Diets of Cattle in North Central South Dakota

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Abstract

This study was conducted over a two year period during the summer months on the Grand River National Grasslands near Lemmon South Dakota on a 2,510 ha pasture to determine cattle diets. Cattle feces were collected monthly near each of 8 permanent water tanks located throughout the pasture. Microhistological analysis of cattle feces was used to identify and quantify diets by plant species. Eight common plant species comprised the greatest portion of the diet. Grasses and grass-like plants accounted for 84 percent to 99 percent of the diets with sedges common in spring (79%) and early summer (53%). Key forage species were, sedges (*Carex* spp), blue grama (*Bouteloua gracilis*), needle and thread (*Hesperostipa comata*) and green needlegrass (*Nassella viridula*) that comprised 82 percent of the diet. These plants are key forage species for monitoring seasonal grazing on the grasslands. Forbs ranged from less than 1 percent to 14 percent. Shrubs were a minor component of the diet making up less than 1 percent. Similarity indices changed throughout the season and ranged from 0 to 99 percent, indicating that some plants were highly selected or avoided by cattle (low similarities) and other plant species were consumed in the same proportions as available on the grassland. Rank order correlation indicated seasonal selectivity with an overall correlation of 0.75.

Key words: diets, livestock, northern Great Plains, monitoring, forage

Introduction

Quantitative information about livestock diets and selectivity for forage plants is essential for efficient and prudent management of our rangeland resources on the northern Great Plains. Diets provide useful information for resource managers to allocate forage resources while maintaining long-term productivity and sustainability of the grasslands.

Hart et al. (1983) reported on cattle diets in Wyoming. Vavra et al. (1977), Reppert (1960), and Walker et al. (1981) have reported on cattle diets in Colorado with few species common to rangelands of the Dakotas. Hirschfeld et al (1996) reported that graminoids made up most of the diet, ranging from 72 percent to 99 percent over a two-year period in central North Dakota. Uresk (1986) in western South Dakota reported that six plants made up 82 percent of the food items. Volesky et al. (2007) found that needle and thread, bluegrasses, and sedges together accounted for 74 percent of the cattle diets. Cattle diets provide information for sound management decisions and information for monitoring key forage species by season of use.

The purpose of this study is to determine forage availability, seasonal diets, and key forage species to monitor for livestock grazing in north central South Dakota.

Study Area

The study area was located on gently sloping mixed grasslands in one 2,510 ha pasture on the Grand River National Grasslands near Lemmon, South Dakota. The climate of this area is semiarid-continental and is characterized by cold winters and hot summers. The 102-year average precipitation for this area is 42.7 cm ((High Plains Regional Climate Center, 2012). Most precipitation falls as rain during the growing season, often in high

intensity thunder showers. The pasture is grazed by cattle over a 6 month (from May through October) period of each year. The stocking rate for cattle was 1.154 ha/animal month with 362 cows on a 2,510 ha pasture.

Dominant native grasses are western wheatgrass (*Pascopyrum smithii* (Rydb.) Á. Löve) and blue grama (*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths). Common sedges include threadleaf sedge (*Carex filifolia* Nutt.) and needleleaf sedge (C. duriuscula C.A. Mey.)_White sage (*Artemisia ludoviciana* Nutt.) and scarlet globemallow (*Sphaeralcea coccinea* (Nutt.) Rydb.) are common forbs. The most common shrub is prairie sagewort (*Artemisia frigida* Willd.). Introduced plant species include crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.) and sweet clover (*Melilotus officinalis* (L.) Lam.).

Methods

Canopy cover (Daubenmire 1959) for all plant species was estimated in June and September of 1983 and in July of 1984 on 30 m transects for each of nine vegetation sites defined according to Natural Resources Conservation Service descriptions. The number of transects to characterize the vegetation varied according to the area comprised by each vegetation type. Vegetation types with less than 40 ha had only a single transect. Vegetation types that ranged from 40 to 405 ha had two transects, and types with greater than 405 ha had three transects. A total of 21 transects (630 quadrats) for the entire pasture was sampled for each period.

Each transect consisted of 30 quadrats delineated by a 20 x 50-cm frame and separated by ten paces (10 m). Total length of each transect was 300 m. Canopy cover and frequency of occurrence were summarized for each transect. Each vegetation site was then averaged for cover and frequency to obtain values by plant species for the entire pasture.

The pasture was stratified into eight permanent areas based on locations of livestock water tanks. Three fresh fecal samples were collected at random near the water tanks each day over a two day sampling period for each month in May, June, July, August, September and October of 1983 and 1984. Water tanks were spaced from 1.1 km to 2.7 km apart. Each sampling period-month consisted of 48 fecal samples (8 areas x 3 samples x 2 days).

The three fecal samples collected each day from each of the eight sites were oven-dried, ground and composited into eight samples. Thus, each sampling period-site was represented by 16 samples and when sites were averaged over the two day period for microhistological analyses.

Plant fragments in the feces were identified and quantified by methods described by Sparks and Malechek (1968), Rogers and Uresk (1974) and Johnson et al. (1983). All fecal material was ground through a Wiley mill using a 1 mm screen. Five microscopic slides of each sample were made of the fecal material. Twenty fields per slide were viewed under a binocular microscope at 100 power for identifiable plant fragments. Hand compounded test mixtures of plants were used periodically to check accuracy and maintain quality control. A minimum similarity of 90 percent was maintained between actual test mixtures of plants and estimated values of plants (Rogers and Uresk 1974).

Canopy cover and frequency of occurrence for each plant species was summarized for each transect, and each vegetation type and was averaged to obtain a value for the entire pasture. Data from microhistological identification of plant fragments were reported as mean percent relative density per day for each plant species. Differences in dietary use of plant species and plant categories (grasses, forbs, shrubs) among months were determined using analyses of variance (SPSS, 2003). Differences were accepted as significant at $p < 0.10$. Where variances were determined to be heterogeneous, Dunnett's T3 method for non-homogeneous variances was utilized (Dunnett 1980).

Kulczyuski's similarity index (Oosting 1956) was used to compare cattle diets with

plant canopy cover to determine degree of association. Spearman's rank order correlation (SPSS 2003) compared overall average canopy cover with cattle diets by total, grass, forbs and shrubs.

Results

Twenty common species were identified on the study site (Table 1). Measurements of average percent canopy cover and percent relative frequency of occurrence revealed crested wheatgrass, blue grama, threadleaf sedge (*Carex filifolia*), western wheatgrass, and needle and thread (*Hesperostipa comata*) to be the most common plants on the pasture. These plants averaged 39 percent, 47 percent, 36 percent, 42 percent and 43 percent frequency of occurrence, respectively. White sage was the most common forb and averaged 16 percent frequency of occurrence.

Eight common plant species were identified in microhistological examination of cattle feces with years combined (Table 2). Grasses and grass-like plants comprised most (84 to 99%) of cattle diets with sedges being by far the most important in this category in spring (79%) and early summer (53%). Five species made up approximately 92 percent of the total diet. Sedges were most abundant in the diet at 35 percent followed by needlegrasses, blue grama and wheatgrasses.

Seasonal trends of the major plants found in the diets during the grazing season were similar for both years and years were combined. Sedges made up most (79%) of the diet early in the season and decreased to a low of 11% in September (Fig. 1). Blue grama increased from a low of 2% in May and begin peaking in July and August at 30 % and 36% respectively in the cattle diets. Needlegrasses were dominate in diets during September (45%) and in October (64%). These key forage species made up 82 percent of the cattle diet. Wheatgrass species were less abundant in spring and late summer (Table 2). Blue grama was most abundant in diets during July and August both years. Consumption of wheatgrasses was consistent throughout the grazing season in diets. Use of forbs ranged from 2 percent to 14 percent, with an average of 4.9 percent. Forbs were abundant in diets during June and July (Table 2). Consumption of forb species increased from May to July and then declined. Shrubs in diets consisted of less than 1 percent during the grazing season.

Percent similarity between forage availability and cattle diets had similarities ranging from 0 percent to a high of 99 percent for grass-grasslike and forb species (Table 3). Low similarities indicate cattle are selecting or avoiding plants while high similarities indicated that cattle are consuming plants in the same relative proportion as available in the pasture. Similarities changed throughout the grazing season indicating seasonal selection of individual plant species. Spearman's rank order correlations were significant at $p=0.01$ for grasses at 0.71, forbs 0.76 and shrubs 0.74. Rank order correlation for all categories combined was significant ($p=0.01$) at 0.75.

Discussion

Sedges (*Carex* species), blue grama, and needlegrasses were important forage species for cattle on the study site and are designated as key species for management and for monitoring. The importance of sedges as forage are common in livestock diets during the spring and is consistent with previous studies in South Dakota, Wyoming, Colorado and Nebraska (Alexander et al. 1983; Hansen and Gold 1977; Hart et al. 1983; Samuel and Howard 1982; Uresk 1984, 1986; Volesky et al. 2007) and re-emphasizes the need for study and management of these species.

Blue grama was most frequent in the diets in mid-season. Needlegrasses and to a lesser degree wheatgrasses, became important late in the season. These changes in importance of forage species over the season should be taken into consideration by rangeland managers and in the evaluation of forage use and regulation of livestock numbers. Efforts to increase forage production should be directed at sedges,

Table 1. Average canopy cover (%C ± SE) and frequency of occurrence (%F ± SE) of plants during three months near Lemmon, South Dakota.

	June 1983		July 1984		September 1983	
Category	%C	%F	%C	%F	%C	%F
Grasses and Sedges						
Agropyron cristatum	25 ± 7	39 ± 11	28 ± 8	39 ± 10	20 ± 5	41 ± 10
Pascopyrum smithii	15 ± 5	43 ± 8	17 ± 4	42 ± 8	8 ± 2	40 ± 7
Aristida purpurea	<1 ± <1	2 ± 1	3 ± 1	11 ± 3	5 ± 1	22 ± 5
Bouteloua gracilis	14 ± 3	41 ± 8	26 ± 5	52 ± 8	15 ± 3	47 ± 7
Carex duriuscula	2 ± <1	6 ± 2	0 ± 0	0 ± 0	10 ± 2	36 ± 5
Carex filifolia	20 ± 5	40 ± 9	16 ± 4	38 ± 8	12 ± 3	29 ± 8
Carex inops	0 ± 0	0 ± 0	3 ± 1	8 ± 3	<1 ±<1	<1 ± 1
Calamovilfa longifolia	<1 ± 1	2 ± 6	0 ± 0	0 ± 0	1 ± <1	11 ± 3
Distichlis spicata	5 ± 3	10 ± 7	6 ± 4	<1 ± 6	5 ± 3	9 ± 6
Koeleria macrantha	3 ± 1	15 ± 4	3 ± 1	13 ± 3	3 ± 1	20 ± 4
Poa pratensis	4 ± 2	12 ± 4	5 ± 4	8 ± 5	4 ± 2	10 ± 4
Hesperostipa comata	7 ± 2	35 ± 8	10 ± 2	40 ± 8	15 ± 2	53 ± 7
Nassella viridula	2 ± 1	6 ± 5	1 ± <1	4 ± 2	2 ± 1	13 ± 4
Other species	1		2		5	
Total	99		120		105	
Forbs						
Ambrosia psilostachya	0 ± 0	0 ± 0	2 ± 1	9 ± 4	3 ± 1	13 ± 5
Artemisia ludoviciana	3 ± 1	15 ± 5	6 ± 2	17 ± 6	3 ± 1	15 ± 4
Symphyotrichum falcatum	0 ± 0	0 ± 0	2 ± 1	8 ± 2	1 ± <1	8 ± 2
Melilotus officinalis	3 ± 2	10 ± 4	<1 ± <1	5 ± 3	2 ± 1	11 ± 4
Sphaeralcea coccinea	1 ± <1	13 ± 4	2 ± <1	17 ± 4	<1 ± <1	11 ± 3
Other species	9		9		16	
Total	16		21		25	
Shrubs						
Artemisia dracunculus	2 ± <1	22 ± 3	5 ± 1	28 ± 4	4 ± 1	26 ± 5
Artemisia frigida	4 ± 1	34 ± 5	7 ± 1	38 ± 5	3 ± <1	32 ± 2
Other species	<1		<1		<1	
Total	6		12		7	

Table 2. Average relative density (%± SE) of plants in cattle diets, two years combined, over six months near Lemmon, South Dakota.

Plant taxa	May	June	July	Aug	Sept	Oct
Grasses and Sedges						
Pascopyrum smithii *Agropyron cristatum*	7±<1a*	8 ±<1a	6±<1a	9± 1a	18± 2b	7±<1a
Bouteloua gracilis	2±<1a	14± 2b	30± 1c	36± 2c	20± 2d	13± 1b
Sporobolus cryptandrus	<1±<1a	<1±<1a	<1±<1b	3±<1b	<1±1b	<1±<1a
Hesperostipa comata *Nassella viridula*	9± 2a	14± 1a	14±<1a	24± 2b	45± 3d	64± 2e
Carex duriuscula *Carex filifolia*	79± 2a	53± 3b	30± 2c	23± 3c	11± 1d	13±<1e
Other grasses[1]	<1±<1a	3±<1b	4±<1b	2±<1b	2±<1b	1±<1c
Total grasses	98±<1a	93±<1b	84± 2c	99± 3a	97±<1d	99±<1a
Forbs						
Sphaeralcea coccinea	<1±<1a	<1±<1b	2±<1b	<1±<1b	<1±<1b	<1±<1b
Meliotus officinalis	1±<1a	5±<1b	10±<1b	<1±<1a	0b	0b
Other forbs	1±<1a	2±<1a	2±<1a	2±<1a	2±<1a	<1±<1b
Total forbs	2±<1a	7±<1b	14± 2b	3±<1c	2±<1a	<1±<1d
Total shrubs	<1±<1a	<1±<1a	<1±<1a	<1±<1a	<1±<1a	<1±<1a

* Means for each row followed by a similar letter are not significantly different at p>0.05.

[1] Other plant species that comprised less than 0.7% of the diet by category included: 10 grasses and sedge species, 13 forbs and 4 shrubs.

blue grama, needlegrasses and wheatgrass species. Blue grama can be increased and maintained by season long grazing at 40 percent-55 percent utilization (Johnson et al. 1951). When the management goal is to increase or maintain needlegrasses, sedges and western wheatgrass, a reduced stocking rate (light grazing) with a lower utilization rate is required (Van Poolen and Lacey 1979; Kipple and Bement 1961; Lewis et al. 1956).

Dietary use of forbs by cattle can vary between years and is attributed to differences in precipitation, especially annual forbs (Rutherford 1980). Use of forb species increased from May to July of each year and then declined. Similar trends have been reported in studies on other rangelands (Uresk and Paintner 1985; Holechek et al. 1982a, 1982b).

Shrubs are generally consumed by cattle late in the growing season when grasses and forbs are mature and less digestible while shrubs remain green and are more palatable.

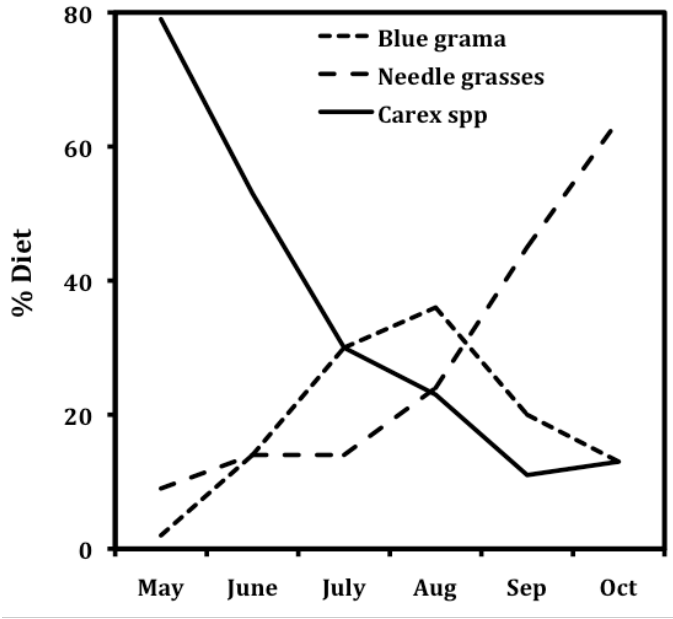

Figure 1. Seasonal trends of blue grama, needlegrasses and sedges in cattle diets from May through October based on average relative density (%) making up 82 percent of the cattle diet.

Table 3. Percent similarity between forage availability and cattle diets during three months at Lemmon, SD.

Category	June 1983	September 1983	July 1984
Grass and Sedges			
Agropyron cristatum *Pascopyrum smithi*	31	33	28
Bouteloua gracilis	95	88	70
Carex filifolia *Carex duriuscula*	66	0	78
Sprobolus spp.	88	77	65
Hesperostipa comata *Nassella viridula*	69	38	99
Forbs			
Meliotus officinalis	60	0	90
Sphaeralcea coccinea	39	34	27

Similar trends have been noted in other studies on other areas (Uresk and Paintner 1985; Holechek et al. 1982b, 1982c; Roath and Krueger 1982).

Several forage species with high similarity indices included blue grama , needlegrasses and Sprobolus spp. High similarity indices indicate that cattle were consuming these forage plants in the same proportions as availability in the pasture. Other plants such as the sedges are highly variable throughout the grazing season. Plants with low similarity indices are highly selected or avoided by cattle. It is apparent from the information that selectivity or avoidance for certain plants changed with seasonal availability in the pasture as demonstrated by Reppert (1960). Spearman rank order correlations by category ranged from 0.71-0.76, indicating that forage were not always selected for by cattle in the same portions as their availability in the pasture.

This study, although conducted in one 2, 510 ha pasture, provides information that is useful to range managers for improvement of range management practices and more efficient allocation of forage for sustained plant productivity. This study shows that dietary variations in plant species do occur throughout the grazing season. Key plants would allow efficient monitoring of the grassland throughout the grazing season. These plants include blue grama, needle and thread, green needlegrass (*Nassella viridula*), needleleaf sedge (*Carex duriuscula*) and threadleaf sedge. Similarity indices and Spearman correlations indicated that selectivity on particular species of plants varied throughout the grazing season by cattle.

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