976) reviewed and evaluated the methods of collection and botanical analyses of domestic livestock diets. They also tabulated the results of diet composition on western rangelands from several locations.

Hansen and Gold (1977) found that almost half the diet of cattle in northeastern Colorado was composed of western wheatgrass (*Agropyron smithii* Rydb.) and sedges (*Carex* spp.) on a yearlong basis. Vavra et al. (1977), working in the same area, reported that blue grama (*Bouteloua gracilis* (H.B.K.) Lag. ex Griffiths) was the most abundant constituent of the summer cattle diet but it ranked eleventh in preference. Western wheatgrass, sedges and needleandthread (*Stipa comata* Trin. & Rupr.) had preference ratings of second, sixth, and seventh, respectively. Kautz and Van Dyne (1978), who also worked in northeastern Colorado, compared the diets of cattle, as well as bison, sheep, and pronghorn antelope, under light and heavy stocking rates and winter and summer seasons. Blue grama, western wheatgrass, and needleleaf sedge (*Carex eleocharis* Bailey) were the major species in the yearlong diet of cattle. Calculated preference ratios indicated that cattle selected for forbs and cool-season grasses and selected against warm-season grasses.

Although specific animals have their preference for different species, diet is also affected by consumer food requirement, food availability and selectivity. Selectivity is low for a hungry animal but increases with increasing satiation (Ellis et al. 1976).

Most authors have reported diets on a seasonal or monthly basis but have not shown the weekly pattern. We initiated this study to determine the kinds, relative amounts, and weekly patterns of species in summer cattle diets on native prairie of southeastern Wyoming.

Study Area and Methods

The study area was two native semiarid grassland pastures at the High Plains Grasslands Research Station northwest of Cheyenne, Wyo. The topography consisted of rolling hills at an elevation of 1890 to 1950 m. The 37-year (1941-1977) average annual precipitation was 37 cm. About 44% of the moisture usually occurred during the months of April through June, while 22% fell in July and August. The frost-free growing season averaged 132 days (U.S. Dep. Commerce 1970-1977). During the study, precipitation averaged 81% of normal. Forage production, measured by clipping to ground level in late August of each year, averaged 988 kg/ha for both pastures.

Hereford and Hereford cross-bred cattle grazed the lightly stocked 295 ha pasture at an average stockng rate of 0.75 AUM/ha from mid May to November or December. The heavily stocked 192 ha pasture was grazed at an average rate of 1.39 AUM/ha from the end of June through October. Animals from the latter pasture were on improved pastures during the spring and fall. Diet sampling was done with esophageal-fistulated cattle. Fistulas were established by the procedure of Van Dyne and Torell (1964). Fistulated animals were 1- or 2-year-old heifers in 1975. Replacements in 1976 and 1977 were 1- and 2-year-old steers. One animal was present all 3 years, another for 2 years. When cattle were on the native range in 1975, dietary forage samples were obtained biweekly from two or three animals per pasture. Early morning and late afternoon collections were made on two consecutive days, respectively, of the same week.

In 1976 the sampling regime was changed to weekly sampling. Samples were collected early morning one week and late afternoon the next. The two samples which were collected during one week from each animal were combined to obtain samples of adequate size for analyses and to monitor any changes which may have occurred from one week to another. Sampling procedure was the same in 1977. Each pasture was sampled by four cattle in 1976 and three or four cattle in 1977. Animals were fasted for 12 hours before collections, then harnessed with collection bags and allowed to collect at will for 30 to 45 minutes.

Diet samples collected from the first of June through the middle of September were analyzed. Fifty-seven, 105, and 72 diet samples were obtained for 1975, 1976, and 1977, respectively. Samples were dried, ground, and mounted on microscope slides as described in Sparks and Malechek (1968). Slides were viewed through a phase contrast microscope at 125 × magnification. Fragments were located by scanning back and forth lengthwise on the slide. Fifty fragments per slide per animal per sample were identified in 1975 and 1977; 25 fragments were identified in 1976. Fragments were identified by comparing them to photomicrographs of a reference collection (Howard and Samuel 1979).

Data were analyzed using unbalanced analysis of variance procedures (Harvey 1975). Pasture and year effects were tested by the variation among animals while the repeated measure effects of weeks and time-of-day were tested by the within-animal error term.

Sixteen different sets of "known" slides were made from ground herbage samples. The identity and percent weight of the three to six species used in each slide were not known to the identifier. The fragments on these slides were identified along with the animal

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Table 1. Regression equations for percent fragments (X) on percent weight (Y) on slides of known plant composition.

Species	Regression equation	r^2	n
Western wheatgrass	Y = 11.809 + .470X	0.83	14
Blue grama	Y = .831 + .789X	0.74	11
Sedges	Y = 2.940 + .549X	0.90	10
Needleandthread	Y = 1.807 + 1.357X	0.92	10

samples. Data from "known" slides were used to obtain regression equations (Table 1) to estimate percent weight of the diet from least square means of percent fragments for western wheatgrass, blue grama, sedges and needleandthread. All forbs were grouped together for purposes of analysis because each species comprised only a small portion of the diet; other miscellaneous grasses were also grouped. Conversion equations were not developed for forbs and other grasses because of the variable botanical composition of these two groups. The forb and other grass groups were assumed to make up the remainder of the diet, after the four major diet species were adjusted to a weight basis.

Results and Discussion

Botanical Composition of the Diet

Western wheatgrass was the species found most often in the diet samples. For the 3 years, average weekly values of western wheatgrass ranged from 30 to 41% by weight of the diet (Table 2). The

Table 2. Average weekly and yearly percent weight of the four major species in cattle diets for 1975 through 1977; pastures combined.

		Species			
Month	Week	Western wheatgrass	Blue grama	Sedges	Needleand-thread
June	1	33 cdef[1]	4 ef	9 a	25 ab
	2	35 bcdef	2 f	10 a	26 a
	3	30 f	5 def	10 a	23 ab
	4	32 ef	7 cdef	11 a	19 abc
	5	41 a	6 def	7 a	12 cde
July	6	32 ef	5 def	12 a	18 bc
	7	34 cdef	14 ab	10 a	14 cd
	8	37 abcde	14 ab	10 a	7 de
	9	34 cdef	18 a	11 a	7 de
August	10	37 abcde	16 ab	10 a	8 de
	11	39 abc	11 bcd	12 a	8 de
	12	39 abc	16 ab	9 a	7 de
	13	41 ab	10 bcde	9 a	8 de
	14	38 abcd	13 abc	8 a	12 cde
Sept.	15	41 ab	10 bcde	9 a	5 e
	16	39 abc	12 abc	7 a	8 de
Year					
1975		32 z	11 x	9 x	16 x
1976		41 x	9 x	10 x	8 y
1977		37 y	11 x	10 x	15 x

[1]Within species, means followed by the same letter are not significantly different ($P<.05$) according to Duncan's multiple range test.

significantly higher amount of this species in the diet during the last week in June (week 5) may have been a response to a specific phenological stage because western wheatgrass headed at about this time. This increase was present both years that diet samples were taken weekly. Cook and Harris (1968) reported a total protein content of 15% in western wheatgrass during the boot stage which was higher than that of the 4th leaf or seed stages. The yearly means were significantly different for the three years; western wheatgrass in the diet was greatest in 1976 and least in 1975 (Table 2). There was no difference in dietary composition of western wheatgrass between the two pastures. Hart and Balla (1982), who used time lapse photography to study grazing on individual tillers of western wheatgrass on the same pastures during 1976 and 1977, also found that forage removal from individual tillers was not influenced by stocking rate.

There was a significant increase in dietary composition of blue grama from the first to the second week in July (Table 2, week 6-7). Streeter et al. (1968) also reported a sharp increase of blue grama in the diet during July at a site 130 km northeast of Cheyenne. Hansen and Gold (1977), who worked 40 km southeast of Cheyenne, reported that blue grama averaged 5% of the diet during April and May and then increased to an average of 12% during the June through August period and remained near that level September through March. Blue grama was the only major diet component which showed a difference in dietary composition between pastures (Fig. 1). The significant increase in dietary blue grama (week 7) was delayed 1 week in the heavily stocked pasture on which grazing was started 5 to 6 weeks later than on the lightly stocked pasture. The increase in blue grama in August in the diet from the heavily stocked pasture was significant only during the last week in August. This late season increase of dietary blue grama was probably related to the higher stocking rate on that pasture. Vavra et al. (1977) reported more blue grama in the diets of cattle on heavily used pastures than on lightly used pastures.

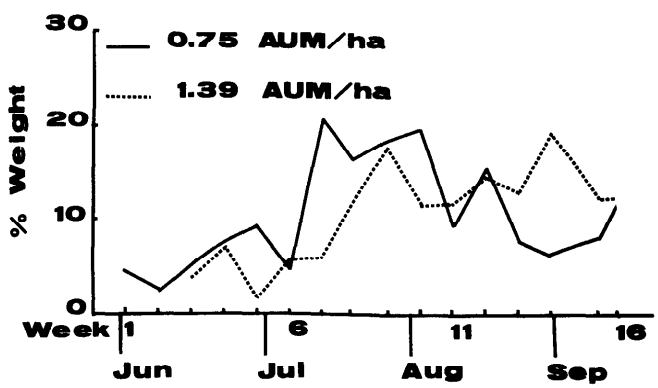

Fig. 1. *Three-year average weekly blue grama percent weight in cattle diets for two native pastures.*

Sedges included needleleaf sedge, which was the major sedge species, and threadleaf sedge (*Carex filifolia* Nutt.). The amount of sedges in the diet remained nearly constant throughout the season and between years (Table 2), and did not differ significantly between pastures.

The amount of needleandthread in the diet differed significantly between weeks and years (Table 2). Collections made in June were mostly higher in needleandthread content than during the rest of the summer. The average amount of needleandthread in the diet was lower in 1976 than in the other 2 years. Between years, there were significant differences during 3 weeks in June and 1 week in August (Fig. 2). The amount of needleandthread was lower in the first 2 weeks in June of 1976 than in the same month the other 2 years. For week 4, more needleandthread was seen in the diet in 1975 than in the other years. In 1975 there was also more dietary needleandthread for week 14 than in 1976, while the amount in the diet in 1977 was intermediate and not significantly different from that in either of the other years. Some of this variation in amount of needleandthread may be accounted for by the uneven distribution of the species on the native range. Rauzi et al. (1976) reported that the weight of needleandthread varied from 0 to 53% of the total phytomass on these pastures.

All grass species other than western wheatgrass, blue grama and needleandthread were grouped together into 'other grasses' which also included unknown graminoids. The number of fragments in the other grass group showed significant differences between years, pastures, and weeks but these were associated with an unknown

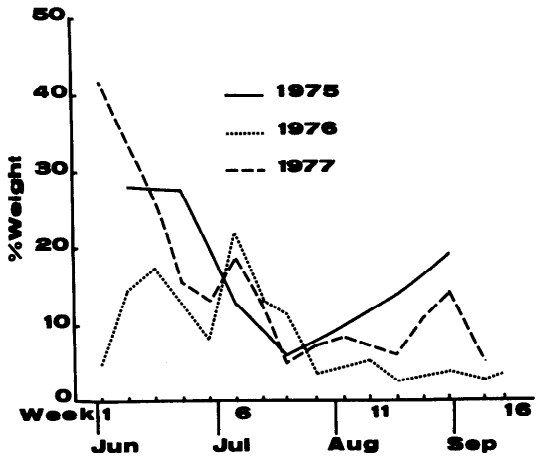

Fig. 2. *Yearly variation in needleandthread content of cattle diets.*

grass-like plant which was seen only in the diet in some collections in 1975 in the heavily stocked pasture. This plant must have been eaten when the animals in this pasture watered out of an irrigation lake which they used only during this year. This plus other confounding factors eliminated any valid conclusions which could be drawn from the data in this group. Forbs and other grasses were not included in Table 3 because they were not converted to percent weight. Both groups contained several species, and reliable regression equations could not be developed.

Table 3. Percent weight for standing crop and cattle diet content. Data are means for 1975 through 1977.

Species	August standing crop, ungrazed	Diet		
		June	July	August
Western wheatgrass	18	33	34	40
Blue grama	46	5	13	13
Sedges	14	9	11	10
Needleandthread	10	20	11	9

Variation Between Sampling Times and Dates

Data from 1975 were also analyzed to determine significant differences between the early morning and late afternoon sampling times. Significantly more blue grama was seen in the afternoon collections (13%) than in the morning collections (9%) when averaged over the summer. There was more blue grama in the afternoon collections in mid and late August (Fig. 3). Van Dyne and Heady (1965) reported that cattle and sheep in the California annual range grazed more grasses and fewer forbs in the afternoon than in the morning.

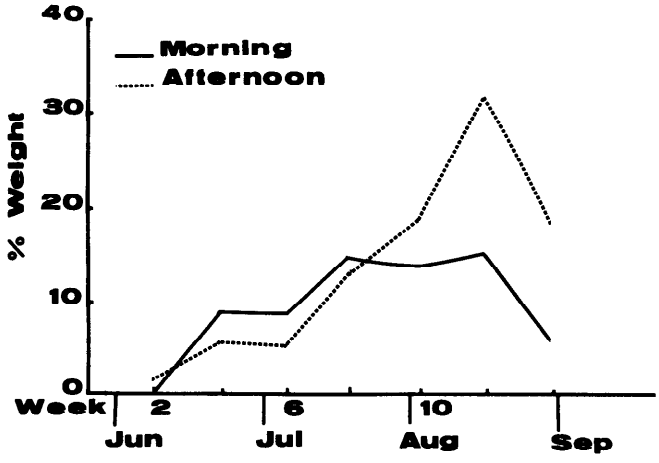

Fig. 3. *Blue grama content of cattle diets for early morning and late afternoon collections during 1975.*

There was a significant time-of-day by week interaction for needleandthread for only one sample period, week 2. Although the amount of needleandthread in the early morning collection (50%) was much higher than in the late afternoon collection (8%) for this period, this difference may not be real because of the uneven distribution of this species in the pastures. Time-of-day did not significantly affect percentages of western wheatgrass nor sedges in the diet.

The average summer diet pattern, showing the relative amounts of the various species, appears in Figure 4. Significant differences within these species or groups have been discussed in detail previously. Here, however, a contrasting pattern of dietary composition of blue grama and needleandthread was visible. The correlation between amounts of these two species in the diet was negative and significant ($r = -.81$).

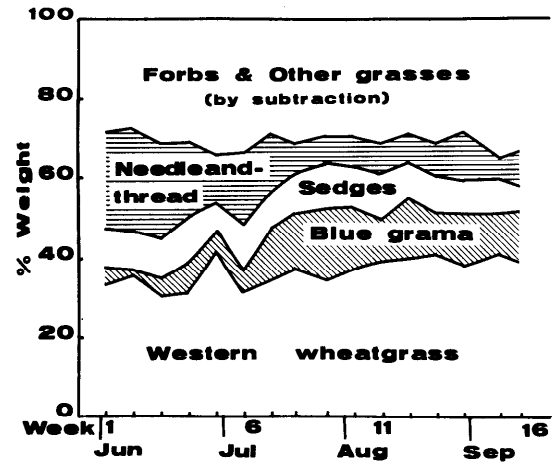

Fig. 4. *Average diet of cattle grazing on semiarid grassland during 1975 through 1977.*

When availability of each species, expressed as percent of toal forage production, was compared with the average percent in the diet, western wheatgrass was selected for, while blue grama was selected against (Table 3). Needleandthread appeared to be selected for in June. These preferences agree with findings of Vavra et al. (1977). Kautz and Van Dyne (1978) reported that cattle in northeastern Colorado selected native cool-season grasses; western wheatgrass, needleleaf sedge, and needleandthread made up over 90% of this group. Cattle selected against warm-season grasses which included about 80% blue grama.

Conclusions

Western wheatgrass was the predominant species in the summer diet of cattle grazing on semiarid grassland in southeastern Wyoming. Western wheatgrass, blue grama, sedges, and needleandthread accounted for about 70% of the diet; various forbs and other grasses made up the remainder. Initially western wheatgrass was about one-third of the diet but increased to about two-fifths. Needleandthread represented about 25% of the diet in early June, declined to about 8% in mid July and remained near that level. Blue grama was about 5% of the diet until early July but then increased to nearly 15% in July and then slowly declined to about 10% by September. Dietary blue grama was apparently influenced by grazing pressure. Also there was more blue grama in the afternoon collections than in the morning collections. Sedge usage was relatively constant during the summer. Western wheatgrass and needleandthread were preferred diet species, while blue grama was

selected against. These species were selected for or against when the collecting animals were hungry and thus the least selective in their diet. Therefore, these preferences should hold true or perhaps intensify throughout the grazing period.

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