Cattle Diets on Semidesert Grassland: Botanical Composition

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Highlight: *Botanical composition of cattle diets on semidesert rangeland was studied by microhistological techniques. Cattle consumed 56% of all species available. Dietary portions of grasses, forbs, shrubs, and unidentifiable plants averaged 45, 32, 19, and 6%, respectively. Composition of diets changed with seasons. Grass contents of diets were highest in summer and lowest in spring. Mesa dropseed was the most common species in diets. Perennial grasses represented dependable sources of forage, but never comprised more than 50% of the steers' diets in any season, and should not be used as the sole criterion for estimating forage production or determining stocking rates. Shrub portions were highest in spring when soaptree yucca was grazed almost exclusively. Forb fractions of diets varied little among seasons but were highest in winter. Forbs and shrubs comprised over one-half of the diets in certain seasons and should be grazed in these seasons if full benefit is to be derived from them. Preference ranking of forage plants evaluated selectivity and palatability but preference trends were inconsistent and most affected by species availability.*

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Semidesert grassland occupies 36 million ha in the Southwest (Campbell and Craft, 1939) with most ranges being grazed by livestock. These ranges are usually grazed yearlong, but Valentine (1967) proposed a seasonal suitability grazing system to restore deteriorated pastures. Cattle diets from this system are compared to those under continuous grazing.

Effective range management depends upon identification of plants which are palatable and nutritious to livestock. Most plants on desert grassland contribute more to cattle diets than is usually believed (Galt et al., 1969). The investigation reported here was initiated to examine species composition of cattle diets further and to compare forage under continuous vs seasonal suitability systems.

Experimental Procedure

Study pastures were on the New Mexico State University Ranch, 38 km north of Las Cruces, where the climate is arid and the frost-free period averages 200 days. Average annual precipitation for a 57-year period was 23 cm, 51% of which fell during the major growing season in July, August, and September (Table 1). Rainfall from July through September was 32%

above average in 1972 but 45% below average in 1973.

Data were collected from one continuously grazed pasture (No. 15 which contained 1348 ha) and three pastures within a seasonal suitability system (Nos. 3N, 3S, and 3W, which contained 451, 526, and 668 ha, respectively). Vegetation was semidesert grassland varying from homogenous stands of black grama (see Table 2 for scientific names) to sand dune areas dominated by mesquite. Botanical compositions of pastures (Table 2) were derived while measuring plant density in circular plots of variable size (Rosiere, 1973). Herbage available (kg/ha) on each pasture duirng each season was calculated by multiplying the average weight of a species times the density of that species in a hectare. Density estimates for pastures by seasons were obtained from 100 randomly located plots.

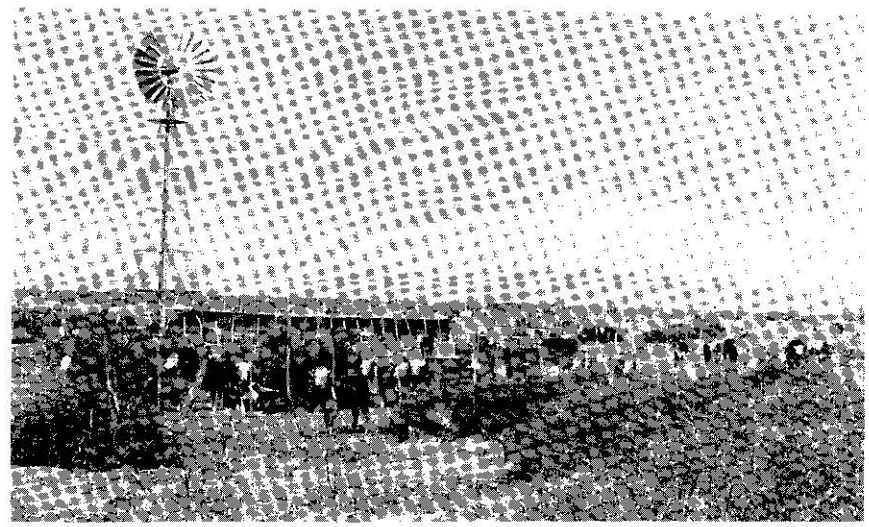
Forage samples were collected from four esophageal fistulated Hereford steers during 10-day periods in August and October of 1972 and in January, May, and July-August of 1973. Steers grazed study pastures for 2 to 3 weeks prior to sampling periods, except in October, 1972. Pastures were sampled once a day at sunrise after steers had been penned overnight. The year-long use pasture and one pasture in the seasonal suitability system were sampled on alternate days each 10-day period. Steers were driven to different plant communities (i.e., black grama - dropseed grassland, mesquite sand dunes, annual grass-forb sites, etc.) within each pasture and then

Table 1. Average long term monthly precipitation and monthly precipitation for 1972 and 1973 on study pastures.

	Precipitation (cm)		
	Jornada Exp. Range	College Ranch[2]	
Months	long term average[1]	1972	1973
January	1.4	0.6	1.8
February	1.1	0.0	3.8
March	0.7	0.0	0.7
April	0.6	0.0	0.0
May	0.7	1.7	4.1
June	1.4	4.1	1.2
July	4.1	4.3	3.6
August	4.3	9.5	3.4
September	3.7	2.4	0.2
October	2.3	5.6	0.0
November	0.9	0.0	0.0
December	1.4	3.8	0.2
Average	22.6	32.0	19.0

[1] Average since 1915 at US Weather Reporting Station on Jornada Experimental Range, 15 km NE of study pastures (US Commerce Dep., 1972).

[2] Data are average of 7 rain gauges on or near study pastures.



permitted to graze at will until approximately 1 kg of plant material was obtained. Collected forage was dried at 55° C for 24 hr in a forced-air oven and then ground through a 1 mm screen in a Wiley mill.

Species composition of cattle diets was determined by a microscopic technique modified from Sparks and Malechek (1968). Microscope reference slides of plant species growing in study pastures and slides of fistulae-collected forage were prepared by covering ground herbaceous material with synthetic resin mounting media and cover slips. Plant particles in slides from diet samples were identified by comparing with species reference slides. Identification was by histological characteristics as reported by Free et al. (1971).

Statistical evaluation was by split plot analysis of variance with Tukey's procedure used to test differences among means (Steel and Torrie, 1960). Preference "ranks" developed from preference indicies (Van Dyne and Heady, 1965) were used to evaluate species preference by cattle.

Results and Discussion

Of the 52 plant species found on the year-long pasture and the 50 species on the seasonal suitability pastures, 28 species were identified in the diets, plus a small number of unidentified species. Twenty species were found to comprise 84%-95% of the steers' diets in all seasons (Table 3). Some species which were observed being grazed were not found in slides of forage. Some plant particles could not be identified due to absence of unique histological features and were often a process of elimination.

Proportions of grasses, forbs, and shrubs in diets changed among seasons (Table 4). Significant changes were also found in the forage available in standing crop among seasons (Table 3). Similar trends were observed on pinyon-juniper grassland (Thetford et al., 1971) and shortgrass plains (Beck, 1969). Grass content did not differ significantly in the two summer diets or between fall and summer diets. Shrub content was highest in spring when large quantities of soaptree yucca were consumed. Inconsistent seasonal variability existed in forb portions of diets.

Preference ranks (Table 3) helped explain differences in selectivity. A rank of "c" (P.I. = 0.7 - 1.3) indicated that the percentage of a species in the diets was the same as in available herbage (i.e., no selectivity). Preference higher or lower than "c" demonstrated selection for or against species, respectively. Preference alone did not always account for proportions of species in diets, because availability was also a major factor influencing dietary composition.

Preference trends were usually inconsistent. For a given species, preference ranks might differ considerably between pastures within season, but in another season ranks for that species might be similar. This, also, indicated that availability affected preference. Studies have shown that preference changed as grazing intensity increased. Leigh and Mulham (1966) found that 56% of sheep diets were comprised of a species that formed only 1% of herbage but that portions in diets decreased as availability decreased. Thus, high preferences lasted only short periods. In this study similar results were noted when the amount

Table 2. Plant composition (%) and total herbage production (kg/ha) on year long (15) and seasonal suitability (3N, 3S, 3W) pastures.

Species and measurement	Summer 1972		Fall 1972		Winter 1973		Spring 1973		Summer 1973	
	15	3N	15	3W	15	3W	15	3N	15	3S
Production (kg/ha)	1015	1627	1322	2062	1347	1638	1320	1591	1669	2143
Composition (%)										
Grasses										
Annual gramas (*Bouteloua* spp.)	T[1]	1	–	2	1	3	1	2	T	T
Black grama (*Bouteloua eriopoda*)	6	13	16	–	7	–	8	6	9	5
Mesa dropseed (*Sporobolus flexuosus*)	9	12	8	8	9	6	4	8	19	18
Sixweeks threeawn (*Aristida adscensionis*)	28	40	41	46	24	55	2	T	1	2
Threeawns (*Aristida* spp.)	6	1	4	1	5	T	2	2	1	1
Others[2]	3	4	5	4	3	2	1	1	2	1
Total grasses	52	71	74	61	49	66	18	19	32	27
Forbs										
Annual snakeweed (*Gutierreza sphaerocephala*)	–	T	T	3	1	2	10	4	2	T
Bladderpod (*Lesquerella fendleri*)	–	T	T	–	T	–	1	14	T	5
Broom snakeweed (*Gutierreza sarothrae*)	3	1	1	4	4	3	17	28	21	41
Deers tongue (*Cryptantha crassisepala*)	–	–	–	–	10	5	13	9	8	4
Desert holly (*Perezia wrightii*)	T	–	T	T	T	–	T	T	T	T
Faint crown (*Aphanostephus ramosissimus*)	2	5	1	1	T	1	5	9	6	3
Goosefoot (*Chenopodium* spp.)	2	T	T	1	T	T	T	–	T	T
Hedgemustard (*Sisymbrium linearifolium*)	–	–	–	–	T	T	–	–	–	–
Hymenopappus (*Hymenopappus robustus*)	–	–	–	–	–	–	T	1	1	2
Leatherweed croton (*Croton corymbulosus*)	5	1	2	4	1	1	10	2	8	6
Orange eriogonum (*Eriogonum abertianum*)	29	2	7	6	13	4	1	1	T	T
Pepperweed (*Lepidium lasiocarpum*)	–	–	–	–	–	–	9	T	3	T
Purslane (*Portulaca* spp.)	T	T	–	–	–	–	T	–	T	–
Russian thistle (*Salsola kali*)	1	5	9	4	3	3	1	1	1	1
Tansymustard (*Descurainia pinnata*)	–	–	–	–	T	1	T	T	T	T
Trailing-four o'clock (*Allionia incarnata*)	5	7	1	1	2	T	T	T	T	2
Wislizenus spectaclepod (*Dithyrea wislizenii*)	T	T	–	T	2	4	2	1	3	1
Wooly paperflower (*Psilostrophe tagetinae*)	–	–	–	–	–	–	1	1	1	1
Others[2]	1	8	3	5	3	4	1	–	7	6
Total forbs	48	29	24	29	39	28	71	71	61	71
Shrubs										
Mesquite (*Prosopis juliflora*)	–	–	–	5	4	–	8	2	2	1
Soaptree yucca (*Yucca elata*)	–	–	2	–	7	2	3	5	3	1
Torrey ephedra (*Ephedra torreyana*)	–	–	–	5	1	4	–	3	2	–
Total shrubs	–	–	2	10	12	6	11	10	7	2

[1] T = 0.4% or less.
[2] "Others" includes those plant species which either comprised less than 2% of the available herbage or were unimportant in the steers' diets.

of flower stalks of soaptree yucca in the steers' diets changed from approximately 70% of spring diets while comprising less than 4% of available herbage to less than 10% of summer diets when availability dropped to less than 2%.

The high preference for certain species greatly exceeded those reported for any species growing on shortgrass pastures (Beck, 1969) and sandhill ranges (Scales, 1972). Wallace et al. (1972) noted that on certain sandhill ranges, herbage quantity was sufficient to allow cattle to select their total diets from any one of several species. Similar conditions seldom exist on depleted semidesert ranges having mixed plant communities and this might account for high preference values of certain desert plants. Van Dyne and Heady (1965) concluded that less abundant species usually were either highly selected or rejected, while abundant ones furnished the bulk of diets and appeared to be neither preferred nor avoided.

Observations that cattle graze primarily grass (Cook et al., 1967) were substantiated during certain seasons. Cattle preferences for grasses, however, were often low and quantities of grass consumed depended upon season and on palatability of forbs and shrubs. Grass contents of diets varied from as high as 78% in summer to as low as 14% in spring. Herbel and Nelson (1966) reported similar trends.

Mesa dropseed was the most important forage plant, and comprised larger, more consistent portions of diets than any other species. There were not significant season or pasture differences in dietary proportions of dropseed. Cattle grazed less selectively on dead and live dropseed herbage than on any other grass.

Palatability of black grama did not appear as great as reported by early workers (Campbell and Crafts, 1939). Preference for black grama was about average when compared to preferences for other species. Lowest preference occurred in spring while highest preference occurred in winter. Watkins (1955) noted that winter growth activity of black grama increased palatability. This observation was confirmed by highest preference for black grama in the year-long use pasture during winter. Black grama was scarce in pasture 3W, so winter preference could not be evaluated in the seasonal suitability system. Strong preference was also shown for black grama in pasture 3S during summer 1973 when quantities of green forage were limited by drought. Similar findings were reported for cattle diets on semidesert ranges in Arizona (Galt et al., 1969).

Highest grass preferences were obtained for perennial three-awns. Preferences for these grasses were

Table 3. Botanical composition (%) and preference rank[1] of plant species in steer diets on year long (15) and seasonal suitability (3N, 3S, 3W) pastures.

Species	Summer 1972		Fall 1972		Winter 1973		Spring 1973		Summer 1973	
	15	3N	15	3W	15	3W	15	3N	15	3S
Grasses (%)										
Black grama	6 c	16 c	20 c	–	11 b	–	5 c	4 c	12 c	8 b
Mesa dropseed	33 a	29 a	10 c	27 a	16 b	11 b	9 b	12 b	26 b	27 b
Sixweeks threeawn	17 d	30 c	19 d	28 d	7 d	15 d	–	1 d	2 b	1 d
Threeawns	6 c	3 a	2 d	5 a	2 d	1 a	–	–	3 a	4 a
Others[2]	–	–	–	–	–	–	–	–	1	1
Total grasses	62 c	78 c	51 c	60 c	36 c	27 d	14 c	17 c	44 c	41 b
Forbs (%)										
Bladderpod	–	2 a	–	–	–	–	2 a	6 d	1 a	10 b
Deers tongue	–	–	–	–	9 c	5 c	–	–	–	–
Desert holly	–	–	6 a	3 a	1 a	–	–	–	–	–
Goosefoot	6 a	1 b	–	1 c	–	–	–	–	–	–
Hedgemustard	–	–	–	–	14 a	13 a	–	–	–	–
Hymenopappus	–	–	–	–	–	–	2 a	3 a	6 a	7 a
Leatherweed croton	3 d	1c	2 c	5 b	1 c	1 b	1 e	1 d	3 d	2 d
Pepperweed	–	–	–	–	–	–	1 e	–	5 b	T c[3]
Purslane	9 a	3 a	–	–	–	–	–	–	–	–
Russian thistle	4 a	5 c	31 a	16 a	12 a	14 a	–	–	2 a	–
Tansymustard	–	–	–	–	11 a	22 a	–	–	–	–
Wislizenus spectaclepod	1 a	–	–	1 a	5 a	6 c	4 b	1 c	5 b	–
Wooly paperflower	–	–	–	–	–	–	–	–	9 a	8 a
Others[2]	6	3	1	1	–	–	–	1	9	5
Total forbs	29 d	15 d	40 b	27 c	53 b	61 a	10 e	12 e	40 c	32 d
Shrubs (%)										
Mesquite	–	–	–	–	–	–	–	–	1 d	10 a
Soaptree yucca	–	–	2 c	1 a	2 d	–	72 a	67 a	8 a	11 a
Torrey ephedra	3 a	1 a	2 a	8 b	2 b	4 c	–	–	–	–
Total shrubs	3 a	1 a	4 b	9 c	4 d	4 d	72 a	67 a	9 c	21 a
Unidentified (%)	7	7	7	6	8	8	5	5	6	8

[1] Preference rank and meanings are derived from the following preference indices:

Preference Index	*Preference Rank*	*Meaning*
2.1 or greater	a	definite preference
1.4 - 2.0	b	some preference
0.7 - 1.3	c	same in diet as available
0.3 - 0.6	d	some avoidance
0.2 or less	e	avoidance.

[2] "Others" include plant species which never comprised more than 4% of the diets for any pasture or 10-day period in the study.
[3] T = 0.04% or less.

highest in summer 1973 when preferences for mesa dropseed were lowest. Annual grasses, primarily sixweeks threeawn, contributed substantially to cattle diets especially in late summer and fall after perennial grasses had matured and before decomposition of smaller plants became pronounced.

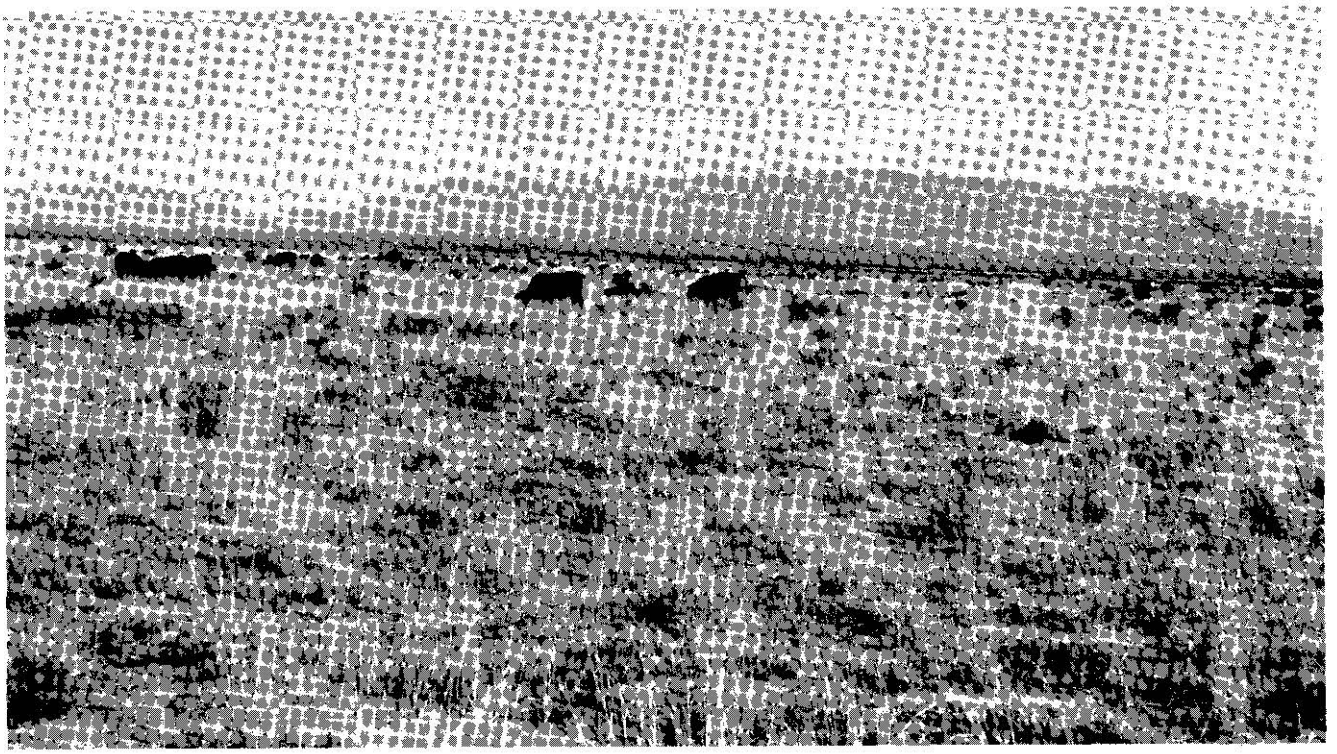
Forb content in diets varied from 61% in winter to 10% in spring and averaged nearly 31% for all seasons. However, most species of forbs were only eaten at certain seasons. Russian thistle was the most dominant forb in diets, particularly in fall when it composed 31% of diets under year-long use conditions. Though not always identified histologically, Russian thistle was observed being grazed in every pasture and at every season. Leatherweed croton and Wislizenus spectaclepod consistently made up small portions of diets. Tansymustard and a hedgemustard were unusually abundant during winter and were the most preferred species during that season. Cattle on other parts of the ranch were observed grazing these forbs persistently. Several cows developed symptoms of tansymustard toxicity, and death of a heifer was attributed to it.

The most dramatic example of selective grazing was soaptree yucca utilization. Steers became adept at locating and cropping developing flower stalks. They spent most of their grazing time searching for yucca plants and would often run to them from

Table 4. Seasonal proportions (%) of grasses, forb, and shrubs in standing crop and steer diets.

Year and season	Grass		Forb		Shrub		Unident.
	Standing crop[1]	Steer diets[1]	Standing crop[1]	Steer diets[1]	Standing crop[1]	Steer diets[1]	Steer diets[1]
1972							
Summer	61[a]	70[a]	39[ab]	21[b]	T*	2[b]	7
Fall	68[a]	55[a]	27[c]	33[ab]	6[a]	6[b]	6
1973							
Winter	58[a]	32[b]	33[bc]	57[a]	9[a]	4[b]	8
Spring	18[b]	15[b]	71[a]	11[b]	11[a]	69[a]	5
Summer	30[ab]	42[ab]	66[ab]	36[a]	5[a]	15[b]	7
Average	47	43	47	32	6	19	6

[1] Means in the same column with different superscripts are significantly different ($P < .05$).
*T = 0.5% or less.



distances of 10 to 15 m. Other cattle in the pastures exhibited similar behavior and rancher observations support these findings.

Mesquite was utilized only in summer 1973 when numerous seedpods were produced. Seedpods constituted most of the consumed material, but small quantities of leaves were also eaten. Higher consumption and preference for mesquite in pasture 3S were attributed to availability of seedpods. Cows had grazed pasture 3S only 2 weeks prior to the collection period and this may have been the reason for more beans being available.

Conclusions

1) Perennial grasses, while representing dependable sources of forage, never comprised more than 50% of the steer diets in any season and should not be used as the sole criterion for estimating forage production or quality.

2) Shrubs and ephemeral grasses and forbs comprised over one-half of the steers' diets in certain seasons, and must be utilized when available if any benefit is to be derived from them.

3) Cattle grazing desert grassland utilize a wide variety of plants when available.

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