Intensive-Early Stocking and Season-Long Stocking of Kansas Flint Hills Range

ED F. SMITH AND CLENTON E. OWENSBY

Highlight: Native Flint Hills bluestem range was stocked at twice the normal rate, 1.7 acres per steer. Daily steer gain and gain per acre were greater for IES. Late summer gain by steers on SLS was less than the gain during early summer on either treatment. For the complete trial, steers under SLS gained more per head, 210 lb compared with 141 lb, due to the 154-day grazing period compared with 75 for IES. Although more grass had been removed by mid summer with IES, by the end of the summer grass yield was higher on IES than on the pasture stocked only half as heavily but full season. Percent big bluestem increased under IES and decreased with SLS. Percent Kentucky bluegrass decreased under IES and increased with SLS, but that may have resulted from more complete burning under IES.

Steer gains during the latter half of the growing season on Kansas Flint Hills range are barely one-half those of the first half of the season (Anderson et al. 1970), because forage quality declines with grass maturation and translocation of nutrients to reserve pools. Reduced intake due to high temperatures may also contribute to slower gains during late summer (Dwyer 1961). Stocking rate effects also become manifest during late summer. Launchbaugh (1957) indicated steer gains were comparable with light, moderate, and heavy use during the early season, but decreased in late summer as stocking rate increased. Apparently, selectivity of animals for forage quality does not become critical until late in the growing season when nutritive value is low, which suggests an increase in forage-use-efficiency by intensive grazing in the early growing season when nutritive value is highest. The advantage would give increased gains per acre without sacrificing gain per animal.

Klipple (1964) tested early-season intensive grazing, late-season intensive grazing, and season-long grazing with steers in eastern Colorado. Monthly cattle gains during the early growing season on pastures stocked season-long were the same as on early-intensive-use pastures; yearly gain/acre on the early-intensive-use pastures was higher than on season-long stocked pastures. Late-season-intensive-use produced less gain per head than season-long or early-intensive-use. Forage production was lower on early- and late-season intensive use pastures than on pastures used all season.

We studied the effects of intensive-early stocking (IES) and season-long stocking (SLS) on steer gain, herbage production, botanical census, and grazing distribution.

Materials and Methods

The study area was two 60-acre pastures in the Flint Hills region of the True Prairie, 5 miles northwest of Manhattan, Kans. Vegetation was primarily warm-season perennial grasses; big bluestem (*Andropogon gerardi* Vitman) and little bluestem (*A. scoparius* Michx.) were the major dominants. Indiangrass [*Sorghastrum nutans* (L.) Nash] and sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] were secondary. Kentucky bluegrass (*Poa pratensis* L.) was sparsely present. Numerous forbs, woody plants, and other grasses constituted the remainder. Range sites were described by Anderson and Fly (1955). The pastures were burned during late April each year.

Cattle

Each year on May 2 from 1972 through 1975, the pastures were stocked with either Angus, Hereford, or Angus × Hereford cross yearling steers averaging 451 lb and approximately 14 months old. Steers were identified and individually weighed the first day of each month and July 15. Weights for 1973 are missing. From the afternoon of the day before being weighed, they were confined in pens without feed or water. One pasture allowed 1.7 acres per steer from May 2 to July 15 (75 days). Steers on the other pasture were allowed 3.4 acres per steer from May 2 to October 3 (154 days).

Herbage Production

Herbage remaining after grazing was estimated by clipping ten 1/100,000th-acre plots in loamy upland, breaks, and clay upland range sites July 16, 1972–74. At the end of the growing season herbage was clipped from 10 caged and 10 uncaged areas in the same range sites. The cage was moved each year. Herbage was separated into grasses and forb-brush components and dried to moisture-free. During 1975, method of yield estimation was changed and those data are not presented.

Botanical Census

Plant census was from modified step-point samples (Owensby 1973). Within each pasture 1,500 points were read along a predetermined grid. Each set of 1,500 points was partitioned randomly into three subsets for statistical analysis. Basal cover and botanical composition estimates were determined in June from 1971 to 1975. The 1971 plant census data were used as a base, and analysis of variance was calculated on the change in basal cover and botanical composition.

Authors are research animal scientist, Department of Animal Science and Industry; and research range scientist, Department of Agronomy, Kansas State Universty, Manhattan 66506.

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Table 1. Perennial grass yields (lb dry matter/acre) at growing season's end by year and range site from caged areas on season-long and intensive-early stocked pastures.

Grazing system	Years			Range sites		
	1972	1973	1974	Loamy upland	Breaks	Clay upland
Season-long	2146[1]	2538	2248	2422[1]	2192	2268
Intensive-early	2278	2493	2729	2863	2435	2202

[1] $LSD_{.05}$ = 282.

Grazing Distribution Surveys

Grazing use was estimated on July 16 and in late November to determine grazing distribution by the Deming method (Deming 1939). Grazing use was estimated ocularly along a line grid throughout each pasture and rated on a scale of 1 to 5 (1 = light use, 5 = heavy use).

Statistical Analyses

Analyses of variance were calculated using subsamples as an estimate of error variance, since the experiment was not replicated. Though not considered strictly statistically valid, the analyses aid in interpretation.

Results and Discussion

Herbage Production

Perennial Grass Component

Perennial grass yield from grazed areas July 16 was greater ($P<.05$) on the SLS pasture (1,301 lb dry matter/acre) than on the IES pasture (872 lb dry matter/acre). The lesser perennial grass amount remaining on the IES pasture at mid-season reflected the higher stocking rate. Although the stocking rate on the IES pasture was two times that of the SLS pasture, perennial grass yields on the IES pasture were 67% of the perennial grass yields on the SLS pasture. Since twice as much grazing use was expected, there appeared to be added growth early in the season on the IES pasture compared with the SLS.

At growing season's end, the perennial grass component after grazing was greater ($P<.05$) on the IES pasture than on the SLS one (1,610 to 1,334 lb dry matter/acre). The rest from July 15 to October 3 gave plants time to produce enough photosynthetic tissue to restore vigor on the IES pasture.

Perennial grass yields for SLS and IES pastures from areas caged to prevent livestock grazing were similar for the first 2 years, but the third year the IES pasture produced more grass than the SLS pasture (Table 1). The higher perennial grass production came from loamy upland and breaks range sites. Greater productivity on the pasture may have been due to an increased vigor of the dominant grasses from late-season rest from grazing.

Forb-brush Component

At mid-season, forb-brush amounts were greater from grazed areas on the SLS pasture than from the IES pasture, except in 1974, when the IES pasture yielded more forbs and brush (Table 2). Forb-brush yields were greater on clay upland and break sites than on loamy upland site. Apparently, IES resulted in greater use of that yield component in 1972 and 1973.

Forb-brush amounts on grazed areas by growing season's end were greater for the SLS pasture than for the IES pasture in 1972, but did not differ in 1973 and 1974 (Table 3). On caged areas, forb-brush amounts were higher in 1972 and 1973 at growing season's end from SLS than for the IES pasture, but yields did not differ in 1974.

Table 2. Forb-brush amounts remaining (lb dry matter/acre) on July 16 by year and range site from grazed areas under season-long and intensive-early stocking.

Grazing system	Year			Range site	Amounts remaining
	1972	1973	1974		
Season-long	220[1]	472	236	Loamy upland	176[1]
Intensive-early	123	167	336	Breaks	293
				Clay upland	307

[1] $LSD_{.05}$ = 83.
[2] $LSD_{.05}$ 115.

Table 3. Forb-brush amounts (lb dry matter/acre) remaining on grazed and caged areas following the growing season on season-long and intensive-early stocked pastures (avg. of all range sites).

Grazing system	Grazed			Caged		
	1972	1973	1974	1972	1973	1974
Season-long	306[1]	293	280	431[2]	569	414
Intensive-early	136	269	371	212	319	524

[1] $LSD_{.10}$ = 135.
[2] $LSD_{.05}$ = 217.

Plant Census

Botanical composition and basal cover between 1971 and 1975 were used to detect change of some important components of the Flint Hills plant communities under season-long and intensive-early stocking. Harmful or beneficial effects of the two grazing systems are evaluated by the magnitude of the change.

Basal Cover

Big bluestem was the only major dominant which changed its basal cover differentially with respect to stocking system, increasing more under IES than SLS on all range sites (Table 4).

Table 4. Basal cover (%) of big bluestem and perennial forbs under season-long and intensive-early stocking (avg. of three range sites).

	Grazing system	
	Season-long	Intensive-early
Big bluestem		
1971	1.10	1.31
1975	1.66	2.71
Change	+0.56	+1.40
$LSD_{.05}$ = 0.62[1]		
Perennial forbs		
1971	0.21	0.23
1975	0.89	0.50
Change	+0.68	+0.27
$LSD_{.05}$ = 0.27[1]		

[1] Least significant differences ($P<.05$) refer only to change in basal cover.

Kentucky bluegrass basal cover increased more from 1971 to 1975 on loamy upland and clay upland range sites under SLS than IES (Table 5). Since regrowth following livestock removal on the IES pasture provides a continuous fuel source, burning was more complete on the IES pasture than the SLS one and resulted in a greater mortality of Kentucky bluegrass on the IES pasture. Grass-like plants, largely cool-season species, behaved similarly to Kentucky bluegrass, increasing in basal cover under SLS and remaining essentially stable under IES (Table 5). Perennial forb basal cover increased under both IES and SLS, but the increase was greater under SLS on all range sites (Table 4). Apparently, increased forb grazing early in the growing season or the more complete burn with IES than with SLS resulted in the differential response.

Table 5. Basal cover (%) of Kentucky bluegrass and grass-like plants in pastures under season-long and intensive-early stocking on indicated range sites.

Grazing system	Range site		
	Loamy upland	Breaks	Clay upland
Kentucky bluegrass			
Season-long			
1971	0.18	0.12	0.37
1975	1.01	0.17	1.10
Change	+0.83	+0.05	+1.47
Intensive-early			
1971	0.60	0.20	0.76
1975	0.86	0.14	0.64
Change	+0.26	−0.06	−0.12
$LSD_{.05}$ = 0.49[1]			
Grass-like plants			
Season-long			
1971	0.21	0.29	0.14
1975	0.93	0.55	0.41
Change	+0.72	+0.26	+0.27
Intensive-early			
1971	0.32	0.27	0.16
1975	0.35	0.16	0.43
Change	+0.03	−0.11	+0.27
$LSD_{.05}$ = 0.36[1]			

[1] Least significant difference ($P<.05$) refer only to change in basal cover.

Overall, IES was more beneficial to the plant community than was SLS, favoring big bluestem and deterring undesirable components such as Kentucky bluegrass, grass-like plants, and perennial forbs.

Percent Composition.

Big bluestem % composition increased under IES over the 4-year period and decreased under SLS (Table 6). The only other major dominant to change in % composition differentially with respect to grazing system was little bluestem, which decreased more under SLS than under IES.

On breaks range sites, sideoats grama % composition increased more under IES than under SLS (Table 7). That was likely due to the increased grazing pressure on breaks sites with IES compared to SLS. Kentucky bluegrass % composition increased on loamy upland and clay upland range sites in the SLS pasture and decreased on the IES (Table 7). Again the more complete burn on the IES pasture probably accounted for the differential response. The breaks range site was lightly grazed under SLS and burned completely, accounting for similar trends in % composition under both systems. Grass-like plants responded similarly to Kentucky bluegrass in % composition changes (Table 7).

Table 6. Composition (% total basal cover) of big and little bluestem under season-long and intensive-early stocking (avg. of three range sites).

	Grazing system	
	Season-long	Intensive-early
Big bluestem		
1971	28.9	26.0
1975	21.7	30.8
Change	−7.6	+4.8
$LSD_{.05}$ 3.8[1]		
Little bluestem		
1971	15.5	11.9
1975	11.0	10.8
Change	−4.5	−1.1
$LSD_{.05}$ = 2.7[1]		

[1] Least significant differences ($P<.05$) refer only to change in percent composition.

Table 7. Composition (% total basal cover) of indicated species under season-long and intensive-early stocking for indicated range sites.

Grazing system	Range site		
	Loamy upland	Breaks	Clay upland
Sideoats grama			
Season-long			
1971	8.0	10.0	7.3
1975	7.1	12.9	11.2
Change	−0.9	+2.9	+3.9
Intensive-early			
1971	3.7	8.6	9.0
1975	6.4	16.7	11.6
Change	+2.7	+8.1	+2.6
$LSD_{.05}$ = 4.0[1]			
Kentucky bluegrass			
Season-long			
1971	4.5	2.8	13.1
1975	12.5	2.0	25.9
Change	+8.0	−0.8	+12.8
Intensive-early			
1971	16.1	3.6	14.3
1975	10.6	1.7	5.7
Change	−5.5	−1.9	−8.6
$LSD_{.05}$ = 3.3[1]			
Grass-like plants			
Season-long			
1971	5.3	6.4	5.2
1975	11.4	6.7	4.1
Change	+6.1	+0.3	−1.1
Intensive-early			
1971	8.7	4.9	3.0
1975	4.5	2.0	4.2
Change	−4.2	−2.9	+1.2
$LSD_{.05}$ = 3.4[1]			
Perennial forbs			
Season-long			
1971	4.1	5.1	8.5
1975	13.3	9.4	11.4
Change	+9.2	+4.3	+2.9
Intensive-early			
1971	6.9	3.9	4.3
1975	5.8	5.7	5.0
Change	−1.1	+1.8	+0.7
$LSD_{.05}$ 5.4[1]			

[1] Least significant differences ($P<.05$) refer only to change in percent composition.

During the 4-year period SLS resulted in an increase in perennial forb % composition, while under IES perennial forb % composition remained relatively stable.

IES favored maintenance of a desirable plant community, but SLS resulted in a slow deterioration of % composition of the desirable species and an increase in undesirable components.

Grazing Distribution

IES resulted in more uniform grazing of all range sites than SLS did. Grazing distribution patterns were essentially the same throughout the 4 years.

By mid-July all areas of the IES pasture had received at least moderate use, with approximately 10% of the total area used moderately heavy. Moderately heavy use was concentrated on an upland ridge along the east side of the unit (Fig. 1A). Two small areas, one near water and another near salt, also had received moderately heavy use. Grazing distribution over all range sites was uniform.

In mid-July approximately 60% of the total area of the SLS pasture had received moderately light use, 35% moderate use, and 5% moderately heavy use (Fig. 1B). Uneven grazing distribution was associated with range sites. Break areas and outfacing slopes away from water were grazed least. Similar range site distribution on the IES pasture did not result in uneven grazing.

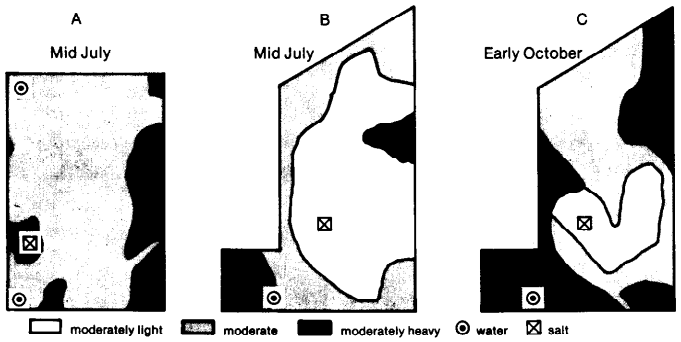

Fig. 1. *Grazing patterns of pastures studied: (A) in mid-July, pasture stocked intensive-early; (B) mid-July, pasture stocked season-long; (C) early (October, pasture stocked season-long.*

In early October after cattle removal from the SLS, grazing was moderately heavy over 40% of the pasture, moderate 40%; and moderately light 20% (Fig. 1C). Again, range site distribution appeared to be the primary determinant for grazing intensity. Usually breaks range sites received moderately light grazing, while level loamy upland and clay upland sites were moderately to moderately heavily grazed.

Cattle Gain

From May 2 to July 15, the daily gain of steers under IES was similar to those under SLS in 1972 and 1974 and greater in 1975; the 3-year average was greater under IES (Table 8). The IES system used grass when its nutritive value was highest. Gain per acre was more under IES. Under SLS, daily gain declined as the season progressed and was lower from July 15 to October 3 than for the earlier period. The 154 days of SLS produced 210 lb gain per steer compared with 141 lb for 75 days under IES.

Conclusions

1. Intensive early stocking (2X) from May 1 to July 15 maintained perennial grass herbage production comparable to that of season-long stocking.

2. Grazing distribution was more uniform under IES than under SLS.

3. Desirable warm-season perennial grasses were favored more by IES than by SLS.

4. Kentucky bluegrass and perennial forbs were favored more by SLS than by IES.

Table 8. Steer gains on intensive-early stocked and season-long stocked pastures.

	Intensive-early stocked	Season-long stocked		
	May 2-July 15 75 days	May 2-July 15 75 days	July 15-Oct. 3 79 days	May 2-Oct. 3 154 days
No. of steers, all years	104	52	52	52
Acres per steer	1.7	3.4	3.4	3.4
Gain per steer (lb)				
1972	132	122	66	188
1974	159	153	109	262
1975	131	117	64	181
Avg.	141	131	79	210
Daily gain per steer (lb)				
1972	1.78[a][1]	1.65[a]	0.84[b]	1.22[c]
1974	2.09[a]	2.01[a]	1.36[b]	1.68[c]
1975	1.77[a]	1.58[b]	0.83[c]	1.18[d]
Avg.	1.88[a]	1.75[b]	1.00[c]	1.36[d]
Gain per acre (lb)				
1972	78	36	19	55
1974	96	45	32	77
1975	77	34	19	53
Avg.	83	39	23	62

[1] Values in same row with different letters differ significantly ($P<.05$).

5. Daily gain and gain per acre by steers were increased by IES compared to SLS.

6. Gain per steer was lower with IES than SLS because of the shorter grazing season, 75 days for IES compared with 154 days for SLS.

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