Diets and Liveweight Changes of Cattle Grazing Fall Burned Gulf Cordgrass

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Abstract

We investigated effects of fall burning of gulf cordgrass *(Spartina spartinae)* rangeland on winter diets and liveweight gains of cattle on the Texas Coastal Prairie during 1979–1981. Gulf cordgrass dominated steer diets (21–76%) regardless of burning treatment. However, Texas wintergrass *(Stipa leucotricha)* on adjacent upland sites accounted for 13 to 36% of animal diets during winter growth periods. Burning increased dietary crude protein content from January to March in all years and increased in vitro organic matter digestibility during February and March. Cattle gained or maintained weights on burned pastures but maintained or lost weight on unburned pastures. Weight gains of animals with access to burned gulf cordgrass, but not Texas wintergrass, equaled gains of animals grazing unburned gulf cordgrass and Texas wintergrass. Burned gulf cordgrass can provide alternative green forage that will improve diet quality of cattle when cool-season species are absent.

Gulf cordgrass *(Spartina spartinae),* a perennial warm-season species, provides abundant but poor quality forage for cattle grazing the Texas Coastal Prairie (Gould 1975, McAtee et al. 1979 a, b). Oefinger and Scifres (1977) and McAtee et al. (1979 a,b) determined prescribed burning or shredding could enhance nutritional value of gulf cordgrass without damaging stand integrity. However, it remains uncertain whether burning results in direct benefits to grazing livestock.

This study was undertaken to test 3 hypotheses: that gulf cordgrass rangeland burned during fall provides greater dietary crude protein and energy during winter than unburned gulf cordgrass; that fall burning increases the proportion of gulf cordgrass in the diet of free-ranging cattle during the winter; and that cattle grazing fall burned gulf cordgrass rangeland have greater gains in liveweight than cattle grazing unburned areas.

Study Area

The study was conducted on the Rob and Bessie Welder Wildlife Foundation Refuge near Sinton, San Patricio County, Texas, on rangelands adjacent to the Aransas River. The area is semiarid (Thornthwaite 1947). Rainfall occurs throughout the year, with a 24-year annual average of 89 cm at the study location. The growing season normally exceeds 300 days. Soils of the area include 3 series: Odem fine sandy loam (coarse-loamy, mixed, hyperthermic, Cumulic Haplustoll), Sinton loam (fine-loamy, mixed, hyperthermic, Cumulic Haplustoll) and Aransas clay (fine, montmorillonitic (calcareous), hyperthermic, Vertic Haplaquoll). The lowland zone was dominated by saline (7.6 pH) Aransas series.

We observed cattle responses in 5-ha pastures during winter after fall burns in 1979, 1980, and 1981. Six pastures surrounding a marsh were located so as to contain uniform stands of gulf cordgrass (Fig. 1). The stands had not been previously burned but had been part of a moderately stocked rotational grazing system before pastures were established. Two pastures (B&C) were randomly allocated as unburned controls. Pastures A&D were randomly chosen for burning treatment in 1979 and 1981 while E&F were reserved for 1980 burning treatment. Annual burning of gulf cordgrass is not feasible because in a year's time the plant's topgrowth does not senesce sufficiently to carry a fire. Each pasture used for the study included 2 vegetative zones. Monospecific stands of gulf cordgrass dominated lower portions of each pasture (ca. 3-ha); with higher elevations containing *Buchloe-Stipa* grassland and *Acacia-Prosopis* plant communities (Scifres et al. 1980) above (ca. 2-ha). The herbaceous component of the upland areas was dominated by Texas wintergrass *(Stipa leucotricha)* during 1980 and

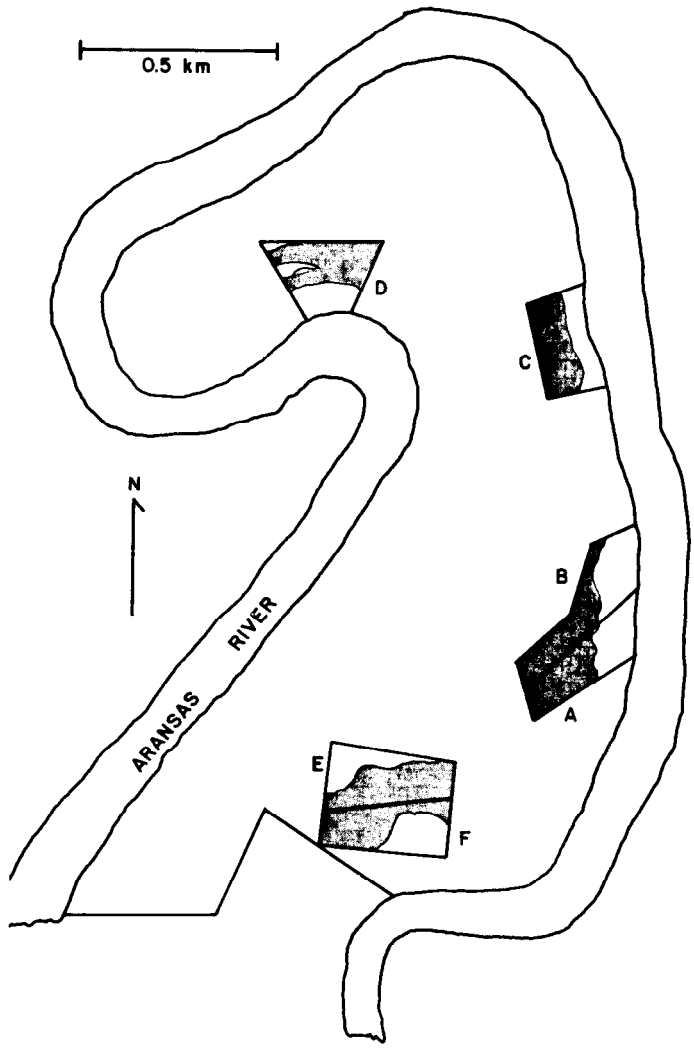

Fig. 1. *Map of experimental pasture locations in the Rob and Bessie Welder Wildlife Foundation Refuge, Sinton, TX. Shaded areas showing location of gulf cordgrass within pastures. Pastures B and C were unburned controls. Pastures A and D were burned in 1979 and 1981; pastures E and F were burned in 1980.*

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1982. During 1981 buffalograss *(Buchloe dactyloides)* dominated uplands on the burned pastures.

Methods

Burning

Burning treatments were applied only to the lower gulf cordgrass zones as headfires following initial backfiring. Burning dates were 23 Oct. 1979; 18 Nov. 1980; and 9 Nov. 1981. Environmental conditions and fine fuel load were measured at the start of each of the burns. Fuel loads were high, ranging from 7,055 to 13,289 kg/ha (Table 1).

Livestock

Brahman × hereford crossbred (0.25 × 0.75) yearlings averaging 205 kg liveweight were selected from a uniform group and randomly allocated to pasture after grouping by weight. Five animals were designated as subsamples within each experimental unit. Three other animals were placed in each pasture to allow stocking rate changes dictated by changing forage conditions. Cattle were stocked on pastures approximately 30 days after burning each year, using grazers to alter stocking rate. Liveweights were recorded without fasting animals, but after trailing them as far as 1.25 km to the weighing facility. We recorded weights monthly during December 15–April 15 the same time each day. Weights were recorded to the nearest 2 kg. Animal gain was calculated monthly as average daily gain.

Diet Collections

Cattle diets were sampled at 4 intervals in each of the 3 years. Four esophageally fistulated steers were grazed in the morning hours in random sequence on each treatment pasture after an 8–12 hr fast. Animals were grazed with cannulas removed and screen-bottom collection bags (1 mm mesh) attached around the neck (Cook 1964, Van Dyne and Torell 1964). We obtained 4 diet samples per pasture at each date.

Diet samples were stirred by hand and randomly subsampled for quality and composition estimates. Subsamples were frozen at −20°C until subsequent lyophilization at −50° C and 0.05 mm Hg. Samples for composition analyses were stored intact; quality samples were ground in a Wiley mill to pass a 2-mm screen.

Diet Quality

We analyzed duplicate subsamples from each animal for crude protein (CP, % organic matter) and in vitro organic matter digestibility (IVOMD). Micro-Kjeldahl procedures (AOAC 1970) were used to estimate percent nitrogen (N), expressed as CP (%N × 6.25). The first stage of the Tilley and Terry (1963) in vitro fermentation procedure was followed by neutral detergent fiber extraction (Goering and Van Soest 1970) to provide an estimate of true forage digestibility. IVOMD of samples was proportionally adjusted to values of laboratory standards of known in vivo organic matter digestibility to correct for variations between runs.

Diet Composition

Diet composition was determined using a point-frame technique. The technique (Chamrad and Box 1964) was altered slightly, in that lyophilized tissues were used, thereby avoiding a water suspension. Lyophilized tissues retained their original physical appearance and were suitable for this study. The fragment hit at each station was identified and recorded. If no hit occurred, the closest fragment to the pin point in a forward 180-degree arc was used. Each sample was analyzed at 20 stations with 5 points per station.

Analysis

Data were analyzed by years using a completely random design analysis of variance for a fixed effects model with 2 replications. Burning treatments and dates within years were main effects. All mean separations were made at $P<0.05$ using Duncan's multiple range test or LSD where appropriate (Steel and Torrie 1960).

Results and Discussion

Burns covered at least 75% of the area in all 3 years. The 1979 burn was most complete, a result of absence of standing water and presence of a dry mulch layer. Fuel was continuous in all years, but in 1980 and 1981 standing water (0 to 25 cm) and decreased quantity of dry mulch left varying levels of stubble and mulch (Table 1). However, burning reduced forage standing crops in all years (Table 2).

Table 1. Environmental conditions and fuel characteristics during burns conducted on the Rob and Bessie Welder Wildlife Foundation Refuge in 1979, 1980, and 1981.

Burn date	Pasture	Wind (km/hr)	Air temp (°C)	Relative humidity (%)	Soil water content (%)	Fuel load (kg/ha)	Fuel water content	
							Standing (%)	Mulch (%)
10/23/79	A	13–16	16	60	19	10,719	56	25
10/23/79	D	10–13	24	38	11	13,289	60	29
11/18/80	E	18–26	10	35	*	10,564	57	67
11/18/80	F	10–16	9	50	*	11,121	53	65
11/9/81	A	11–16	16	63	*	7,055	63	40
11/9/81	D	10–13	17	63	*	8,548	64	56

*Soil was saturated and had 1 to 25 cm of standing water present at the time of the burns.

Table 2. Total availabile standing crop (kg/ha) on burned and unburned pastures on gulf cordgrass rangeland, at the Rob and Bessie Welder Foundation Refuge, Sinton, Texas.[1]

Month	Year					
	1980		1981		1982	
	Burned	Unburned	Burned	Unburned	Burned	Unburned
January	1881	4645*[2]	652	4233*	3178	5122*
February	1773	3440*	459	3207*	2394	4043*
March	530	3400*	545	3003*	1389	3808*
April	438	3567*	429	3336*	1810	4041*

[1]Cordgrass vegetation zone and upland vegetation zones combined after correction for proportion of total pasture area represented by each.
[2]Treatment means for a year and month followed by an asterisk are significantly different ($P<0.05$).

Table 3. Available standing crop (%) of herbaceous and woody (<1m) vegetation as compared to concurrent diet samples (%) from esophageally fistulated steers grazing gulf cordgrass rangeland on the Rob & Bessie Welder Wildlife Foundation Refuge, Sinton, Texas during 1980, 1981, 1982 grazing periods.

	Available Standing Crop								Diet Composition							
	January		February		March		April		January		February		March		April	
Species/Category	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn	Burn	Un-Burn
								1980								
Gulf cordgrass	6	59	2	76	5	82	8	81	70bc[1]	76c	40abc	73bc	33ab	29ab	31ab	21a
Texas wintergrass	21	8	21	4	17	2	26	3	3a	1a	37d	13ab	36cd	25bcd	27cd	17abc
Total graminoids	48	81	32	84	42	92	50	88	98b	98b	95b	99b	95b	71a	90b	72a
Forbs	52	19	68	16	56	5	49	6	3a	2a	3a	1a	4a	14a	7a	12a
Shrubs	0	0	0	0	1	3	1	5	0a	2a	1a	1a	1a	15b	4a	12b
								1981								
Gulf cordgrass	45	47	48	63	27	72	60	64	57b	63b	65b	49ab	11a	37ab	55ab	46ab
Texas wintergrass	0	10	0	11	0	8	2	11	0a	1a	2a	27b	3a	19ab	0a	8a
Total graminoids	95	76	91	94	60	88	80	87	100	74*	97	91	61	86*	91	70
Forbs	3	21	6	5	30	7	8	11	0	16*	3	4	16	11	4	9
Shrubs	2	3	3	1	10	5	12	2	0	10	1	4	21	2*	5	21
								1982								
Gulf cordgrass	3	53	4	66	8	72	12	68	59bc	12a	80d	44abc	37ab	25a	49abc	24ab
Texas wintergrass	5	5	21	10	12	6	11	2	11ab	21ab	4a	13ab	32b	32b	18ab	15ab
Total graminoids	73	90	68	91	59	85	50	82	100b	94b	97b	97b	96b	96b	98b	83a
Forbs	27	10	27	9	38	12	49	16	0a	4ab	2ab	2ab	3ab	4ab	2a	10b
Shrubs	0	0	5	0	3	3	1	2	<1a	2a	<a	<1a	2a	4a	<1a	5a

[1]Means for a diet composition category within years followed by a common letter are not significantly different at 0.05 level.
*Means within a month significantly different at 0.05 level.

Diet Composition

Gulf cordgrass dominated extrusa regardless of burning treatment, probably because of the relatively greater quality of live tissue in topgrowth of unburned gulf cordgrass (Scifres and Drawe 1980) as compared to dormant plants, and the predominance of the cordgrass in unburned stands (Table 3). Cattle on burned treatments frequently ate gulf cordgrass even though its availability was lower on those pastures; extrusa from burn treatments generally contained >30% gulf cordgrass. When alternative forage was present in burned treatments, as in March 1981, gulf cordgrass was consumed less frequently while sedges, forbs, and shrubs temporarily increased in diet samples. Gulf cordgrass content in extrusa from diets from burned areas rarely exceeded its contribution to diets in unburned areas. Precipitation in October 1981 exceeded 30 cm and promoted extensive growth of forage prior to grazing, possibly affecting animal preference by increased availability and quality of other species. These data show that gulf cordgrass will not be grazed to the exclusion of other species and therefore any management scheme must consider all species present.

Texas wintergrass was frequently found on upland areas burned in 1980 and 1981 and in the unburned pastures B & C. We noted its increase in extrusa samples during February or March occurred subsequent to onset of active growth. Low precipitation in fall, 1979 resulted in less Texas wintergrass growth in unburned treatment pastures. Texas wintergrass was initially rare in diet samples from burned treatments, but increased later in 1980. Cattle grazing burned pastures readily consumed Texas wintergrass when it was actively growing, but spent much time grazing low elevation burned areas containing gulf cordgrass.

Forbs were eaten infrequently, but contributed protein disproportionate to their occurrence in diets (Huston et al. 1981). Forbs comprised 26% of January 1981 diets for cattle on unburned treatments, a time when diet quality estimates of burn and control treatments were similar.

Diet Quality

Extrusa IVOMD was improved by burning treatment except in 1982 (Table 4). Diet samples from burned areas in February and March 1982 contained greater % live leaf than those from unburned (68 and 93% for burned vs. 40 and 73% for unburned). In other months and years, extrusa had similar live leaf content (Angell 1983), coincident with similar IVOMD observed for both treatments. The shift away from gulf cordgrass to other species in 1982 did not improve cattle diet quality over quality levels observed on burned areas. Extrusa samples obtained in 1981 contained ≥ 95% graminoids, predominately gulf cordgrass. Forbs and shrubs were similar in both treatments during 1982, giving a clearer picture of the contribution of gulf cordgrass and Texas

Table 4. Crude protein (%) and in vitro organic matter digestibility (%) of extrusa samples from fistulated cattle grazing burned or unburned gulf cordgrass in conjunction with unburned upland vegetation.

	Crude protein		Organic matter digestibility	
Month	Burned	Unburned	Burned	Unburned
		1980		
January	8.7 b[1]	5.6 a	48 a	45 a
February	12.5 c	6.8 a	52 b	46 a
March	14.4 d	12.4 c	58 cd	56 bc
April	14.6 d	14.4 d	65 e	62 de
		1981		
January	8.5 a	8.1 a	58 a	56 a
February	7.8 a	8.6 a	57 a	60 ab
March	14.4 d	11.1 b	70 d	64 bc
April	13.1 cd	12.0 bc	63 bc	65 c
		1982		
January	10.8 bc	9.7 b	60 de	58 d
February	7.4 a	5.7 a	50 b	46 a
March	14.2 e	11.3 bcd	62 e	54 c
April	12.4 cd	12.7 de	67 f	63 e

[1]Means within years for a diet category followed by a common letter are not significantly different at 0.05 level.

wintergrass to diet quality. Reasons for the lack of improvement of IVOMD are not readily apparent. Regrowth of burned gulf cordgrass can be highly digestible (McAtee et al. 1979 a), but quality of clipped regrowth samples is variable (Oefinger and Scifres 1977).

Diet CP improved in March each year regardless of burning treatment (Table 4) because new forage growth began for all species. We surmise that cattle diet quality will be low during midwinter but will exceed requirements of growing cattle after March 1. During January 1980 Texas wintergrass was dormant following a dry fall. At that time extrusa samples from burns contained 70% gulf cordgrass, controls 76%. Extrusa from burned areas had significantly greater CP than samples from unburned controls, apparently a result of consumption of gulf cordgrass regrowth in burned treatment pastures.

Livestock Performance

In 2 of 3 years, cattle on burned treatment pastures gained at a greater rate than on unburned pastures (Table 5). The midwinter

Table 5. Average liveweight (kg) and average daily gain (ADG) (kg/au/da) of yearling cattle grazing burned or unburned stands of gulf cordgrass on the Rob and Bessie Welder Wildlife Foundation Refuge.

	Liveweight		ADG	
Period	Burned	Unburned	Burned	Unburned
		----------1980----------		
Dec.–Jan.	222 ab[1]	218 ab	–.09 a	–0.20 a
Jan.–Feb.	220 ab	212 a	–.08 a	–0.18 a
Feb.–Mar.	237 b	217 ab	0.52 c	0.15 b
Mar.–April	257 c	228 ab	0.51 c	0.28 b
Season average[2]			0.21 y	0.01 x
		----------1981----------		
Dec.–Jan.	229 a	226 a	–0.06 a	0 a
Jan.–Feb.	231 a	227 a	0.09 ab	0.04 ab
Feb.–Mar.	237 a	230 a	0.17 b	0.07 ab
Mar.–April	254 b	247 b	0.48 c	0.50 c
Season average			0.17 x	0.15 x
		----------1982----------		
Dec.–Jan.	219 cd	206 abc	–0.07 bc	–0.30 a
Jan.–Feb.	221 d	205 a	0.10 c	–0.05 bc
Feb.–Mar.	215 bcd	201 a	–0.23 ab	–0.16 ab
Mar.–April	242 e	219 cd	0.74 e	0.50 d
Season average			.14 y	0 x

[1]Means for liveweight or ADG within a year followed by a common letter are not significantly different at $P<0.05$.
[2]Season averages within years followed by a common letter are not significantly different at $P<0.05$.

period of late December to February was critical as indicated by generally negative rates of gain. That period was characterized by frequent cold, damp weather which stressed animals. At that time both diet quality and forage growth rate were increasing, yet livestock gains were poor until after mid March, indicating growing animals grazing burned gulf cordgrass will need some form of supplementation to maintain gains during mid-winter. Mature cows, have lower requirements for nutrient concentration (NRC 1984) and consequently would probably require little or no supplementation when grazing on burned gulf cordgrass range.

When cattle had access to both Texas wintergrass and burned gulf cordgrass, as in 1980 and 1982, associated spring ADG was greater than ADG on unburned areas. Cattle on burned gulf cordgrass pastures tended to maintain weight better in winter and gained weight faster in spring than cattle on unburned pastures.

During 1981, weight gains of cattle with access to burned gulf cordgrass but not to Texas wintergrass equalled gains of cattle with access to Texas wintergrass but not to burned gulf cordgrass. This points to the value of Texas wintergrass as a winter forage and gives insight into the better performance noted for 1980 and 1982.

Conclusions

Regrowth of burned gulf cordgrass vegetation will improve cattle diet quality during late winter and early spring. Cattle grazing burned gulf cordgrass will out perform cattle on unburned gulf cordgrass when other forage species are equally represented. Even when cattle do not have access to quantities of cool-season grasses, access to burned gulf cordgrass will provide diet quality and animal performance to levels similar to pastures which contain Texas wintergrass. Prescribed burning of gulf cordgrass is an effective means of improving diet quality during winter and can be expected to result in lowered supplemental feeding in winter. Rotation periods greater than the 1-year interval used here may be needed to provide enough standing dead material to provide a complete and uniform burn on gulf cordgrass communities.

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