

# A Stocking-Rate Guide for Beef Production on Blue-Grama Range<sup>1</sup>

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## Highlight

A stocking-rate guide for cattle on blue-grama range was developed at Central Plains Experimental Range. The guide is based on the amount of herbage left ungrazed at the end of the summer season as it relates to gain per animal and gain per acre. Maximum dollar returns per acre from yearlings were obtained when 300 lb of air-dry herbage were left at the end of the season. The average optimum stocking rate was 2.6 acres/yearling month.

Approximately 30 million acres of shortgrass range are grazed annually by livestock in the Central Great Plains. Ranching enterprises today are

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plagued with increasing operation costs and a plateaued level of income. This situation demands an increasing requirement for more efficient grazing practices. The quantity and quality of forage available to livestock, and the use they make of it, determine grazing efficiency. Grazing efficiency is readily altered by changes in stocking rate. At Central Plains Experimental Range, light-stocking rates result in high animal daily gains and low animal gain per acre; while moderate- to heavy-stocking rates result in low animal daily gains and high animal gain per acre.

This paper presents a stocking-rate guide for blue-grama range grazed from May 1 to October 31. The stocking-rate guide is not based on percent utilization but is based on herbage left ungrazed at the end of the grazing season. The amount of ungrazed herbage is a quantitative factor that can be readily recognized and related to gain per animal and gain per acre.

## Methods

Central Plains Experimental Range, located 38 miles northeast of Fort Collins, Colorado, has an average annual precipitation of 12 inches. An average of 8.3 inches falls during the period May 1 to September 30. Blue-grama grass (*Bouteloua gracilis* (HBK.) Lag. ex Steud.) is the dominant forage species.

Grazing intensity-of-use studies with yearling Hereford heifers were initiated in 1940 and con-

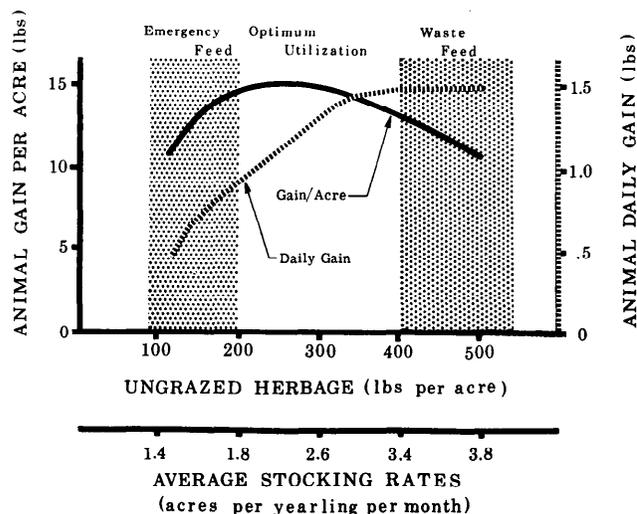


FIG. 1. Stocking-rate guide for beef production on upland blue-grama pastures grazed May 1 through October 31.

tinued through 1963. Three half-section pastures were stocked from May 1 to October 31 to give light, moderate, or heavy grazing. The three pastures used to develop this stocking-rate guide included primarily upland range sites on soils of the Ascalon and Shingle series.

Animal days of grazing, animal gains, and herbage utilization were reported by Klipple and Costello (1960) for the 14-year period 1940 through 1953. Similar measurements were made in five years of the period from 1954 through 1963. Thus complete data were available for 19 years. Fifty-seven grazing periods (19 years  $\times$  3 grazing intensities) were used to develop the stocking-rate guide.

Utilization estimates were made using the pasture-comparison method (Bement and Klipple, 1959), where herbage remaining ungrazed at the end of the season was the factor upon which the utilization judgment was made.

Animal daily gain and animal gain per acre were calculated for each grazing intensity in each of the 19 years studied. Daily gain and gain per acre were plotted in relation to herbage remaining ungrazed for each of the 57 grazing periods. Gain-per-acre and daily-gain curves were fitted to the data and standard deviations were computed. The combination of the daily-gain curve, gain-per-acre curve, ungrazed herbage, and average stocking rate resulted in the stocking-rate guide (Fig. 1).

Cattle sale data for the years 1964, 1965, and 1966 were used to evaluate the effects of stocking rate on cattle return per acre. Cattle return per acre, as used here, was the dollar value returned per acre by the cattle that grazed the vegetation. Labor, land, sale, and transportation costs were not included. Death losses for the yearling heifers on upland pastures were negligible and were omitted.

Spring cattle prices were those received for similar cattle at the auction sale in Greeley, Colorado. Fall cattle prices were those received at the annual Crow Valley Livestock Association Sale conducted at the Experimental Range.

The amount of herbage remaining ungrazed at the end of the season can be readily estimated to within 50 lb/acre by a trained observer. For this reason, average stocking rates which left 150, 200, 250, 300, 350, 400, 450, and 500 lb/acre of ungrazed herbage were selected from the stocking-rate guide to study cattle return per acre. The average number of animals per section (640 acres) and average animal gain per season were calculated from the stocking-rate guide for each of the selected stocking rates. Cattle prices for 1964 through 1966 were applied to the calculated beef production to estimate cattle return per acre at each of the selected stocking rates.

## Results

The stocking-rate guide (Fig. 1) shows animal gain per acre and animal daily gain in relation to ungrazed herbage remaining at the end of the grazing season and approximate stocking rate. The standard deviation for the animal-daily-gain curve is  $\pm 0.27$  lb/day, and for the gain-per-acre curve is  $\pm 0.97$  lb/acre.

Maximum average gains of 15 lb/acre were obtained at a stocking rate of 2.2 acres/yearling per month. At this stocking rate approximately 250 lb of air-dry herbage were left on the ground at the end of the grazing season. Maximum average daily gains of 1.45 lb/animal were made by leaving at least 350 lb of herbage at the end of the season; this required at least 3.2 acres/yearling month.

Table 1 shows the effects of stocking rate on cattle return per acre. It also shows how cattle returns per acre were determined for each stocking rate using 1966 price data. Cattle returns per acre, using price data for 1966, 1965, and 1964, are summarized in Table 2. Calculations for 1964 and 1965 were made in the same manner as shown in Table 1 for 1966. Spring and fall prices as well as the spread between spring and fall prices differed in each of the three years. In 1966 and 1964 lighter animals brought a higher price per pound than heavier ones. The price was lower for animals heavier than 570 and 540 lb, respectively, in 1966 and 1964. In 1965 there was no price change between the lighter and heavier animals. In spite of differences in price factors, maximum cattle returns per acre occurred when approximately 300 lb/acre of air-dry herbage were left ungrazed at the end of the grazing season. This is the approximate center of the optimum utilization area on the stocking-rate guide where the average stocking rate is 2.6 acres/yearling month.

Table 1. Cattle returns per acre from May 1 to October 31 grazing at different stocking levels using 1966 price data.

Item	Unit	Ungrazed herbage left (lb.)							
		150	200	250	300	350	400	450	500
Yearling heifers/section (640 acres)	No.	67	58	49	41	34	31	29	28
Acres/heifer month	ac.	1.60	1.85	2.19	2.63	3.12	3.45	3.70	3.80
Gain/acre	lb.	13.09	14.58	15.07	14.82	13.63	12.62	11.74	11.46
Gain/head/day	lb.	0.70	0.90	1.10	1.30	1.42	1.45	1.45	1.45
Gain/head 6 mo. (180 days)	lb.	126	162	198	234	256	261	261	261
Spring weight/head	lb.	400	400	400	400	400	400	400	400
Fall weight/head	lb.	526	562	598	634	656	661	661	661
Spring cattle value/CWT (May '66)	\$	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50
Spring cattle value/head	\$	106.00	106.00	106.00	106.00	106.00	106.00	106.00	106.00
Fall cattle value/CWT (Nov '66)	\$	22.80	22.80	22.10	22.10	22.10	22.10	22.10	22.10
Fall cattle value/head	\$	119.93	128.14	132.16	140.11	144.98	146.08	146.08	146.08
Sale return/head	\$	13.93	22.14	26.16	34.11	38.98	40.08	40.08	40.08
Sale return/section	\$	933.31	1284.12	1281.84	1398.51	1325.32	1242.48	1162.32	1122.24
Spring cost of cattle	\$	7102.00	6148.00	5194.00	4346.00	3604.00	3286.00	3074.00	2968.00
Interest on spring cost @ 5% 6 mo.	\$	177.55	153.70	129.85	108.65	90.10	82.15	76.85	74.20
Misc. costs @ \$1.16/head (spray 20¢, salt 10¢, tax 86¢)	\$	77.72	67.28	56.84	47.56	39.44	35.96	33.64	32.48
Interest plus misc. costs	\$	255.27	220.98	186.69	156.21	129.54	118.11	110.49	106.68
Cattle return per section	\$	678.04	1063.14	1095.15	1242.30	1195.78	1124.37	1051.83	1015.56
Cattle return per acre	\$	1.06	1.66	1.71	1.94	1.87	1.76	1.64	1.59

### Discussion

When 300 lb of herbage remain ungrazed at the close of the season, animal production is at an optimum and herbage production is probably near optimum for this type of livestock operation. Leaving 300 lb of herbage at the end of the grazing season does maintain herbage production. Blue

grama does not have a smooth seasonal growth curve at Central Plains Experimental Range. It grows in spurts as moisture becomes available. It is not unusual for this grass to grow and then become dormant two or three times during the summer season. Grazing cattle remove portions of the leaf tissue as it is produced during these spurts of

Table 2. Cattle returns per acre from May 1 to October 31 grazing at different stocking levels using price data from 1964, 1965, and 1966.

Item	Unit	Yearling heifers per section (no. per 640 acres)							
		67	58	49	41	34	31	29	28
Ungrazed herbage left	lbs.	150	200	250	300	350	400	450	500
Fall weight/head	lbs.	526	562	598	634	656	661	661	661
Spring cattle value/CWT									
1966	\$	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50
1965	\$	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
1964	\$	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75
Fall cattle value/CWT									
1966	\$	22.80	22.80	22.10	22.10	22.10	22.10	22.10	22.10
1965	\$	21.70	21.70	21.70	21.70	21.70	21.70	21.70	21.70
1964	\$	18.80	18.10	18.10	18.10	18.10	18.10	18.10	18.10
Spring-Fall price spread									
1966	\$	3.70	3.70	4.40	4.40	4.40	4.40	4.40	4.40
1965	\$	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
1964	\$	2.95	3.65	3.65	3.65	3.65	3.65	3.65	3.65
Cattle return per acre									
1966	\$	1.06	1.66	1.71	1.94	1.87	1.76	1.64	1.59
1965	\$	1.96	2.40	2.63	2.70	2.49	2.32	2.17	2.10
1964	\$	0.90	1.03	1.37	1.56	1.51	1.42	1.33	1.28

growth. Under heavy stocking rates much of the new leaf tissue is removed, leaving little photosynthetic material for herbage production. Under light stocking less new leaf tissue is removed and more photosynthetic material is available for production. The amount of photosynthetic material working during these spurts of growth influences the quantity of herbage produced.

The most important effect of heavy grazing on vegetation was a reduction in herbage yield (Klippel and Costello, 1960). Klippel and Bement (1961) reported that herbage yields lowered by heavy grazing could be restored by the use of a light stocking rate. Hyder et al. (1966) found that species composition of the vegetation on these pastures was not affected by 23 years of summer grazing at heavy intensities.

An operator must consider vegetation, livestock, and economics as he makes management decisions of: 1) when a pasture should be stocked, 2) what rate of stocking should be used, 3) when the livestock should be taken off, and 4) where they should go. This stocking-rate guide will be helpful in making management decisions for upland blue-grama ranges similar to those at Central Plains Experimental Range. In all but 4 of the 24 years of this study the stocking-rate guide would have provided a sound basis for the stocking-rate decision.

In April, when the stocking-rate decision is made, there is no way of knowing what kind of season is to follow. Wide yearly and seasonal fluctuations in forage production as well as annual and seasonal variations in forage quality will occur.

In drouth years, similar to 1954, forage production is negligible. In such a case the range and livestock manager must decide when to move and where to go. He may decide to stay in a pasture even though there are less than 200 lb of herbage remaining because blue-grama ranges respond quickly if adequate moisture is received. In using this emergency feed he must consider the lowered animal gains and the amount of growing season remaining if adequate rains were to come.

On the other hand, there will be years similar to 1957 when blue-grama yield was not above average but early moisture produced an abundance of Russian thistle (*Salsola kali* var. *tenuifolia* Tausch). The cattle avidly grazed the thistle from June through September. In this case, animal-daily gains of two lb were realized for the 180-day season. Daily gain would be much higher than that expected from the guide in such a year, and properly increased stocking rates could improve the gain per acre.

In order to make wise stocking-rate adjustments during the grazing season, more information is needed: 1) to evaluate the quality of forage available at any given time, and 2) to determine the amount of leaf tissue needed to sustain fast herbage growth. The quantity of forage of a given quality needed to make optimum gains should also be known. When an operator can evaluate each of his pastures on the basis of quality and quantity of forage available as well as the quantity of leaf tissue required for rapid growth, he can better make the decisions of when and where to move. Until this information is available, the stocking-rate guide developed at Central Plains Experimental Range will help him with his initial stocking and will be of some assistance in making later adjustments.

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