50 Years of RANGE RESEARCH REVISITED

With a Special Focus on Current Research

KSU RANGE FIELD DAY

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50 YEARS OF RANGE RESEARCH REVISITED

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INTRODUCTION

Native Range Resources of Kansas

Kansas grassland evolved under semi-arid to subhumid climates, characterized by much the same weather extremes of temperature, rainfall, and snowfall we are familiar with today. As a result of prehistoric glacial activity and other natural forces then and later, plants have migrated from their places of origin, so that today Kansas ranges are simple-to-complex mixtures of perennial grasses and forbs, plus a few native annuals and biennials. Species composition has been modified by the introduction of Kentucky bluegrass and cool-season annual grasses, particularly Japanese brome. Most of the introductions are now "naturalized" enough to be considered permanent parts of Kansas range vegetation.

Through the ages to modern times, wildfires - many started by lightning, but most by primitive people - influenced development of fire-tolerant grasses and suppressed woody vegetation. Certain woody plants, however, always were present as natural components of some grasslands. Browsing by animals and frequent prairie fires were largely responsible for maintaining "normal" amounts of woody species.

In prehistoric time, numerous large herbivores subjected herbaceous vegetation to grazing stress. After the last glacial retreat (15,000 to 25,000 years ago), buffalo emerged as the major dominant large grazer, although the prairies and plains simultaneously supported many pronghorn antelope, elk, deer, prairie dogs, rabbits, rodents, and insects. And each exerted grazing pressures on the vegetation. There is little doubt that during and long before Spanish explorations into Kansas, most of the grassland was used almost continuously throughout the year by one roving herd of buffalo after another and other grazing animals. Grazing and trampling by buffalo and their associates were often intensive, as was uncontrolled grazing by livestock in the late 1800s after most of the wild grazers had been eliminated.

Palatable plants have persisted under nearly all grazing regimes by domestic livestock, whether or not the ranges have been managed economically. The ability of desirable range plants to endure and recover from heavy use underscores the important role of prehistoric grazers in range-plant evolutionary development.

Approximately two-fifths of Kansas (about 20 million acres) is native rangeland, reestablished native range, and grazed woodland. Native vegetation is characterized by various kinds of grassland. Most stockmen and others in the field of range management have general knowledge of kinds and amounts of forage that can be produced on conservatively stocked ranges in different geographical areas. Although important features of range production are reasonably well understood, grazing management and related practices that affect livestock performance are not so well understood.

Importance of Range and Range Livestock Management

Kansas has more than 6 million head of cattle. About 1.7 million beef cows and their calves depend entirely or in part on native range, and 1.75 million grass-fed cattle and calves are marketed in the state each year. In addition, 170,000 sheep and a variety of wildlife, including approximately 35,000 deer, share the range resources and supplementary roughages. The need to improve conversion efficiency of forages to livestock products already exists; future demands on the state's grazing resources will be even greater.

Use of native range for livestock production involves change, including problems and opportunities that accompany change in management. Grazing procedures should be appraised regularly and altered to take advantage of practices that research demonstrates to be more profitable than existing ones.

Early research by the Kansas Agricultural Experiment Station on range and range livestock related burning practices and stocking rates to the conservation of Flint Hills grazing resources. Over the years, research priorities have shifted toward increasing range livestock production efficiency on a sustained basis throughout the state. Investigations at both Manhattan and Hays have centered on improved livestock performance in harmony with maintaining desirable plant composition, optimum forage yields, wildlife habitat needs, watershed protection, recreational requirements, and esthetic values.

Presented here are recommendations for range and range-livestock management based on experiments at Manhattan and Hays. Practices that make more efficient use of grazing resources should increase livestock production and improve economic returns to producers, communities, and the state.

SECTION 1

Proper Stocking Rates

Proper grazing intensity of native range requires stocking so livestock can convert forage to saleable products most efficiently and economically on a sustained basis. The plant community must be maintained in a vigorous condition to provide desirable vegetation, sufficient ground cover for soil and water conservation, and habitat for wildlife and to increase the probability of a reliable forage supply during drought.

In long-term, rate-of-stocking studies at Manhattan and Hays, forage production was greatest on lightly stocked, intermediate on moderately stocked, and least on heavily stocked ranges (Figures 1 and 2). Moderate stocking, the most economically efficient grazing intensity, left 40 to 60 percent of the current year's forage ungrazed at the end of the growing season.

Quality of range vegetation varies not only among plant species, plants of the same species, and plant parts, but also with weather and soil characteristics, and seasonally with plant development, age of regrowth, grazing management, and such range treatments as burning, mowing, nitrogen fertilization, and pesticide applications. Forage samples collected from esophageally-fistulated steers grazing Flint Hills bluestem range had consistently higher crude protein and digestible energy than did forage samples clipped to approximate grazing activities of the livestock. Properly-stocked ranges are grazed in small-to-large patches, rather than uniformity throughout, because given the opportunity, livestock choose their diets. Selective grazing is highly important for animal performance, so ample forage should be available to livestock the entire time they are on range. Overstocking ranges to the extent that grazing animals are restricted to forage they would not otherwise select is a major cause for reduced stocker gains, reproductive performance, and weaning weights.

Proper stocking of native range is using the fewest acres a grazing animal requires to achieve maximum performance in a specified time (Table 1, and Figure 3). Proper stocking also maintains desirable and vigorous range plant communities. Overstocking shortgrass range near Hays throughout the growing season for seven years reduced soil-moisture intake on a clay upland range site. Lowered plant vigor from heavy grazing and decreased water penetration from intensified soil packing interacted to change plant species composition and to reduce forage production.

Recommendations:

- Stock ranges at "long-term" rates that will maintain desirable, vigorous plant species from season to season.

- Encourage livestock to graze the range as evenly as economically feasible: Control availability of drinking water at wells and by fencing ponds; place salt boxes, mineral feeders, back oilers, dust bags, and other objects that attract livestock to less-used parts of the range; and fertilize small areas with nitrogen or burn an acre or less on sites where conventional aids do not attract grazing animals satisfactorily. Ride the range frequently and drive livestock into underutilized areas.

- Keep in mind that range forage production may vary widely from season to season, but that livestock performance is not benefited by varying stocking rates seasonally in attempts to match changes in plant production. During severe drought, however, remove stock from ranges earlier than normally anticipated to avoid weight losses.

- Judge proper stocking rates by evaluating these factors: Individual animal performance (profitable stocker gains, weaned calving percentages, and weaning weights); presence of the major desirable grasses and forbs that are adapted to each range site; and patchy covering of ungrazed forage remaining at the end of the growing season and at the start of the next growing season.

Figure 1. Forage yields and forage left at the end of the grazing season on Flint Hills bluestem range site stocked heavily, moderately, and lightly with yearling steers from May 1 to October 1 from 1950 through 1966. Data presented below are from 1958 through 1966.

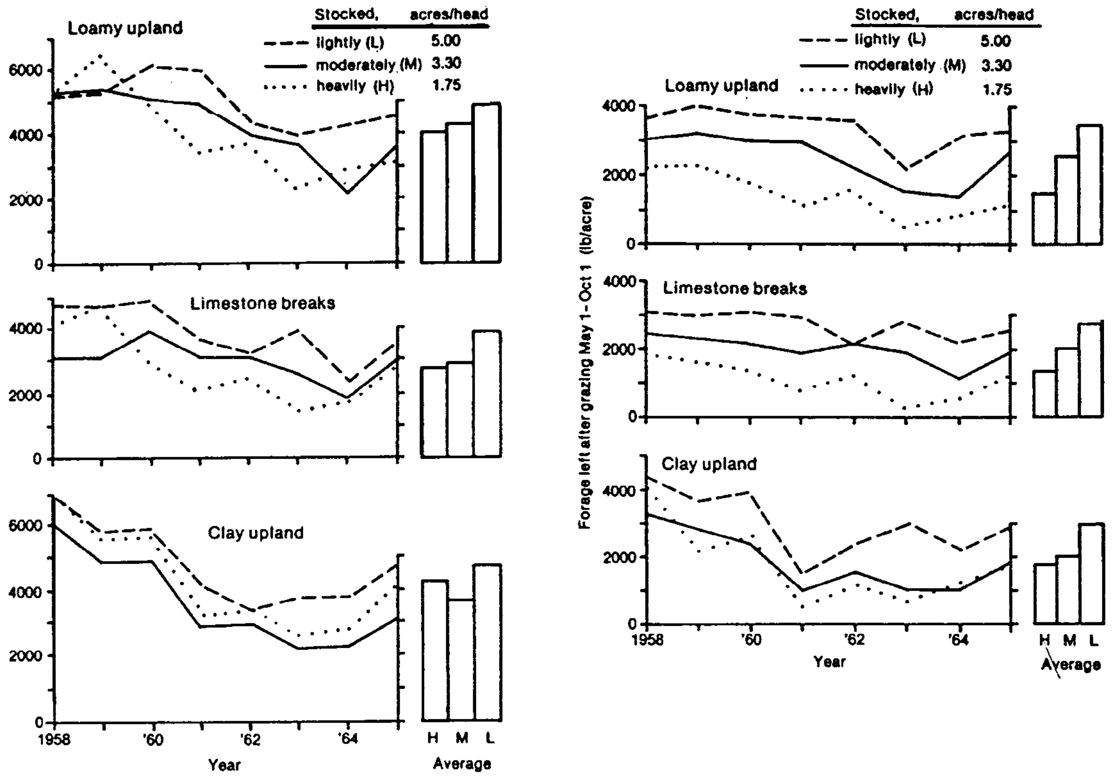


Figure 2. Forage yields and forage left at the end of the grazing season on a clay upland range site stocked stocked heavily, moderately, and lightly with yearling steers from May 1 to October l from 1956 through 1966

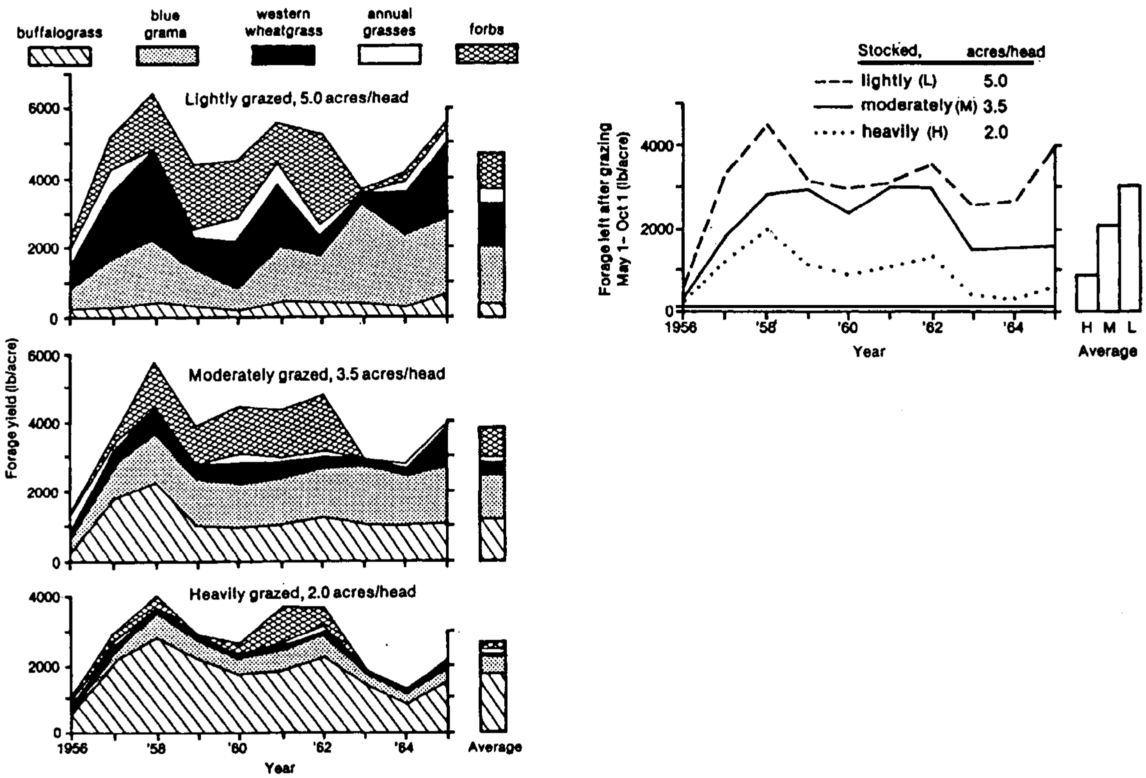


Figure 3. Average cumulative gains of yearling steers on Flint Hills bluestem range (left) and clay upland shortgrass range (right) stocked lightly, moderately, and heavily from May 1 to October 1, 1950-1966 at Manhattan and from May 1 to November 1, 1946-1957 at Hays.

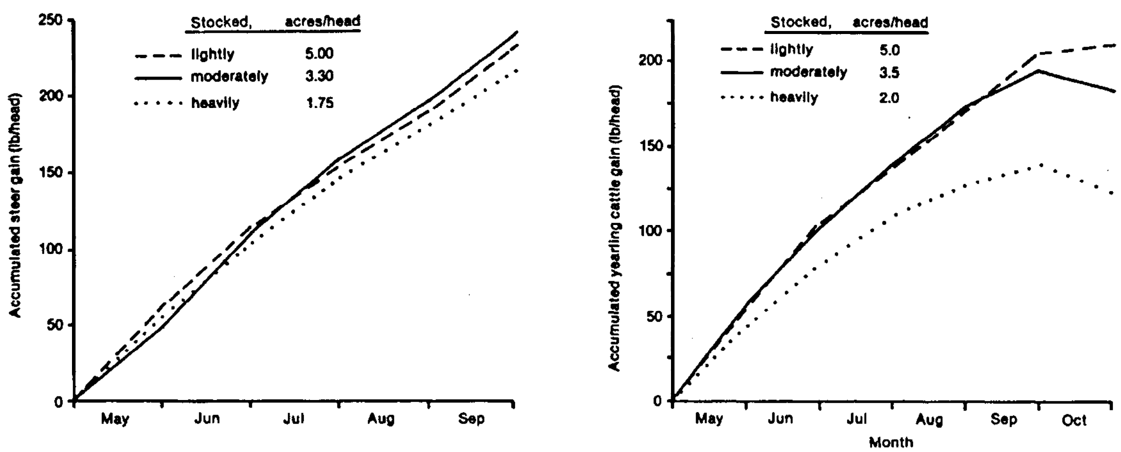


Table 1. *Average daily gains of yearling steers on Flint Hills bluestem range stocked lightly, moderately, and heavily May 1 to October 1, 1950 to 1966.*

Range stocked		Month					May-Oct average
		May	Jun	Jul	Aug	Sep	
May l-Oct 1	Acres/head	Yearling steer daily gain (lb/head)					
Lightly	5.00	1.99	1.71	1.37	1.21	1.34	1.52
Moderately	3.30	1.83	1.74	1.58	1.24	1.24	1.57
Heavily	1.75	1.86	1.75	1.28	1.16	1.10	1.43

SECTION 3

Deferred-rotation Grazing

A three-pasture rotation system was compared with season-long, continuous grazing from 1950 to 1967 at Manhattan (Figure 4). Concentrating livestock on two pastures to defer grazing on the third, and grazing the deferred pasture heavily the latter part of the growing season reduced gains of yearling steers an average of 23 pounds per head (Figure 5). Compared with seasonlong continuous grazing, average daily gains of steers in the deferred-rotation system decreased significantly after the first two months of the grazing season. The deferred-rotation system, however, favored desirable plant species, increased grass production, and decreased forb yields (Table 2).

Major Conclusions from Research on *Grazing Systems* The indicated increase in carrying capacity shown by the deferred-rotation system studied in Flint Hills bluestem at Manhattan was approximately 16 percent. Considering that under deferred-rotation grazing, yearling steers gained an average of 23 pounds per head less than did those under continuous grazing stocked at the same rate, “stocking up” to take advantage of increased carrying capacity would have further reduced individual gains while possibly increasing gains per acre.

Livestock performance per head is a function of stocking rate rather than of range condition. Increasing stocking rates to take advantage of improved range condition increases livestock gain per acre but reduces individual animal performance. Usually it is most profitable to stock range for maximum individual animal performance, with as many individuals as possible making top performance (reproductive efficiency, weaning weight, gain per head). It is unrealistic to assume that increased gain per acre will compensate for reductions in gain per head, unless livestock market prices and production costs are compatible.

In planned grazing systems, as with other methods of managing livestock on range, the practicality of procedures that increase carrying capacity and/or livestock production must be evaluated on the basis of livestock market prices, production per animal, production costs (fertilization, expansion of facilities, additional labor and management costs, etc.), and the role of such systems in integrated livestock production programs. Profitability of livestock gains on range may depend on compensatory gain efficiency of young animals and cost items in the total livestock production enterprise.

Recommendations

- Poor-condition range probably benefits more from deferred-rotation grazing at stocking rates commensurate with optimum livestock performance than does comparably stocked range in good-to-excellent condition. Therefore, consider current range condition when contemplating specialized grazing systems.

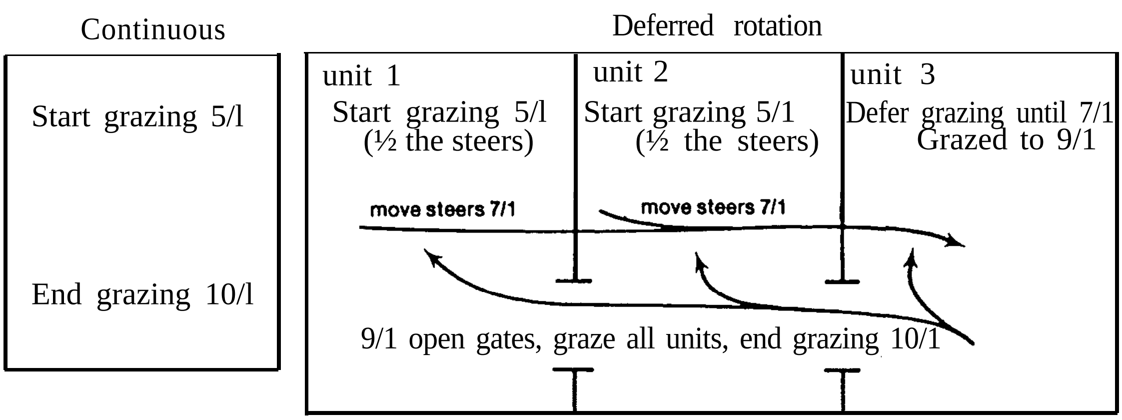
- In so far as possible, base stocking rates on livestock performance and attempt to arrive at the optimum production per head in relation to beef production per acre.

- To resolve grazing-distribution problems that cannot be overcome by conventional livestock distribution measures, force animals to use the entire range more uniformly by cross-fencing. Place division fences so that resulting units will be of optimum size. Pay particular attention to livestock watering developments, and relative location of under- and overused areas. Stock each range unit simultaneously or in a deferred-rotation system, depending on the adaptability of management options and livestock performance (in relation to grazing system) during two or three seasons.

- Avoid moving livestock from relatively immature to mature vegetation.

- Adapt all grazing systems to the nutritional and reproductive needs of livestock.

Figure 4. Schematic for a deferred rotation grazing system stocked with yearling steers on Flint Hills bluestem range from May 1 to October 1, 1950-l967.



Deferment rotated to unit 2 (2nd year), unit 3 (3rd year), etc.

Figure 5. Average cumulative gains (left) and average daily gains (right) of yearling steers on Flint Hills bluestem range stocked season-long or in a deferred rotation system from May 1 to October 1, 1950-1967. * = Gains/hd/day within a given month are statistically different (P<.005).

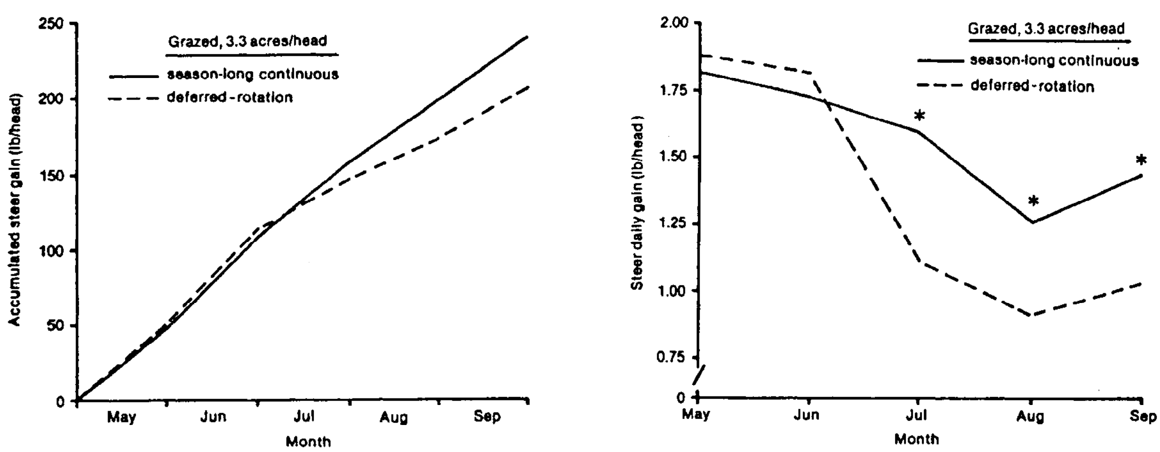


Table 2. *Grass and forb average yields on indicated Flint Hills bluestem range sites grazed by yearling steers season long continuously and in a seasonal deferred-rotation system. May 1 to October 1, 1950 to 1967.*

Forage group	Grazing	Range site: Loamy upland	Range site: Limestone breaks	Range site: Clay upland	Average[1]
	3.3 acres/head	Yield (lb/acre, air-dry)			
Grass	Season-long, continuous	3920	2560	3160	3390
	Deferred rotation	4250	3400	3970	3970
Forbes	Season-long continuous	300	340	490	360
	Deferred rotation	270	160	340	26011

1. Averages weighted according to relative proportion of the three range sites.

SECTION 4

Intensive Early Stocking

Results of Manhattan, KS Research

Rate-of-stocking studies near Manhattan on Flint Hills bluestem range grazed May 1 to October 1 showed that yearling steers made approximately two-thirds of their total gain during the first half (May 1 to July 15) of the growing season from 1950 to 1967. Stocking heavier increased total beef production per acre but reduced individual animal gains during the five months or the summer grazing season. Gains per head, however, were not reduced by any increases in stocking rate from start of grazing until July 15; heavier stocking rates after July 15 decreased animal gains.

Research on intensive early stocking Flint Hills bluestem range compared season-long stocking (3.3 acres per yearling steer, May 1 to October 1, on both unburned and late-spring-burned range) with twice the normal season-long stocking rate (1.67 acres per yearling steer on late-spring-burned range) May 1 to July 15. In contrast with season-long grazing, intensive early stocking increased beef production 35 pounds per acre over gains from unburned range and 22 pounds per acre over gains from burned range (Table 3). During the first 10 weeks of the forage growing season, steers grazing intensively early-stocked range and those grazing all season on burned range gained the same up to July 15; so individual performance was not reduced by doubling the stocking rate the first half of the growing season.

The large increase in livestock gain per acre from intensive early stocking resulted from steers averaging 1.83 pounds per head daily for two and one-half months compared with only half as many animals averaging 1.30 pounds daily on burned range and 1.07 pounds daily on unburned range stocked season-long for five months (Table 4).

Perennial grass yields were slightly higher (Tables 5) and forb and brush production lower on range stocked intensively early in the growing season than on ranges grazed at the normal rate all season (Table 6).

Grass-stand composition steadily improved on range stocked intensively early and remained stable or deteriorated on ranges stocked all season; forbs increased in the plant cover more under season-long stocking than under intensive early stocking.

Grazing distribution was more nearly uniform on range stocked intensively early in the season than on burned range stocked all season. Fuel for burning was distributed more uniformly on intensively early stocked range than on range grazed season long.

Livestock concentration, shortness of grazing season, and evenness of burning probably interacted favorably to improve grazing distribution.

By the end of growing season, food reserves in big bluestem (a major constituent of Flint Hills bluestem range) did not differ between ranges stocked intensively early in the season and those stocked all season (Figure 6). That is, heavier-than-normal grazing each spring, followed by summer-fall resting, did not reduce range-plant vigor after three years.

Intensive-Early Stocking - Stocking Rate

Stocking rate effects on intensive-early stocked Kansas Flint Hills range were studied from 1982 through 1987. Rates were 2X, 2.5X, and 3X normal season-long stocking rates for 500-550 lb steers. Overall, growing season precipitation during the study period was below normal, with late-summer precipitation much below normal in the second and third years of the study. Grass remaining in mid July decreased with increased stocking rate, but by early October was similar under the 2.5X and 3X stocking rates, but continued to be lower than that under the 2X rate. There was no difference in forb herbage in mid July forb standing crop with respect to stocking rate. In early October, forb herbage was either not affected by stocking rate (1993, 1986, and 1987) or was greater under the highest stocking rate (1982, 1984, and 1985). The major changes in botanical composition and basal cover were a reduction in Indiangrass and an increase in Kentucky bluegrass as stocking rate increased. Botanical composition of big bluestem increased under the 2X rate, but did not change under the higher rates. Steer gains (lb/head) differed among years, but within each year, gains were similar on pastures stocked at different rates (Table 7). Year-to-year variability in steer gains was likely due to changes in cattle type used in the study. In 1982 and 83, British-cross steers purchased from local sale barns were used. During the remainder of the study, Brangus-cross steers from a single source were used. Because average daily gain was not influenced by stocking rate, gain per acre was increased in direct proportion to increasing stocking rate.

Intensive-Early Stocking - Grain Supplementation

A 4-year study was conducted on Kansas Flint Hills bluestem range to monitor animal gain, grass and forb standing biomass following grazing, plant population dynamics, and in two years, subsequent feedlot performance of steers under intensive-early stocking supplemented with increasing levels of sorghum grain. Each year from 1988 through 1991, crossbred beef steers were stocked at 0.24 ha/100 kg of initial steer weight from 5 May to 15 July. Steers in twice-replicated pastures were given no supplementation, 0.91 kg rolled sorghum grain per head daily, or 1.82 kg rolled sorghum grain per head daily, which corresponded to approximately 0, 0.3, and 0.6% of body weight $^{-1}$. All steers were implanted with estradio1 17 beta in 1988 and zeranol in

1989-91 during initial processing and had unlimited access to a lasalocid/mineral mixture during the entire trial. In 1989 and 1990, representative groups of steers selected from all treatment/pasture combinations were subjected to a feedlot finishing phase and carcass data were obtained. Grass and forb standing crops were estimated each year at livestock removal in mid July and again in early October. Pretreatment species composition and basal cover were determined in 1988 and compared to those at the end of the study. In mid July, when cattle were removed, residual standing biomass of grass increased in direct proportion to increasing level of supplement. Standing biomass of grass at the end of the growing season did not differ among pastures with different supplement levels. Forb standing biomass did not differ among pastures with different supplement levels in July or October. Changes in plant populations among treatments during the course of the study were minimal. During the early portion of the grazing period, sorghum grain supplementation did not significantly influence steer gains, but average daily gain during the latter part of the grazing period increased in direct proportion to increasing level of sorghum grain supplement (Table 8). Daily gain, feed intake, carcass characteristics, and gain:feed ratio were not different among treatments during the feedlot phase (Table 9). Although conversion efficiencies may be economically marginal, low-level grain supplementation has the potential to increase the daily gain of cattle grazing early-season tallgrass prairie under an intensive-early stocking program.

Recommendations

- Use stocker-type grazing animals for intensive early stocking; the system is suited for weaned livestock that is still growing, but it is not practical for reproductive stock.

- Burn range concurrently with start-of-growth of the major warm-season perennial grasses, which generally is late April in northern Kansas and mid-to-late April in southern Kansas. Stock two times the normal seasonal rate for yearling animals from the beginning of the forage growing season to July 15, then move the livestock to a feedlot.

- After November 1 to start off forage growth the next spring, you can use the carry-over old growth as a holding area for stockers as they are accumulated to be ready for intensive early stocking during the spring growing season or for a cow herd.

Figure 6. Food reserves of big bluestem on pastures stocked intensive-early and season-long with steers from 1972 through 1975.

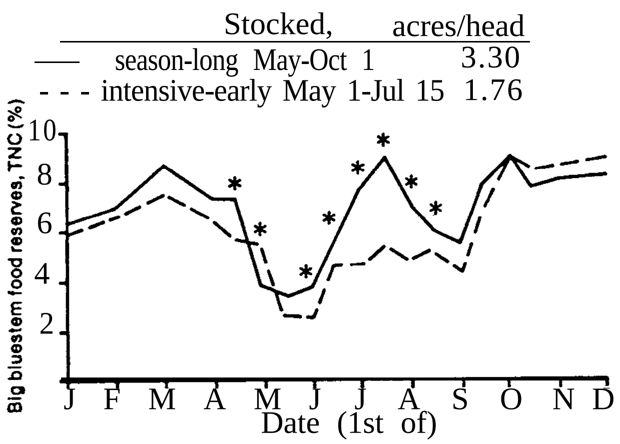


Table 3. *Beef production per acre by yearling steers on Flint Hills bluestem range under season-long and intensive-early stocking and indicated late-spring burning treatments. 1972 to* 1977.

	Stocking system		
	Season-long May l-October 1, 3.30 acres/head		Intensive-early May l-July 15, 1.67 acres/head
Year	Range not burned	Range burned May 1	Range burned May 1
	Yearling steer beef production (lb/acre)		
1972	30	56	79
1973	41	48	72
1974	61	79	94
1975	48	49	70
1976	54	63	93
Average	47	59	82

Table 4. *Daily gains of yearling steers (lb/head) on Flint Hills bluestem range under season-long and intensive-early stocking and indicated late-spring burning treatments, 1972 to 1977.*

	Stocking systems		
	Season-long May 1-Oct 1, 3.30 acres/head		Intensive-early May 1-Jul 15, 1.67 acres/head
Year	Range not burned	Range burned May 1	Range burned May 1
	Yearling steer daily gain (lb/head)		
1972	0.84	1.23	1.72
1973	0.90	1.06	1.51
1974	1.30	1.69	2.11
1975	1.17	1.18	1.78
1976	1.14	1.34	2.03
Average	1.07	1.30	1.83

Table 5. *Average yields of perennial grass for three major Flint Hills bluestem range sites under season-long and intensive-early stocking with yearling steers. 1972 to 1975.*

	Stocking system	
Range site	**Season-long May 1-Oct 1, 3.30 acres/steer**	**Intensive-early May 1-Jul 15, 1.67 acres/steer**
	Perennial grass yield (lb dry matter/acre)[1]	
Loamy upland	2480	2860
Limestone breaks	2190	2440
Clay upland	2270	2000
Average	2310	2500

1. Range late-spring burned annually May 1.

Table 6. *Combined yields of major perennial forb and brush species on grazed and ungrazed areas averagedfor three major Flint Hills bluestem range sites and, for years indicated, under season-long and intensive-early stocking with yearling steers, 1972 to 1975.*

		Stocking system	
Area	Year	Season-long May 1-Oct 1, 3.30 Acres/steer	Intensive-early May l-Jul 15, 1.67 acres/steer
		Perennial forb + brush yield (lb dry matter/acre)[1]	
Grazed	1972	310	140
	1973	290	270
	1974	280	370
	Average	290	260
Not grazed	1972	430	210
	1973	570	320
	1974	410	520
	Average	470	350

1. Range late-spring burned annually May 1.

Table 7. *Influence of stocking rate on average daily gain of intensive-early stocked steers.*

	Stocking Rate						
	Gain per steer (lb/d)				Gain per acre, lb		
Year	1.75	1.50	1.25	Average	1.75	1.50	1.25
1982	139	128	136	134[a]	76	84	113
1983	132	121	136	130[a]	73	80	112
1984	165	165	167	167[b]	91	109	137
1985	207	185	174	189[c]	114	121	143
1986	185	189	196	189[c]	101	125	160
1987	178	183	187	183[c]	98	120	154
Average	167	163	165		92	106	136

[a,b,c] Year averages with a common superscript are not different (P<.01).

Table 8. *Influence of Level of Grain Supplementation for Intensive-Early Stocked Steers on Average Daily Gain (ADG)*

	Level of Supplementation			Probability [a]	
Item	**0**	**2**	**4**	**L**	**Q**
Early ADG, lb/d (5/1 - 6/7)	2.48	2.61	2.79	. 32	.53
Late ADG, lb/d (6/8 - 7/15)	1.90	2.25	2.39	.07	.54
Total ADG, lb/d (5/l - 7/15)	2.19	2.43	2.59	.16	.86

[a] L = linear effect of increasing supplement level; Q = quadratic effect of increasing supplement level.

Table 9. *Influence of supplementation level during the intensive-early stocking period on subsequent feedlot performance and carcass characteristics of steers* (2 *yr summary).*

	Levels of Supplementation			Probability [a]	
Item	**0**	**2**	**4**	**L**	**Q**
Initial Wt, lb	780	796	807	.11	.88
Final Wt, lb	1173	1191	1194	.16	.55
DMI, lb/d	22.3	22.5	22.4	.87	.51
ADG, lb/d	3.48	3.51	3.44	.68	.53
Gain:Feed	.156	.156	.154	.61	.89
Carcass Wt, lb	720	731	737	.07	.70
Dressing %	64.1	63.8	64.6	.07	.07
Yield Grade	3.00	3.05	2.99	.95	.61
Marbling	Sm^{27}	Sm^{33}	Sm^{20}	.61	.40

[a] L = linear effect of increasing supplement level; Q = quadratic effect of increasing supplement level.

SECTION 5

Prescribed Burning

Fire has always occurred on grasslands; in recent times it has been used as a management practice to increase livestock production and maintain high-quality rangeland. Prescribed burning has been researched on Flint Hills bluestem range near Manhattan since the early 1900s, on various range sites in central Kansas since 1971, and on clay upland shortgrass range near Hays since 1975.

Burning bluestem range May 1, after spring growth had started, had no major effects on forage quality or the chemical composition of yearling steer diets from May 1 to October 1 (Table 10). Although yearling steers selected forage higher in crude protein and lower in lignocellulose than in samples hand-clipped (on both burned and unburned range), they also took in larger proportions of lignin and relatively indigestible cell-wall constituents. There was little difference in apparent digestibility of steer diets on unburned or burned range, yet animals on range burned in late spring gained approximately 11 percent more than did those on unburned range (Figure 7). The differences in livestock performance, despite similarities in diet composition, indicated that forage intake by yearling steers was greater on burned than on unburned range.

A long-term study comparing the effects of annual burning with no burning indicated that livestock gains were typically greater when grazing burned pasture. When summarized across the 40 years of the study, we observed an average increase of 14% in total gain for steers grazing burned pasture (Figure 8).

On grazed areas, forage yields were similar on unburned range and grassland burned in late spring (May 1), but yields were reduced by burning in mid spring (April 10) or early spring (March 20) (Figure 7); forb yields were lower on range burned in late spring than on range unburned or burned earlier in the spring.

Amounts of soil moisture in the upper five feet of a loamy upland range site correlated well with range forage production (Figure 9). Areas not burned and those burned in early or mid spring generally had less soil moisture than did those burned in late spring (May 1), the ideal time to burn considering range forage production and livestock gains.

Late-spring burning consistently produced a more desirable plant-species composition than did burning earlier or not burning (Figures 10 and 11). Ground covered by living plant bases of big bluestem and indiangrass was greater on late-spring burned range than on range burned earlier or not burned; ground cover of little bluestem was unchanged except by early-spring burning, which reduced it. Low-producing Kentucky bluegrass and naturalized annual species - cool-season grasses - were essentially eliminated on burned sites, as indicated by reduced ground cover regardless of time rangeland was burned. Basal cover of perennial forbs was reduced by late-spring burning.

Late-spring burning effectively controlled eastern redcedar, buckbrush, and most other undesirable woody plants except smooth sumac, which maintained itself regardless of date range was burned.

Late-spring burning of Flint Hills bluestem range also improved grazing distribution, because livestock sought vegetation that developed after the fire in preference to vegetation on areas heavily grazed the previous season but not burned because of insufficient grass left for fuel.

Results of Hays Research

Evaluation of vegetation response to wildfires occurring from November through March has indicated that burning during dormancy is detrimental to herbage yield. To test late-spring burning, annual burning on April 26 for three consecutive years was compared to adjacent unburned plots (Table 11). Western wheatgrass production almost tripled the first two years, but increased only slightly the third year. Shortgrasses, buffalograss and blue grama, were essentially unaffected the first year, but reduced during subsequent years. Japanese brome and red threeawn were substantially reduced in all years, as was western ragweed in the second and third years. Total herbage was increased in year 1, slightly reduced in year 2, and greatly reduced in year 3. Evidently, late spring prescribed burning can be used periodically, but not repetitively, to improve range condition by increasing western wheatgrass and reducing large quantities of undesirable grasses and forbs. This research is further supported by prescribed burning of a seeded stand of pure western wheatgrass on April 1 for four consecutive years. Tiller density and herbage yield were improved by burning compared to the control, particularly in the first year. Additionally, invasion by other species (weeds) was prevented by burning. Livestock responses to burning of shortgrass range have not been evaluated.

Recommendations

On shortgrass range in western Kansas, annual burning, even late in spring after vegetation growth has been initiated, appears to lead to reduced productivity, particularly of warm-season shortgrasses. However, responses to the first year of burning were positive in terms of herbage yield and reduction of annual brome, red threeawn, and western ragweed. Late spring burns can be used periodically to control these species, remove excess mulch, and improve cool-season forage production from western wheatgrass.

Recommendations

Precautions

- Frequent range burning is recommended for the Flint Hills and other areas in eastern Kansas. Currently, prescribed burning of ranges in central and western Kansas is for special purposes.

- Carefully plan prescribed burning and have the utmost respect for maintaining control of vegetation fires. Sufficient fire-control equipment is a must; at least two spray rigs (one along each fire line) are necessary. Fire can be spread uniformly along fire lines most efficiently by using “drip torches” that distribute a mixture of gasoline and diesel fuel. (Diesel fuel in the mixture produces residual flames, generally needed to ignite vegetation under controlled burning conditions.)

- Notify all neighbors and the rural fire district of your intention to burn.

- If smoke might present a traffic hazard, notify the proper law-enforcement agencies.

- Obtain from your local county extension agent the latest State Department of Health rules and regulations pertaining to agricultural burning.

- Monitor weather reports several days before the tentative date of burning; obtain both short- and long-range forecasts.

- Do not start broadcast burning on a calm day or when there are only intermittent shifting breezes. In addition to difficulties in getting a fire to move and generate heat, burns started under those conditions are subject to being blown out of control if a wind should come up suddenly from an unexpected direction. Furthermore, temperatures too cool or too hot will retard the fire or increase fire intensity beyond control.

Time of burning

- Burn range concurrently with start-of-growth of the major warm-season perennial grasses, which generally is late April in northern Kansas and mid-to-late April in southern Kansas.

- Burn range under as ideal conditions as possible - when there is a moist mulch, winds are steady at 5 to 20 miles per hour, and the day is clear and air temperatures are mild.

Method of burning

- Use natural firebreaks, including roads, trails, and cowpaths along fence rows, when possible.

- In open grassland, spread fire slowly and extinguish the flames outside the fire lines with motorized water-spraying equipment.

- Use appropriate means to remove woody vegetation along fire lines and preburn it under low, wildfire-hazard conditions.

- Follow the steps illustrated in Figure 12.

Figure 7. Average gains per head of yearling steers (left), average forage yields (center), and average yields of forbs on Flint Hills Bluestem range; unburned and burned annually on March 20, April 10, or May 1; range stocked moderately (3.3 acres/steer) from May 1 to October 1, 1950-1967.

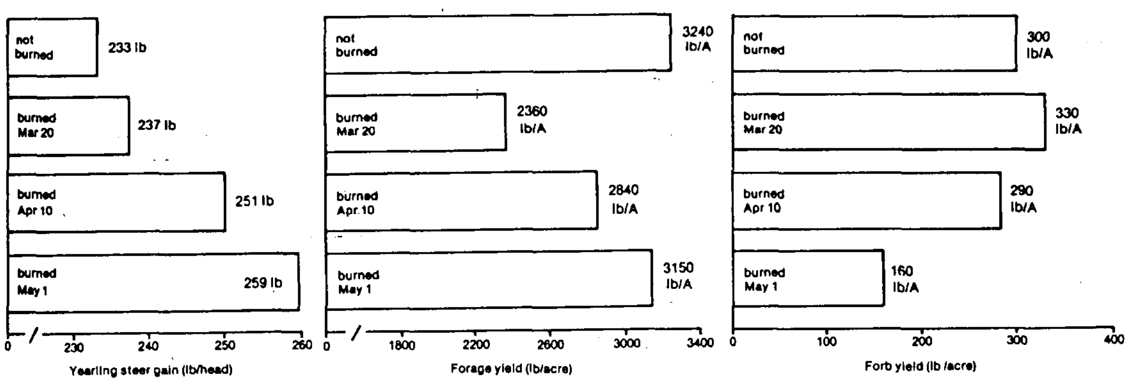


Figure 8. Increase in steer gain on late spring burned pastures over unburned.

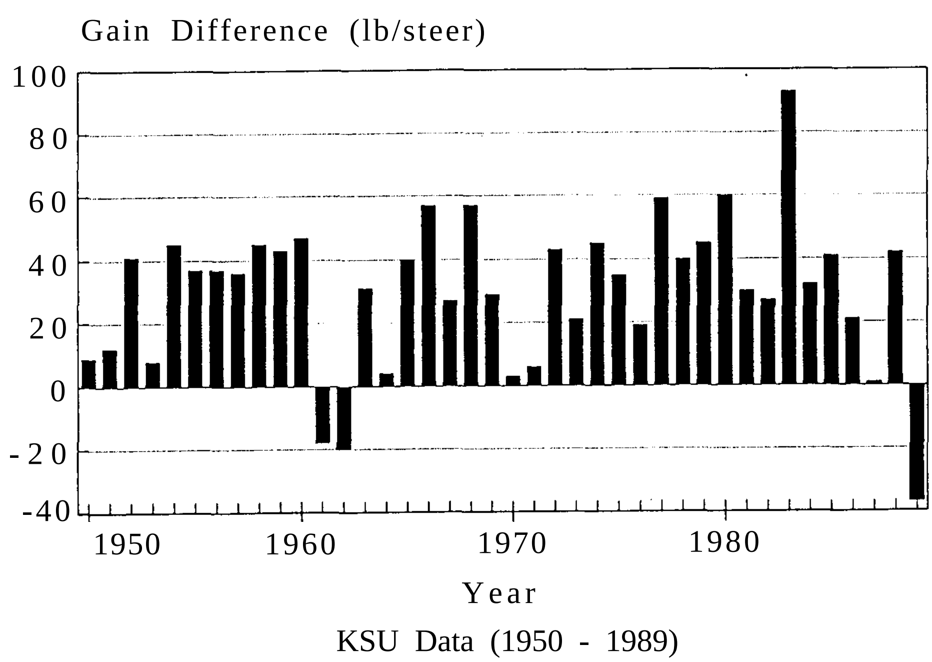


Figure 9. Soil moisture in the upper 5 feet of soil on Flint Hills Bluestem range; unburned and burned annually on March 20, April 10, or May 1; range stocked moderately (3.3 acres/steer) from May 1 to October 1, 1950-1967.

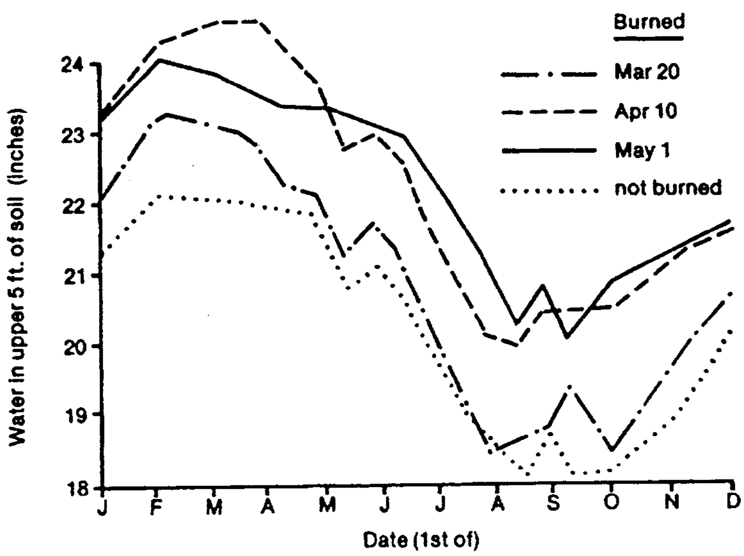


Figure 10. Percentages of ground covered by living plant bases for indicated species on Flint Hills Bluestem range; unburned and burned annually on March 20, April 10, or May 1; range stocked moderately (3.3 acres/steer) from May 1 to October 1, 1950-1967.

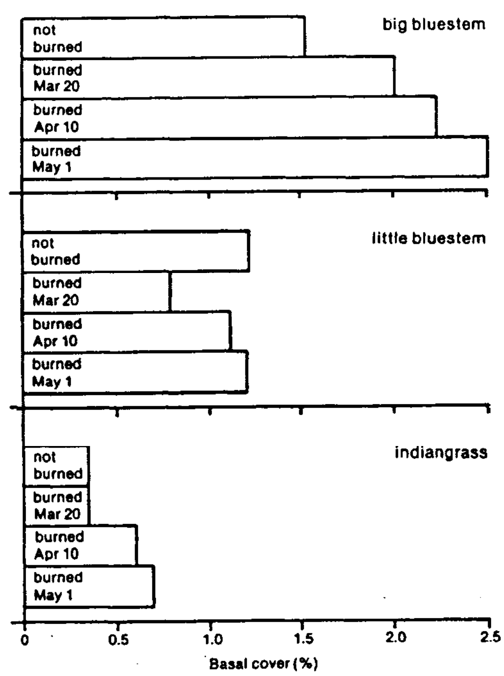


Figure 11. Percentages of ground covered by living plant bases for indicated species on Flint Hills Bluestem range; unburned and burned annually on March 20, April 10, or May 1; range stocked moderately (3.3 acres/steer) from May 1 to October 1, 1950-1967.

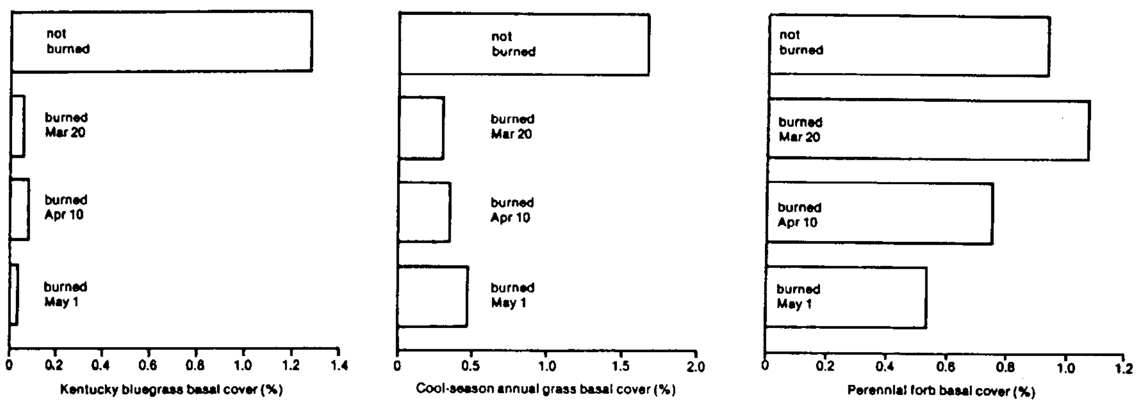
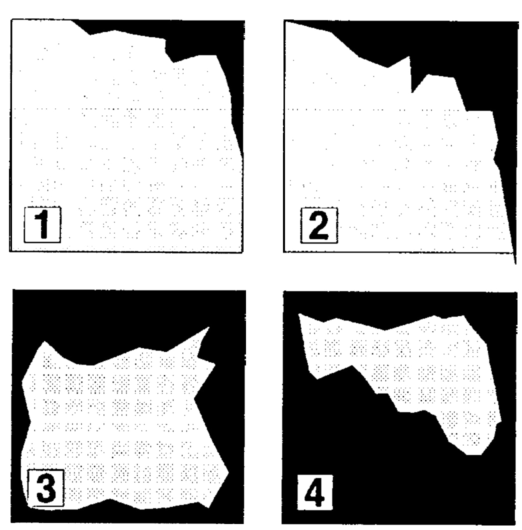


Figure 12. Proper method to burn rangeland. 1. Start a backfire at the furtherest point downwind. 2. Spread fire simultaneously each direction from starting point on downwind side. 3. After the backfire has burned 50 to 100 feet into the wind, bring fire around windward sides and ignite at a quickened, steady pace.



Wind 5-20 mph

Table 10. *Percentages of chemical constituents of forages, averaged over five months (May to October), in diets selected by yearling steers (fitted with esophageal fistulas) and in samples clipped by hand to simulate diets selected by the steers on unburned Flint Hills bluestem range, compared with late-spring burned range, 1972.*

Chemical composition of forage sample	Method of collecting forage sample on range: Selected by steers: Not burned	Selected by steers: Burned May 1	Clipped by hand: Not burned	Clipped by hand: Burned May 1
Partial analysis	% of dry matter[1]			
Least digestible				
Neutral detergent fiber (cell-wall constituents)	80.70	82.41	77.74	74.99
Acid detergent fiber (lignocellulose)	52.97	51.39	81.70	76.57
Lignin	12.75	11.35	7.05	6.24
Most digestible				
Crude protein	10.24	10.95	5.30	5.86
Neutral detergent solubles (cell contents)	31.37	29.99	51.12	52.48
Hemicellulose	24.50	28.08	31.80	31.97
Cellulose	35.14	34.49	34.77	32.56
Apparent digestibility				
Total dry matter	49.76	49.16	--	--

1. Percentages, within each method of collecting forage samples, underscored by the same line do not differ significantly (P< 0.05).

Table 11. *Herbage production (lb dry matter/acre) response to annual burning on AprII 26 for three consecutive years measured in plots on a clay upland range site at Hays, Kansas.*

Category	Year	Treatment: Unburned	Treatment: Burned	Yield change due to burning	
buffalograss & blue grama	1975	630	660	+	30
	1976	910	410	-	500
	1977	1410	1070	-	360
western wheatgrass	1975	500	1450	+	950
	1976	370	1280	+	910
	1977	170	300	+	130
Japanese brome	1975	410	80	-	330
	1976	330	30	-	300
	1977	70	0	-	70
red threeawn	1975	20	0	-	20
	1976	70	0	-	70
	1977	160	60	-	100
western ragweed	1975	100	210	+	110
	1976	280	70	-	210
	1977	270	70	-	200
total herbage	1975	1660	2410	+	750
	1976	1960	1790	-	170
	1977	2200	1500	-	700

SECTION 6

Wildfire

Each year throughout Kansas untimely accidental range fires occur, generally from late fall to mid spring when vegetation is dormant, humidities are low, soil surfaces are dry, and wind velocities are above average. Some grass crowns and tillers may be killed by heat or combustion under smoldering organic material, but major detrimental effects appear to be associated with exposure of dormant plant-regenerative tissue to winter weather extremes, soil moisture evaporation, and the puddling action of early-spring rains especially on bare, fine-textured soils.

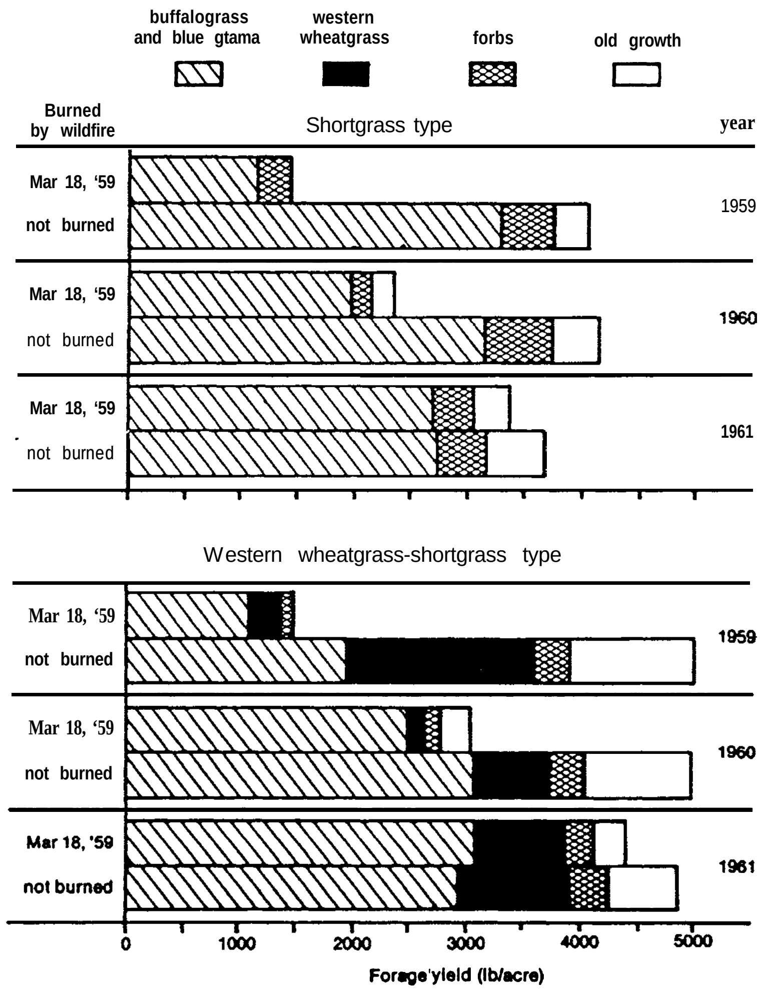
Near Hays in 1959, all plants that grew on range burned by wildfire in early spring were shorter than plants on nearby unburned range - which indicated that reduced soil-moisture intake on early-burned range, coupled with exposure, lowered plant vigor and hence forage yields (Figure **13).** Timely range burning generally favors native perennial grasses and decreases other kinds of plants, but fall to mid-spring fires may interact with spring weather conditions to increase less desirable plants. Contiguous wildfires near Hays, one in November and the other in March, resulted in yield differences of western ragweed the next growing season.

Management of ranges burned from late fall to mid spring, whether planned or accidental and regardless of location, may require adjustments in stocking rates for one or more seasons - because of reduced forage yields. Livestock grazing range only partly burned, avoid unburned sites and concentrate on burned areas. To circumvent that, the remaining old growth should be burned at the proper time (late spring, after new growth has started), mowed closely from mid to late April, or fenced and grazed separately one to three seasons. Another alternative is to reduce stocking to what the burned areas will carry until grazing distribution from the fire is no longer a problem. If one of those choices is not used, the heavy grazing for several seasons after the fire may result in further, long-lasting damage to the parts of the range burned by wildfire.

Recommendations

- Wildfires frequently do not take in an entire range unit. Prevent livestock from concentrating on burned parts of range by burning or mowing significant "missed" areas from mid to late April (in southeastern Kansas) to late April-early May (in northwestern Kansas), or by adjusting stocking rates to the carrying capacity of the burned area until fire-caused livestock-grazing-distribution problems no longer exist (one to three seasons), or by separating burned from unburned areas with cross fencing for one or three seasons (if that is practical with regard to fencing requirements and livestock water supplies) and grazing the resulting fenced units independently (if necessary, fence lanes of access to water supplies).

Figure 13. Yields of major forage groups on October 1 for three growing seasons on clay upland shortgrass range with two vegetation types near Hays in areas protected from grazing after a wildfire on part of the range on March 18. 1959.



SECTION 7

Range Fertilization

Among the three major elements - nitrogen, phosphorus, and potassium - used to fertilize Flint Hills bluestem range in the early 1950s, only nitrogen increased forage yields significantly (Mader 1956). In later fertilization comparisons on the same site, with and without residual and added phosphorus, nitrogen alone still was the only nutrient to increase yields of bluestem range significantly (Table 12). In addition, nitrogen fertilization improved the efficiency of soil-moisture use by bluestem range (Table 13).

Applying 40 pounds of N per acre late each spring from 1972 to 1976 increased carrying capacity of grazed bluestem range 50 percent. Livestock performance, however, was more efficient on burned, fertilized range than on fertilized, unburned range (Tables 14 and 15). Comparing forage samples clipped from treated ranges indicated that burned, fertilized bluestem range produced slightly lower-quality forage than did unburned, nonfertilized range. Comparing forage samples collected from esophageal fistulated steers that had grazed on the two treatments, however, showed that except for crude protein, the animals selected diets similar in composition from both ranges. Other than close similarities in relative amounts of cellulose and hemicellulose in samples clipped by hand and those from esophageal fistulated animals, steers selected diets that differed greatly in chemical composition from the clipped samples. Nitrogen-fertilized Flint Hills bluestem ranges had to be burned in late spring to prevent shifts to undesirable plants in the vegetation.

Nitrogen fertilizer was applied annually during spring for four years at different rates on two contrasting range sites near Hays. N increased forage yields up to two or three times those on range without N (Figure 14). Applying 40 pounds of N per acre May 1 annually (for four years) on shortgrass range near Hays increased carrying capacity for yearling steers approximately 50 percent compared with that of unfertilized range (Table 16). Although steer gains per head on the fertilized and unfertilized ranges were comparable (Table 17), beef production per acre on the fertilized range was increased more than 50 percent (Table 18). Japanese brome and western wheatgrass were major forages during spring and early summer on fertilized range. Those species gave way to blue grama, buffalograss, and forbs during summer and early fall.

Recommendations

Flint Hills region

- Burn fertilized range when big bluestem has an inch of new growth, usually in late April.

- Apply 40 pounds of N per acre about May 1. Aerial application may be necessary on rough topography; otherwise, conventional ground rigs may be used.

- Increased stocking rates on nitrogen-fertilized ranges approximately 50 percent above normal, conservative stocking rates for unfertilized ranges.

Mixed prairie and shortgrass regions

- Apply 40 pounds of N per acre from early to late April and stock range when grasses begin spring growth. Sites with western wheatgrass and Japanese brome start to grow two to four weeks earlier than does vegetation on sites with all warm-season perennial grasses and forbs.

- Increased stocking rates approximately 50 percent above normal, conservative stocking rates for unfertilized ranges.

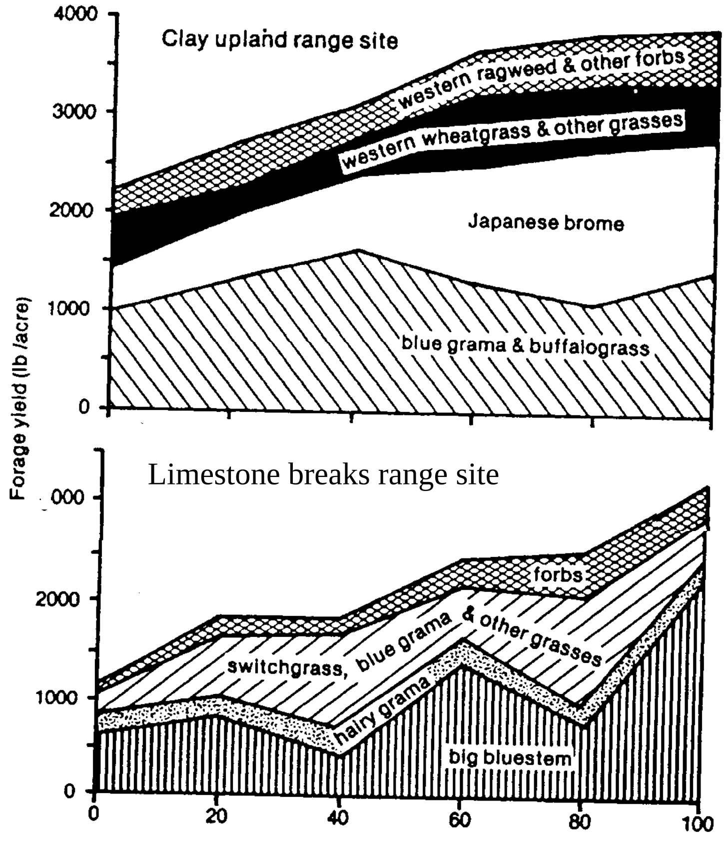
General for all regions

- Use the lowest-priced nitrogen fertilizer per unit of N that is compatible with type of application equipment required for the site; profit depends largely on the market prices of livestock and fertilizer.

- If range vegetation fails to respond to 40 pounds of N per acre, add the most readily available form of phosphorus (40 to 60 pounds of P per acre) with nitrogen to small areas protected from livestock grazing; observe the treatment compared with nitrogen alone for a growing season before making major applications of fertilizer. On southeastern Kansas range, include potassium (60 to 80 pounds of K per acre) in small-scale trials. Normally, however, available phosphorus and potassium in Kansas, range soils are adequate.

- Take advantage of increased production and palatability of forage on fertilized range by stocking early in the growing season. Compensate for overstocking during drought years by removing livestock earlier than usual during the grazing season.

Figure 14. Average yields of major forage species on two important range sites in mixed prairie near Hays fertilized annually on May 1, 1969 to 1973 with indicated rates of nitrogen.



Nitrogen fertilization (lb N/acre)

Table 12. *Yields of forage in 1963 on Flint Hills bluestem range fertilized that spring with phosphorus and nitrogen at rates indicated on sites that had not received phosphorus before 1963 compared with sites having residual P from annual applications, 1951 to 1955.*

Fertilizer applied, Spring 1963			**Phosphorus added annually, 1951 to 1955**	
Phosphorus	**Nitrogen**		**None** [1]	**44 lb P/A** [2]
lb P/acre	lb N/acre		Forage yield in 1963 (lb dry matter/A)	
0	0		4030	3980
0	33		4600	4410
0	67		4660	5310
		Average	4430	4570
20	0		4540	4160
20	33		4890	5190
20	67		4560	5770
		Average	4660	5040

1. Plots with no phosphorus added from 1951 to 1955 contained 12 lb P/A in the upper six inches of soil before fertilization in 1963.
2. Plots that received phosphorus from 1951 to 1955 contained 90 lb P/A in the upper six inches of soil before fertilization in 1963.

Table 13. *Moisture-use efficiency of vegetation on Flint Hills bluestem range fertilized with 0 and 50 pounds N/acre, 1965 to 1969.*

Nitrogen fertilization rate	Year				
	1965	**1966**	**1967**	**1968**	**Average**
lb N/acre	Dry matter yield (lb/inch of precipitation)				
0	101	115	183	112	128
50	157	130	183	163	158

Table 14. *Beef production per acre on late spring burned and unburned Flint Hills bluestem range fertilized with nitrogen at rates indicated and grazed with yearling steers May 1 to October 1, 1972 to 1976.*

Range burning treatment	Year	Nitrogen fertilization rate (lb N/acre)		
		0	**40**	**80**
		Beef production (lb/acre)		
Burned May 1	1972	56	99	137
	1973	48	68	69
	1974	80	95	104
	1975	48	69	63
	Average	58	83	93
Not burned	1972	39	68	84
	1973	41	54	58
	1974	61	69	75
	1975	48	54	57
	Average	47	61	68

Table 15. *Average daily gains of yearling steers May 1 to October 1 on late spring burned and unburned Flint Hills bluestem range fertilized with nitrogen at rates indicated, and grazed 1972 to 1976.*

Range burning treatment	Year	Nitrogen fertilization rate (lb N/acre)		
		0	40	80
		Yearling steer average daily gains (lb/head)		
Burned May 1	1972	1.23	1.42	1.27
	1973	1.06	0.99	0.84
	1974	1.69	1.48	1.19
	1975	1.18	1.16	0.95
	Average	1.29	1.26	1.06
Not burned	1972	0.84	0.99	0.77
	1973	0.90	0.80	0.69
	1974	1.30	0.99	0.99
	1975	1.17	0.96	0.90
	Average	1.05	0.94	0.84

Table 16. *Nitrogen fertilization and stocking rates on clay upland shortgrass range near Hays, grazed with yearling steers May 1 to October 1, 1973 to 1977.*

Nitrogen[1] fertilization rate (lb N/acre)	Yearling steer stocking rate measured in:	Year				
		1973	1974	1975	1976	Average
0	Acres/head	3.16	3.51	3.51	3.16	3.34
	Steer days/acre	53	46	45	51	49
40	Acres/head	2.43	2.10	2.10	2.10	2.18
	Steer days/acre	69	77	74	72	73

1. Ammonium nitrate 1973-74; urea 1975-76. Broadcast applications May 1.

Table 17. *Gains of yearling steers May 1 to October 1 on clay upland shortgrass range near Hays, fertilized with 0 and 40 pounds of N per acre annually May 1, 1973 to 1977.*

Nitrogen fertilization rate	Year				Average
	1973	1974	1975	1976	
lb N/acre	Yearling steer summer gain (lb/head)				
0	229	149	226	188	198
40	232	170	199	197	200

Table 18. *Beef production per acre on clay upland shortgrass range near Hays, fertilized with 0 and 40 pounds of N per acre annually (May 1) and grazed with yearling steers May 1 to October 1, 1973 to 1977.*

Nitrogen fertilization rate	Year				
	1973	1974	1975	1976	Average
lb N/acre	Beef production (lb/acre)				
0	73	42	64	59	60
40	96	81	94	93	91

SECTION 8

Native Hay

Harvest date is the most important operator-controlled factor in producing native hay. It can affect hay yield, forage quality, stand composition, and usable regrowth.

Near Manhattan, during an eight-year period, the best quantity-quality relationship for native hay came from harvesting in mid July (Figure 15). Hay quality was also affected by cutting date. As the growing season progressed, indigestible plant tissue increased as plants translocated nitrogen compounds to stem bases and underground stems (rhizomes). It was not possible to obtain maximum quantity and quality hay in the same cutting. The compromise cutting stage near Manhattan was early-to-mid July. Reduced plant-food reserves decreased hay yields the next year when harvest was later. After being cut, active hay plants produced new top growth. That drew on stored food in the crowns and roots. When time between harvesting and grass dormancy was not adequate for replenishing reserves, plants went into winter with low food reserves (Figure 15). Hay production was lowered the next season. Haying in August and September also changed stand composition; as desirable warm-season perennial grasses became less abundant, undesirable vegetation increased (Figures 16). After eight years of being cut September 1, a bluestem meadow was dominated by showywand goldenrod, a weedy forb of low value for hay.

Clipping (to stimulate grazing of plant regrowth after hay had been cut) reduced yields, tiller numbers, and food reserves the next season. The same would hold true for cutting a meadow more than once during the growing season or cutting grazed pastures late in the growing season.

Nitrogen appeared to be the only fertilizer that increased herbage yields enough to warrant using it on native hay meadows. Applying 33 to 67 pounds of N per acre increased hay yields 0.75 to 1.00 ton of dry matter per acre; adding phosphorus to the extent of increasing the amount of available P seven- to eightfold in the top six inches of soil had no consistently significant effect on hay yields (Table 19). Crude protein of early- and late-cut hay also was increased by nitrogen fertilization; but again, phosphorus had no important effect (Table 20).

Nitrogen fertilization of a Flint Hills bluestem hay meadow several years in a row caused an increase in cool-season Kentucky bluegrass (Table 21). Such a composition change negated benefits of N fertilization. Late-spring burning controlled that shift, so meadows fertilized with nitrogen must be burned in late spring. Otherwise, too much of the hay produced will be low-producing weedy plants.

Recommendations

- Cut native hay in early-to-mid July in northern parts of Kansas and slightly earlier in southern Kansas.

- Do not allow livestock to graze regrowth until after frost; late summer-early fall grazing lowers meadow productivity the next growing season.

- Apply 30 to 40 pounds of N per acre about May 1, depending on cost of nitrogen application, anticipated increase in tonnage, and price of hay.

- In eastern Kansas, burn fertilized meadows in late spring (April 15 in southeast; May 1 in northeast) to control increases in undesirable weedy vegetation. If regrowth is grazed after frost, enough grass must remain as fuel to carry a late-spring fire.

Figure 15. Average hay yield and crude protein content and food reserves for big bluestem on Flint Hills bluestem meadow mowed annually from 1960 to 1969 on indicated dates.

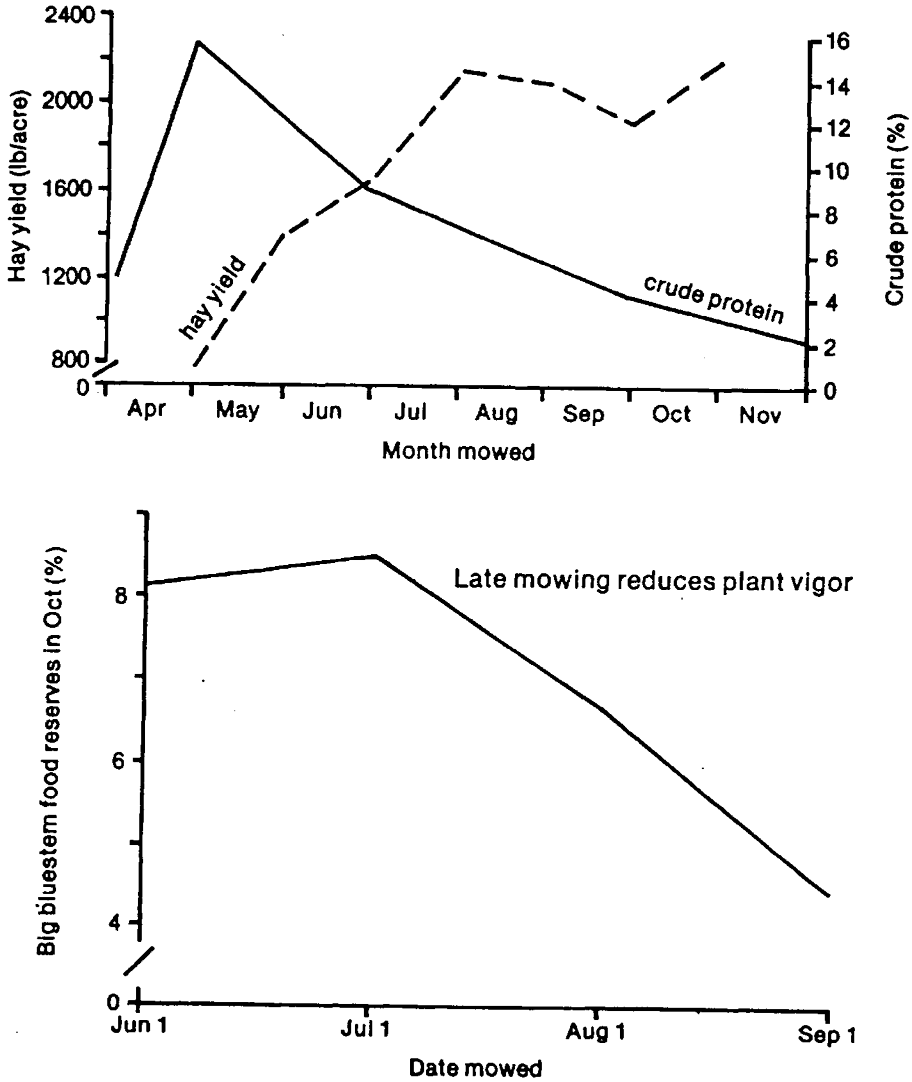


Figure 16. Ground covered by indicated plant species in November, 1967 after 8 years of mowing Flint Hills bluestem meadow annually on dates indicated.

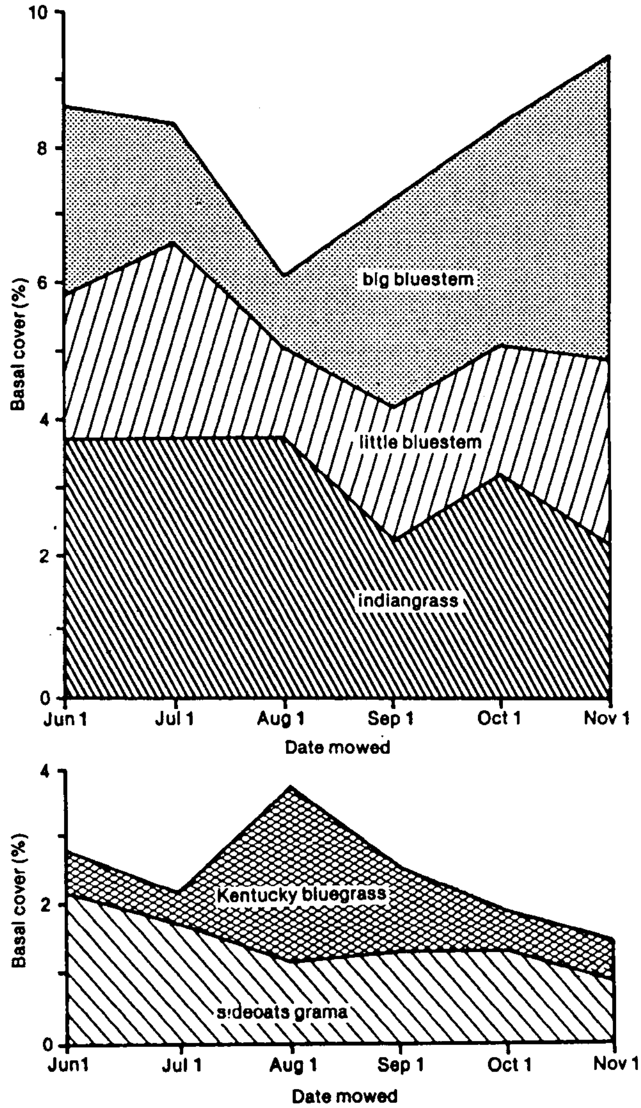


Table 19. *Yield of hay harvested in mid July 1963, on Flint Hills bluestem meadow fertilized that spring with phosphorus and nitrogen at rates indicated (yields from sites that had not received phosphorus before 1963 are compared with yields from sites having residual P from annual applications of phosphorus from 1951 to 1955).*

Fertilizer applied, spring 1963			Phosphorus added annually, 1951 to 1955	
Phosphorus	**Nitrogen**		**None**[1]	**44 lb P/A**[2]
lb P/acre	lb N/acre		Hay yield mid July, 1963 (lb dry matter/A)	
0	0		4070	4050
0	33		4700	4520
0	67		4800	6340
		Average	4520	4970

1. Plots with no phosphorus added from 1951 to 1955 contained 12 lb P/A in the upper 6 inches of soil before fertilization in 1963.
2. Plots that received phosphorus from 1951 to 1955 contained 90 lb P/A in the upper 6 inches of soil before fertilization in 1963.

Table 20. *Average crude protein content of big bluestem cut for hay in mid July, 1963, compared with that cut in mid September on Flint Hills bluestem meadow fertilized in spring with phosphorus and nitrogen at rates indicated.*

Spring applied, 1963			Hay cut in:	
Phosphorus	Nitrogen		Mid July	Mid September
lb P/acre	lb N/acre		Crude protein content (%)	
0	0		4.9	3.3
0	33		5.5	4.0
0	67		5.7	4.0
		Average	5.4	3.8
20	0		5.2	3.5
20	33		5.3	3.5
20	67		6.2	4.3
		Average	5.6	3.8

Table 21. *Ground covered by plant bases (basal cover) of Kentucky bluegrass, an undesirable grass on Flint Hills bluestem range and hay meadows, fertilized with 0 and 50 pounds of N per acre from 1965 to 1969.*

	Nitrogen fertilization rate (lb N/acre)	
Year	**0**	**50**
	Kentucky bluegrass basal cover (%)[1]	
1965	0.50	0.69
1966	2.31	2.00
1967	1.94	5.50
1968	2.62	5.12

1. Percentages underscored by the same line in a given year do not differ significantly (P < 0.05).

Rannells Flint Hills Prairie

Land Description

The Hilas Bay and Emma Browning Rannells Flint Hills Prairie Preserve is located immediately south of Manhattan adjacent to K-177 on the east side of the highway (Figure 1). The 2104.7-acre area was bequeathed to the Kansas State University Foundation by Lou R. Adams and Helen R. Sampson for the sole use and benefit of the range research program with the specific condition that the area may never be sold, conveyed, or assigned by the grantee, and that the property may be only used for research uses which will be limited to those which do not alter the condition of the property and preserve it in its existing condition. Further, the area may be never used for recreational purposes. During the interim between the gift of the property and the deaths of Lou Adams and Helen Sampson, the grantors reserved the full benefits and use of the property, rents, issues, and profits for the duration of their natural lifetimes. Section 4, a part of the original Rannells holdings, was not included in the bequest. In order to restore the Rannells holdings to their original state, LMIC purchased Section 4 for $391,860. A gift of $200,000 from Mrs. Adams was used as a major part of that purchase. With the addition of the 640 acres from this purchase the total acreage in the Rannells Flint Hills Prairie rose to the present 2744.7 acres There were several memoranda of agreement that were executed as to the use of the area. The gist of those agreements includes:Use of the area will be limited to research aimed at beef production systems. No research which greatly alters the natural vegetation will be conducted. All moneys derived or donated for the Rannells Flint Hills Prairie shall be used for maintenance and upkeep of the area or to conduct research on the area. Clenton Owensby was named Project Director and Manager of the Rannells Flint Hills Prairie.

With the deaths of Mrs. Sampson in January, 1988, and the death of Mrs. Adams in March, 1989 the use of the property has fallen to the range research programs of ASI and Agronomy. Moneys were received in 1988 from the rental of the area for the half previously controlled by Helen Sampson. Rent from the 1988-1993 period was deposited in the KSU Foundation for use on the Rannells area. Mrs. Sampson in her will left a substantial sum of money to be used to support students in the range livestock area. It has been agreed that the income from the bequest will be used to support two graduate research assistantships to work on the Rannells Flint Hills Prairie, one each in the Departments of Animal Sciences and Industry and Agronomy. In addition, it is anticipated that up to five undergraduate scholarships can be supported from the fund, and that they will be divided equally between ASI and Agronomy.

Figure 1.

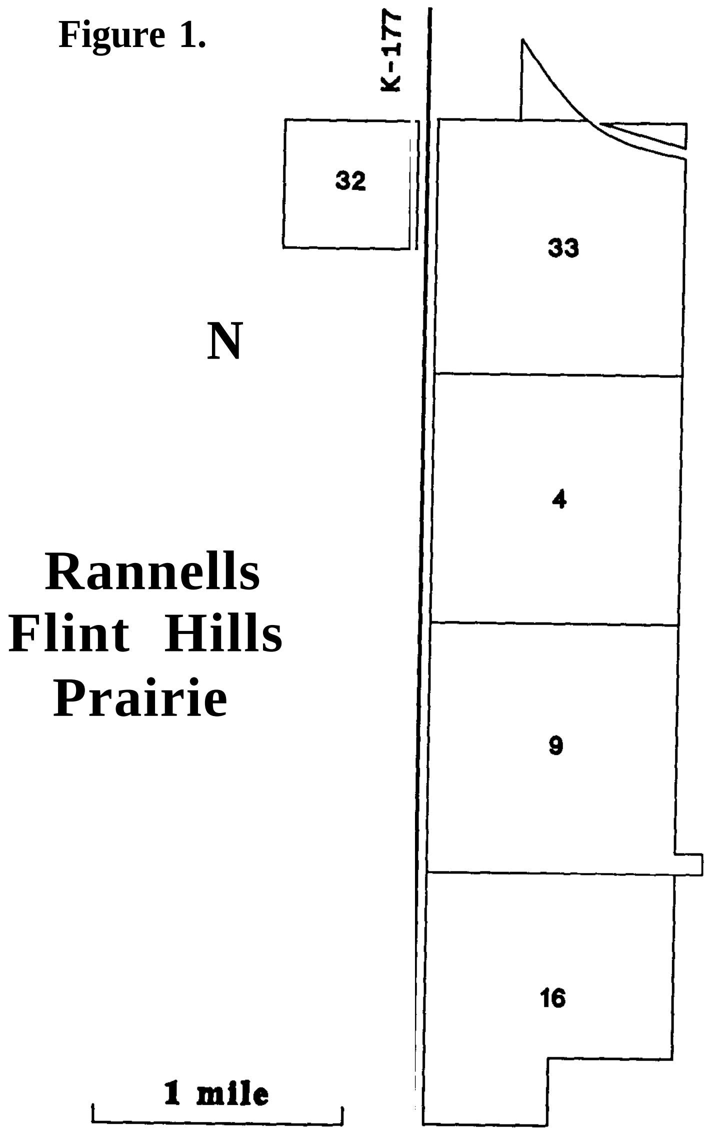


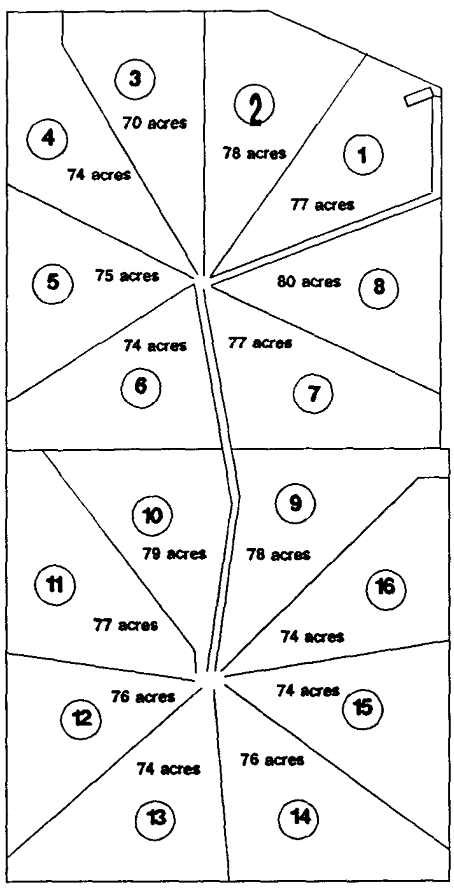
Figure 1.
K-177
32
33
N
4
Rannells
Flint Hills
Prairie
9
16
1 mile

Physical Facilities

Current

The area currently developed for research is fenced as shown in Figure 2 using high -tensile electric fencing. All other fencing on the area is extremely poor and the entire perimeter fencing will need to be replaced. Livestock water is supplied primarily by ponds and undeveloped springs. On the 160 acres on the west side of K-177 water is supplied by a windmill. There are four sets of working pens currently on the area. Three of the working pens were there when the area was given for LMIC use, but they are in the planned acquisition for the 4-lane highway project and will be replaced. From October, 1989 to December, 1993 a new set of metal pens and cattle handling equipment was constructed. A headquarters building was erected in the spring of 1994. Nine ponds were constructed in the winters of 1993 and 1994 to provide reliable water for the research pastures.

Figure 2. Current developed fencing scheme.



Research Plans

All electric-fenced pastures were intensive-early-stocked at two times the season-long rate for a 2-year period to determine possible inherent differences in livestock gains among pastures, Differences in inherent gain potential among pastures apparently are minimal, but the information will be used as a covariate for statistical analyses of data from future research experiments.

Current Research Project

We are currently conducting a trial that is designed to determine whether steers should be implanted with a growth hormone on native grass and in the feedlot, implanted in the feedlot alone, implanted on native grass alone, or not implanted. We will measure performance on native grass and in the feedlot. This trial is being conducted for both intensive-early stocking and season-long stocking. Grazing distribution under the two grazing systems is being measured using a grid overlay of two pastures for each stocking system. Percent area grazed and patterns of grazing will be determined and analyzed using a graphical information system (GIS). To determine the frequency of grazing of individual plants, 100 big bluestem plants have been individually marked and grazed or ungrazed and plant height determined on a biweekly basis.

Potential Future Research Projects

To determine stocking rate effects on late-season steer gain and vegetative responses as affected by high and low early-season stocking densities.To determine when, and at what rate, to supplement with grain and protein steers under intensive-early stocking. Plant and animal responses will be measured.To determine the effect of winter grazing versus late spring burning on plant and animal responses on pastures intensive-early stocked with steers.

Management and Use of the Area

The area is leased to the Kansas Agricultural Experiment Station by the Kansas State University Foundation with responsibility for its use and management shared by the Heads of the Department of Agronomy and the Department of Animal Sciences and Industry. Further, the day-to-day management responsibility for the area is assigned to Clenton Owensby, with input from Bob Cochran. Research planning will be a joint effort with Bob Cochran and Clenton Owensby as co-leaders. The cattle required for stocking the area is a definite concern. We initially plan to use cattle supplied by a cooperator who pays a grazing fee for use of the area. While this approach has been useful to our program in past studies, there have been problems associated with research goals which have resulted in lost research data. Ideally, a revolving fund should be established in LMIC for purchase of needed cattle and receipts from cattle sales redeposited for subsequent purchases. However, substantial initial funding must be obtained to develop such a revolving fund. Since the Rannells Flint Hills Prairie offers a major potential gain in the ability of the range program to do research, a funding drive could be mounted.

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