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BOTANICAL SPECIES OF PLANTS EATEN AND INTAKE  
OF STEERS GRAZING LIGHT, MEDIUM  
HEAVY USE SHORTGRASS RANGE

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BOTANICAL SPECIES OF PLANTS EATEN AND INTAKE OF  
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It is difficult to determine the diet of grazing herbivores. These animals select plant species and can even discriminate for or against portions of plants while grazing. Prior to the adaptation of the esophageal fistula to grazing studies by Torell (1954) dietary information about plants selected and the nutritional quality of herbivore diets was determined largely by close observation of animals as they grazed or by before and after herbage sampling techniques. Where exact dietary information is necessary, it is most accurate to use the animal as the direct sampling agent rather than to rely on indirect information.

Quantitative information on the amount of individual plants eaten and the nutritive value of the diet requires that there be a direct measurement of intake or excretion coupled with dietary utilization information.

Since it is difficult to measure the amount of forage eaten by grazing animals, the total collection of excreta is usually the method of choice for determination of forage intake. Fecal excretion can be combined with dietary utilization estimated from in vitro digestibility estimated on dietary samples collected by esophageal fistulated animals by the relationship:

$$\text{Intake} = \frac{\text{Dry matter in feces}}{100 - \text{digestibility}}$$

The purpose of this study was to measure the botanical species eaten, the dietary nitrogen content and the intake of grazing steers as affected by season and intensity of use of shortgrass rangelands.

## Methods

Esophageal fistulas were established in 12 yearling steers. Four steers were randomly allotted to one of 3 pastures which had a long history of light, medium and heavy use by cattle. These pastures were located at the Pawnee Site in eastern Colorado. The animals were allowed to adjust to the range for one month prior to collection. Esophageal samples were collected in June, July and August. The animals were caught in the early morning, the esophageal plugs removed, esophageal bags attached and they were allowed to graze for about 1 hour, then they were gathered and esophageal samples removed. It was planned to collect at least 5 samples from each steer during each month, however, animal management problems limited the number of samples collected during July and August.

The animals were bagged with fecal collection bags for a 5 day period during each month. The fecal collections were weighed and sampled twice daily for chemical determinations.

Esophageal samples were frozen and stored. At a later date they were thawed, mascerated in a Waring blender, washed on a 200 mesh sieve and a small portion of the mascerated material spread over microscopic slides according to the procedure of R. M. Hansen<sup>1</sup>. Five or more slides were prepared from each sample and botanical composition estimated from the frequency of occurrence of individual species of plants in 40 microscopic fields<sup>2</sup>.

A portion of each esophageal sample was dried at 60°C, and ground through a 40 mesh screen. The digestibility of the samples was estimated by an in vitro

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<sup>1</sup>Personal communication, R. M. Hansen, Colorado State University, Dept. of Range Science.

<sup>2</sup>Appreciation is expressed to Barbara Cavender who made the analyses.

procedure (Tilley and Terry, 1963). The in vitro values were adjusted to in vivo basis through a regression equation developed from the in vitro fermentation of forages of known digestibility.

The ground samples were analysed for nitrogen content by the standard macro Kjeldahl procedure (AOAC, 1960).

## Results

### animal management

The esophageal steers were grazed with privately owned yearling heifers. Many of these heifers were in heat during June and excessive riding and disturbance resulted. For this reason the steers were removed to an adjacent range and introduced into the study pastures for a five day period in July and August. Since successful dietary collections were not always possible due to rumen contamination and animal refusal to graze when the esophageal bags were installed, a limited number of dietary samples were collected in July and August. It was particularly difficult to obtain samples on the heavy use range. The social problems resulting from mixing steers and heifers was not anticipated. Heifers will be used in future studies to alleviate this problem. However, it is much more difficult to obtain fecal collections with heifers because of the problem of separation of urine and feces.

### botanical composition of the diet

The botanical species identified in the esophageal samples are listed in table 1. There were 10 grasses, 10 forbs, 1 sedge and 2 shrubs present.

Four of the grass species were present in appreciable amounts, blue grama, western wheatgrass, buffalograss and red threeawn. Other grasses appeared only occasionally and were not important in their contribution to the total diet.

Grasses made up the largest proportion of the diet (table 2). A greater proportion of grass was present in the heavy use pasture. The proportion of grass increased as the intensity of use of the pastures increased. There was a seasonal decline of grasses in the diet in medium and light use pastures. The proportion of grass in the heavy use pasture was high throughout the grazing season.

Blue grama was the most important plant species in the diet of steers (table 3). It made up a relatively constant average frequency throughout the summer with slightly lower overall frequency in July. It was more important in the heavy than in medium or light use pastures, especially in August. The frequency was least in the medium use pasture.

Western wheatgrass was found in a much greater proportion during July sampling than during June or August (table 5). Apparently this grass was available at this time due to its growth characteristics and was consumed especially during July. This grass was more frequently found in the medium use pasture than in light or heavy use pastures. These differences in diet frequency were probably due to pasture differences and indicate that the steers ate this grass preferentially when it was available.

Red threeawn was eaten principally during the month of June. It was more common in samples from medium and heavy use pastures than in light use pastures (table 6). Apparently this grass was most desirable in June and eaten so that little was available during the balance of the grazing season. In the light use pasture where more variety of plant species were available, the preference for red threeawn did not appear to be as great since it appeared in esophageal samples throughout the season, whereas it was virtually absent in samples from medium and light use pastures in July and August.

The only sedge of importance was sun sedge. It was used more frequently in June than in July or August and was found more frequently in the heavy use pasture (table 7).

Forbs made up an overall average of approximately 40% of the diet (table 8). This proportion decreased as the intensity of use of the pastures increased. The peak use in heavy and medium use pastures occurred in June whereas in the light use pasture the use of forbs increased regularly as the season progressed so that over half (58%) of the total diet was made up of forbs in August in the light use pasture. The lowest frequency of forbs was found in August in heavy and medium use pastures.

The occurrence of specific forbs in esophageal samples was variable. On certain days the cattle were observed to seek out certain forbs actively. For the balance of the season they were largely neglected. This time relationship to specific forb use is probably related to the rapid development and rapid maturity characteristic of many forbs. When conditions were proper for their development they passed through their life cycle rapidly. A particular stage of growth for animal selectivity may be critical with other growth stages being relatively unpalatable to cattle. It is also possible that by selecting certain forbs intensely for short periods of time, cattle effectively reduced the availability of the forb for the balance of the grazing season.

Of the 18 forbs identified in esophageal samples, only four were of considerable importance. These were scarlet globemallow, *Eriogonium* spp.; Belvedere summercypress (*Kochia scoparia*) and evening primrose. The other forbs were eaten but their occurrence was either specific in time or was so low in frequency as to be of minor importance in the diet.

Scarlet globemallow was found most often in esophageal samples from the light use pasture (table 9). It had about equivalent occurrence in medium and heavy use pastures with a slightly greater occurrence in light use samples. This forb was most important during the June sampling.

Eriogonum species were most common in the heavy use pasture with a high frequency in July (table 10). It occurred most frequently in June in the medium use pasture samples and in August in the light use pastures. There may be a relationship (not observed) in the intensity of use and the development of this forb, or selection of this forb may be related to the presence or absence of other desired species of plants on the pastures.

Kochia scoparia was rarely found in esophageal samples from the heavy use pasture (table 11). It was common in the medium use pasture samples in July and August and in the light use pasture samples in August. The selection by cattle of this forb is probably related to its availability and to its growth form which may be affected by the intensity of use and climatological conditions.

Evening primrose was found more frequently in esophageal samples from the light use pasture (table 12). It was generally more common during the months of June and July than in August.

The shrubs found in esophageal samples consisted mostly of fringed sage-wort (table 13). The frequency was greatest in the medium use pasture in August, followed by June with the least frequency in July.

The shrub was also found in August and June samples in the heavy use pasture with a relatively low occurrence in the light use pastures. The occurrence of shrubs in the summer use pastures in this area is minor.

Apparently summer grazing can effectively reduce the occurrence of fringed sagewort and 4-winged saltbush in the pastures.

The species of plants eaten by steers on shortgrass prairie is a reflection of its availability and of animal preference, the composition of the diet varies seasonally and with the degree of use the pastures were exposed to. Preference ratings cannot be made until information about relative availability is made available. This will be done by comparing dietary data to the herbage standing crop data (see report by Uresk and others). The steers were able to maintain a diet of relatively constant dry matter digestibility (table 14) by constantly shifting the individual plants selected to plants which were relatively high in digestibility due to stage of development.

#### intake and utilization of diet

Dry matter digestibility was lower on the heavy use pastures at all collections. There was little difference in dry matter digestibilities in esophageal samples from medium and light use pastures. The digestibilities of dry matter according to season of use within the months of June, July and August were remarkably constant. There was a higher variability in the estimates of dry matter digestibilities in the early samples. The steers, within the grazing season from June through August were able to select a diet with fairly constant dry matter digestibilities. This was possible even though definite changes in botanical species eaten occurred.

The steers grazing the medium use pasture excreted the greatest amount of fecal material while those on the heavy use pastures expelled the least. The fecal output increased in all pastures as the season progressed (table 5).

The dry matter intake estimates indicate that from June through August

the steers tended to increase their dry matter intake. The intake on the heavy use pasture was lower than on medium or light pastures while the steers grazing the medium use pasture had the greatest intake.

The differences in intake according to season are largely the results of greater excretion of fecal material since digestibility was not appreciably different according to season (table 14).

The steers on the medium use pasture ate more and had a slightly more digestible diet while those grazing the heavy use pastures ate less total diet which was lower in digestibility than those from the other two grazing intensities.

Normally dry matter digestibility would be expected to decline with advancing plant maturity and a modest increase in intake would usually occur as digestibility declined during the growing season.

Mature forage was sampled in the winter of 1969 and results of intake and digestibility on mature forage will be measured. Continued dietary sampling will be made in 1970 to determine if the relationships between intake and digestibility are consistent with the limited information obtained during 1969.

The diets of steers grazing heavy and medium use pastures were higher in protein content than in light use pastures for the season. Values for individual months did not follow this trend. Dietary protein decreased in the light use pastures as the season progressed. Protein in the diet was higher in medium use pastures in July than in June or August while protein from light use pastures was lower in July than June. Protein in fecal samples followed these same trends, although the differences were much less pronounced.

Dietary quality and intake of steers grazing the heavy use pastures was consistently lower than those grazing the medium and light use pastures.

#### References

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Table 1. Species of plants found in esophageal samples of steers grazing the intensity of use pastures at the IBP Pawnee Site in 1969.

Scientific Name	Common Name
<u>Grasses</u>	
<i>Agropyron smithii</i>	western wheatgrass
<i>Aristida longiseta</i>	red threeawn
<i>Bouteloua gracilis</i>	blue grama
<i>Buchloe dactyloides</i>	buffalograss
<i>Sitanion hystrix</i>	bottlebrush squirreltail
<i>Stipa comata</i>	needle-and-thread
<i>Schedonnardus paniculatus</i>	tumblegrass
<i>Muhlenbergia torreyi</i>	ring muley
<i>Sporobolus cryptandrus</i>	sand dropseed
<u>Sedges</u>	
<i>Carex heliophila</i>	sun sedge
<u>Forbs</u>	
<i>Astragalus</i> spp.	--
<i>Oenothera</i> spp.	evening primrose
<i>Psoralea tenuiflora</i>	slimflower scurfpea
<i>Sphaeralcea coccinea</i>	scarlet globemallow
<i>Bahia oppositifolia</i>	plains bahia
<i>Townsendia grandiflora</i>	--
<i>Verbena bracteata</i>	big bract vertena
<i>Erigeron canadensis</i>	horseweed fleabane
<i>Eriogonum</i> spp.	--
<i>Cleome serrulata</i>	bee spiderflower
<i>Ratibida columnaris</i>	Wright prairie coneflower
<i>Kochia scoparia</i>	belvedere summercypress
<i>Lithospermum incisium</i>	gromwell
<i>Lesquerella ludoviciana</i>	silver bladderpod
<i>Oxytropis lambertii</i>	Lambert crazyweed
<i>Liatrus punctata</i>	dotted gayfeather
<i>Cirsium undulatum</i>	wavyleaf thistle
<i>Sophora sericea</i>	silky sophora
<u>Shrubs</u>	
<i>Artemisia frigida</i>	fringed sagewort
<i>Atriplex canescens</i>	four-wing saltbush

Table 2. PROPORTION (% FREQUENCY) OF GRASS IN ESOPHAGEAL SAMPLES OF STEERS (1969)<sup>1</sup>

	June	July	August	Mean
Heavy	67 (20)	53 (48)	65 <sup>2</sup>	65 (22)
Medium	53 (31)	58 (15)	52 (17)	54 (24)
Light	56 (19)	52 (18)	41 (14)	51 (18)
Mean	59 (23)	55 (21)	48 (16)	

<sup>1</sup> Numbers in parenthesis are standard errors.

<sup>2</sup> Only one sample available

Table 3. PROPORTION (% FREQUENCY) OF BUFFALO GRASS IN ESOPHAGEAL SAMPLES OF STEERS (1969)<sup>1</sup>

	June	July	August	Mean
Heavy	5 (6)	1 (1)	2 <sup>2</sup>	4 (5)
Medium	1 (2)	8 (11)	5 (10)	4 (8)
Light	1 (2)		2 (5)	1 (3)
Mean	3 (4)	4 (8)	3 (7)	

<sup>1</sup> Numbers in parenthesis are standard errors.

<sup>2</sup> One sample analysed.

Table 4. PROPORTION (% FREQUENCY) OF BLUE GRAMA IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	32 (18)	22 (10)	56 <sup>2</sup>	32 (18)
Medium	19 (14)	20 ( 4)	15 ( 9)	18 (11)
Light	23 (13)	29 (12)	33 (11)	29 (12)
Mean	27 (16)	24 ( 9)	28 (16)	

<sup>1</sup> Numbers in parenthesis are standard errors.

<sup>2</sup> One sample analysed.

Table 5. PROPORTION (% FREQUENCY) OF WESTERN WHEATGRASS IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

Month	June	July	August	Mean
Heavy	3 ( 5)	28 (23)	2	7 (14)
Medium	9 (10)	19 ( 6)	23 (16)	15 (11)
Light	7 ( 3)	15 (22)	5 ( 4)	8 (10)
Mean	6 ( 7)	20 (17)	12 (12)	

<sup>1</sup> Numbers in parenthesis are standard errors.

Table 6. PROPORTION (% FREQUENCY) OF RED THREEAWN IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	9 ( 8)	0	2	7 ( 8)
Medium	14 (12)	0	0	7 (11)
Light	3 ( 3)	1 ( 2)	1 ( 3)	2 ( 3)
Mean	8 ( 9)	1 ( 1)	1 ( 2)	

<sup>1</sup> Numbers in parenthesis are standard errors.

Table 7. PROPORTION (% FREQUENCY) OF SUN SEDGE IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	17 (12)	7 ( 7)	4	14 (12)
Medium	6 ( 6)	9 ( 5)	7 ( 3)	7 ( 5)
Light	13 ( 6)	4 ( 1)	1 ( 1)	8 ( 7)
Mean	12 (10)	7 ( 5)	3 ( 4)	

<sup>1</sup> Numbers in parenthesis are standard errors.

Table 8. PROPORTION (% FREQUENCY) OF FORBS IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	30 (18)	40 (36)	25 <sup>2</sup>	31 (21)
Medium	42 (29)	39 (16)	32 (20)	39 (24)
Light	44 (19)	46 (18)	58 (14)	48 (18)
Mean	38 (22)	42 (21)	44 (21)	

- <sup>1</sup> Numbers in parenthesis are standard errors.  
<sup>2</sup> One sample analysed.

Table 9. PROPORTION (% FREQUENCY) OF SCARLET GLOBEMALLOW IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	13 ( 7)	18 ( 8)	12 <sup>2</sup>	14 ( 7)
Medium	9 ( 8)	15 ( 8)	10 ( 4)	11 ( 8)
Light	19 (14)	33 (14)	18 (14)	21 (15)
Mean	14 (10)	22 (13)	14 (10)	

- <sup>1</sup> Numbers in parenthesis are standard errors.  
<sup>2</sup> One sample analysed.

Table 10. PROPORTION (% FREQUENCY) OF ERIOGONIUM SPECIES  
IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	5 (11)	21 (29)	12 <sup>2</sup>	7 (13)
Medium	10 (12)	< 1 ( 1)	0	5 (10)
Light	2 ( 5)	0	13 (10)	4 ( 8)
Mean	5 (10)	4 (12)	8 ( 9)	

<sup>1</sup> Numbers in parenthesis are standard errors.  
<sup>2</sup> One sample analysed.

Table 11. PROPORTION (% FREQUENCY) OF KOCHIA SCOPARIA  
IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	1 ( 2)	0	0	< 1 ( 2)
Medium	< 1 ( 1)	17 (14)	11 (21)	7 (13)
Light	1 ( 2)	0	11 (15)	3 ( 8)
Mean	1 ( 1)	8 (13)	10 (16)	

<sup>1</sup> Numbers in parenthesis are standard errors.

Table 12. PROPORTION (% FREQUENCY) OF EVENING PRIMROSE  
IN ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	3 ( 5)	6 (10)	0	4 ( 5)
Medium	2 ( 3)	< 1 ( 1)	3 ( 5)	2 ( 3)
Light	9 ( 9)	10 ( 8)	4 ( 2)	8 ( 7)
Mean	5 ( 6)	5 ( 7)	3 ( 4)	

<sup>1</sup> Numbers in parenthesis are standard errors.

Table 13. PROPORTION (% FREQUENCY) OF SHRUBS IN  
ESOPHAGEAL SAMPLES OF STEERS (1969).<sup>1</sup>

	June	July	August	Mean
Heavy	4 ( 8)	1 ( 1)	10 <sup>2</sup>	3 ( 8)
Medium	5 ( 6)	2 ( 3)	16 (19)	7 (11)
Light	< 1 ( 1)	2 ( 4)	1 ( 1)	1 ( 2)
Mean	3 ( 6)	2 ( 3)	8 (13)	

<sup>1</sup> Numbers in parenthesis are standard errors.

<sup>2</sup> One sample analysed.

Table 14. PERCENT DRY MATTER DIGESTIBILITY  
OF ESOPHAGEAL SAMPLES.<sup>1</sup>

Intensity of use	June	July	August	Mean
Heavy	57.9	53.0	56.0 <sup>2</sup>	55.6
S.E.	5.1(4)	3.8(4)		
Medium	60.1	64.6	61.3	62.0
S.E.	4.7(10)	1.9(4)	2.0(4)	
Light	59.5	61.6	61.9	61.0
S.E.	4.1(12)	2.8(4)	2.9(4)	
Mean	59.2	59.7	59.7	

<sup>1</sup> Numbers in parentheses refer to the number of samples.  
<sup>2</sup> One sample analysed.

Table 15. DRY FECES WT. (Kg.)

300 Kg. Animal				
	June	July	August	Mean
Heavy	1.74 (.09)	2.12 (.12)	2.76 (.16)	2.21
Medium	2.29 (.17)	2.34 (.23)	2.94 (.30)	2.52
Light	2.05 (.10)	2.09 (.07)	2.83 (.11)	2.32
Mean	2.03	2.18	2.51	

Table 16. DRY MATTER INTAKE OF STEERS.

	Kg./300kg. animal			
	June	July	August	Mean
Heavy	4.1	4.5	6.3	5.0
Medium	5.7	6.6	7.7	6.7
Light	5.1	5.5	7.4	6.0
Mean	5.0	5.5	7.1	

Table 17. PERCENT CRUDE PROTEIN IN DIET SAMPLES

	% Dry Matter			
	June	July	August	Mean
Heavy	13.8	11.8	<sup>1</sup>	12.8
Medium	12.0	15.1	11.5	12.9
Light	13.3	12.3	9.1	11.6
Mean	13.0	13.1	10.3	

<sup>1</sup> Sample missing.

Table 18. PERCENT CRUDE PROTEIN IN DRY FECES.

	June	July	August	Mean
Heavy	9.3	11.2	9.0	9.9
Medium	11.3	11.9	10.3	11.1
Light	11.2	10.5	9.7	10.5
Mean	10.6	11.2	9.6	