Cow-Calf Response to Stocking Rates and Grazing Systems on Native Range[1, 2]

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Highlight

Studies of grazing management for cow-calf operations on native range have been conducted on the Texas Experimental Ranch since 1960. Three stocking rates and three grazing systems were evaluated. Calf production was greater from the deferred-rotation grazing systems than from continuous grazing at the same stocking rate. Heavier stocking rates reduced calf production per animal unit slightly, but production per acre increased significantly. The net returns per animal unit were greatest from the Merrill system, stocked at a moderate rate, and the net returns per acre were greatest from heavy continuous stocking. The optimum stocking rate for this range appeared to be between 40 and 50 animal units per section and it was profitable to use the Merrill grazing system.

La Produccion de Vacas y Becerros a Differentes Cargas y Sistemas de Pastoreo con Rotacion en Pastizales Naturales

Resumen[5]

Se llevó a cabo un estudio en el rancho experimental de Texas cerca de Throckmorton, Texas, E.U.A., comprendiendo un período de diez años. Los tratamientos fueron: pastoreo todo el año a tres diferentes cargas de animales: pesado (12.8 acres por vaca), moderado (20.8 acres por vaca), ligero (28.4 acres por vaca) y dos diferentes sistemas de pastoreo con rotación a la carga moderada.

La producción de becerras por vaca fué mas alta para los sistemas de pastoreo con rotación que para el pastoreo por todo el año a la misma carga moderada. La producción por vaca fué menor en el tratamiento de pastoreo todo el año a la carga pesada pero la producción por acre fué mayor que en todos los otros tratamientos. También el ingreso neto por acre. El ingreso neto por vaca fué mayor en el cuarto potrero rotación llamado Sistema de Merrill.

El coeficiente de agostadero óptimo fué entre 12.5 y 15 acres por unidad animal.

Many studies have investigated the influence of stocking rates and grazing systems upon livestock production. Increasing the stocking rate results in reduced gains per animal and increased gains per acre until the potential production of the range is reached (Stoddart, 1960). At this point, further increases in stocking rate result in reduction of both gains per animal and gains per acre. Correct range use lies somewhere between maximum production per animal and maximum immediate return per acre (Stoddart and Smith, 1955).

Grazing systems are quite varied and seldom has the same system been tested in two different locations. Heady (1961) has reviewed studies comparing continuous grazing with various special grazing systems, and he concluded that for California annual type vegetation, continuous grazing was the most desirable. In the California annual type, vegetational changes are so rapid that any improvement to one pasture is lost before the cycle of a deferred-rotation system can be repeated.

Grazing studies on the U. S. Southern Great Plains Field Station compared continuous grazing with a 3-division rotation where cattle were moved at one month or shorter intervals (McIlvain et al., 1955). Rotation grazing appeared to be slightly more beneficial to vegetation than continuous grazing, however, these two systems were not greatly different with respect to steer gains or economic returns. On the same station a comparison of a 2-division rotation with continuous grazing indicated that there was little difference between the systems. Pastures on the Southern Plains Experimental Range were in good condition when these studies began.

A systematic, 4-pasture deferred-rotation tested on the Ranch Experiment Station near Sonora, Texas, produced greater cattle gains per head and per acre than did continuous grazing at light, moderate, or heavy stocking (Merrill, 1952 and 1965). Vegetational improvement under the 4-pasture deferred-rotation system, stocked at a moderate rate, was as rapid as under light continuous stocking. The experimental pastures on the Sonora station were in poor condition when the study was initiated.

The objectives of this study were to determine the stocking rate for optimum livestock production from native range in the Rolling Plains region of Texas and to evaluate two different systematic deferred-rotation grazing systems.

Study Area and Methods

The climax vegetation of the Rolling Plains region includes mid and tall grasses. Continuous, close utilization by livestock for almost 100 years had reduced the vegetation on the study area to primarily short and mid grasses. Most of the decreaser species that were once a major part of the plant community were still present at the start of this

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Table 1. Combinations of stocking rates and grazing systems studied and the acreages used for each treatment.

Stocking rate	Grazing system	Acres per treatment
Heavy	continuous	585
Moderate	continuous	598
Light	continuous	602
Moderate	switchback	640
Moderate	Merrill	1099

study, but they made up only a very small part of the total composition. Texas wintergrass (*Stipa leucotricha*) and buffalograss (*Buchloe dactyloides*) each accounted for approximately 35% of the vegetation at initiation of the study. Sideoats grama (*Bouteloua curtipendula*), the third most important species, contributed 6 to 12% to the vegetative composition in 1960. During 1965 and 1968, fall and winter precipitation resulted in large populations of Texas broomweed (*Xanthocephalum texanum*), an undesirable annual forb. In most years, perennial grasses accounted for over 80% of the vegetation with less than 10% annual grasses and about 10% forbs. This vegetation is relatively stable and changes in composition occur slowly; however, plant vigor responds rather rapidly to grazing treatments.

Although the frostfree period averages about 220 days, forage production continues throughout the year except when limited by drought. Peak forage production normally occurs in April, May, June, and September while July and August are usually hot and dry. However, if adequate rainfall is received in July and August, forage production will continue at a high level throughout the summer.

The 40-year average annual precipitation for Throckmorton County was 24.96 inches; however, the eight-year average at the Experimental Ranch headquarters was 27.51 inches. Annual rainfall was below the county average for only two of the eight years. The average monthly distribution of rainfall during the study was fairly normal, although there was considerable variation from the normal in several years.

The Texas Agricultural Experiment Station in cooperation with the Texas Experimental Ranch Committee and Swenson Land and Cattle Company established the Texas Experimental Ranch in 1959 for the purpose of conducting grazing management research. Prior to the initiation of this research, the experimental area was in one pasture. Soil and range surveys were conducted on the area and fences were planned so that all pastures would be as comparable as possible.

The treatments consisted of three different stocking rates and three grazing systems (Table 1). The three stocking rates compared under a continuous grazing system were heavy (12.8 acres per animal unit), moderate (20.8 acres per animal unit), and light (28.4 acres per animal unit). The three grazing systems, all stocked at moderate rate, were continuous (yearlong) grazing, switchback system (Joubert, 1958), and Merrill system (Merrill, 1952).

The switchback system consisted of two pastures and one herd of cattle (Table 2). The stocking rate (acres per animal unit) was divided into the total acreage of both pastures to determine the number of animal units to be carried. All of the cows were then placed in one of the pastures and rotated on the schedule shown. The Merrill system of deferred-rotation consisted of four pastures and three herds of cattle (Table 3). The combined carrying capacity of all four pastures was calculated and divided equally into three herds of cattle which were rotated according to a fixed schedule. The switchback system required two years and the Merrill system required four years to complete a cycle of deferment.

Table 2. Herd rotation and deferment periods for switchback grazing system using 2 pastures and 1 herd.

Date	Pastures	
	G	H
March 16 to June 15	Graze	*Rest*
June 16 to December 15	*Rest*	Graze
December 16 to March 15	Graze	*Rest*
March 16 to June 15	*Rest*	Graze
June 16 to December 15	Graze	*Rest*
December 16 to March 15	*Rest*	Graze

A group of three-year-old Hereford heifers were obtained during the fall of 1959 and were randomly allocated to the pastures. These heifers weaned their first calves in October 1960 but records were not obtained from this calf crop. Records were obtained for these same cows and their calves for the period 1961 through 1968. All of the cows remained on the same treatments for the duration of the study, or until they had to be permanently replaced. Multiple bulls were used in all pastures with never more than 20 cows per bull. The bulls were fertility tested prior to breeding and different bulls were used each year. The breeding season was from March 15 to June 15 and the calves were weaned in early October. All cows and calves were weighed individually in late March, mid-June, and September of each year. All calf weights shown are the averages of the mean heifer and mean steer weights. Cottonseed cake (41% crude protein) was fed to all cows during December, January, and February at the rate of 1.5 pounds per cow per day.

Table 3. Herd rotation and deferment periods for the Merrill grazing system using 4 pastures and 3 herds.

Date	Pastures			
	K	L	M	N
Feb. 16 to June 15	Graze	Graze	Graze	*Rest*
June 16 to Oct. 15	*Rest*	Graze	Graze	Graze
Oct. 16 to Feb. 15	Graze	*Rest*	Graze	Graze
Feb. 16 to June 15	Graze	Graze	*Rest*	Graze
June 16 to Oct. 15	Graze	Graze	Graze	*Rest*
Oct. 16 to Feb. 15	*Rest*	Graze	Graze	Graze
Feb. 16 to June 15	Graze	*Rest*	Graze	Graze
June 16 to Oct. 15	Graze	Graze	*Rest*	Graze
Oct. 16 to Feb. 15	Graze	Graze	Graze	*Rest*
Feb. 16 to June 15	*Rest*	Graze	Graze	Graze
June 16 to Oct. 15	Graze	*Rest*	Graze	Graze
Oct. 16 to Feb. 15	Graze	Graze	*Rest*	Graze

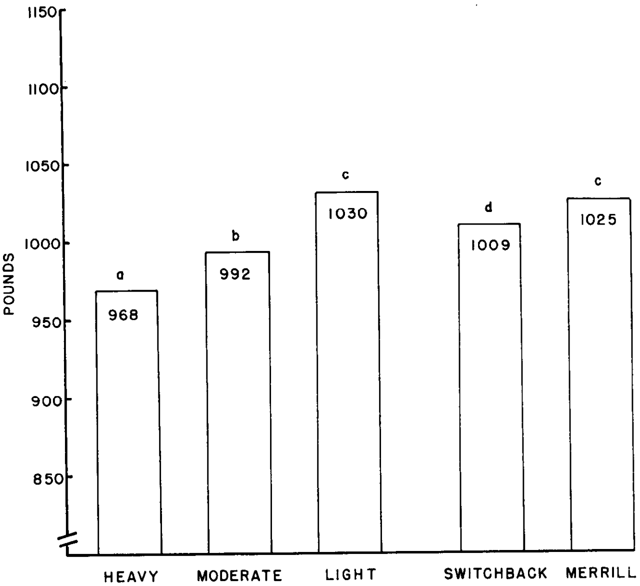

FIG. 1. Cow weights from heavy, moderate, and light continuously stocked pastures, and switchback and Merrill deferred-rotation grazing systems averaged across eight years and three weighing periods per year. (abcd Means having different superscripts differ significantly at the .05 level of probability.)

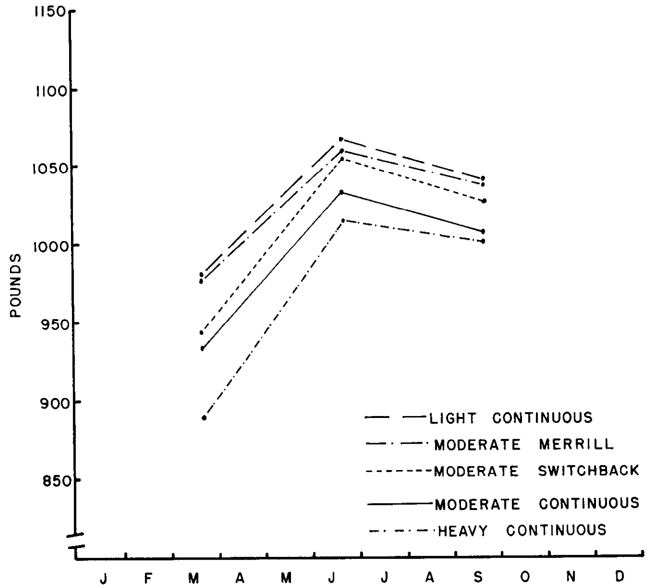

FIG. 2. Spring, summer, and fall cow weights for five grazing treatments averaged for the period 1961 through 1968.

Results and Discussion

Cow Weights

Seasonal and annual fluctuations in the weight of a cow are direct indicators of her nutritional status. Since the average weights and age were the same for all cow herds when they were allocated to the treatments, any resulting differences in the average weights of cows on various treatments were the result of differences in their nutrient intake.

Both stocking rates and grazing systems significantly influenced the average weights of cows on the treatments during the eight-year period (Fig. 1). Cow weights from light continuous stocking and from the Merrill system did not differ significantly, but all other treatments were significantly ($P < .05$) different. Heavy stocking resulted in lower cow weights while cows from both moderately stocked deferred-rotation systems were heavier than those from moderate continuous use.

There were significant seasonal fluctuations in the average weights of cows on all treatments. Cows on the heavily stocked pasture lost the most weight during the winter, gained the most during the spring and lost the least during the summer (Fig. 2). The greatest differences among treatments were evident in the early spring and the smallest differences were in the fall. Seasonal weight changes under the Merrill system and light stocking were very similar. Average cow weights fluctuated more under the switchback system than under moderate continuous grazing or the Merrill system. The greater concentration of livestock under the switchback system resulted in intensive grazing on one pasture followed by rotation to a rested pasture with abundant forage. The rotation dates in March and June corresponded fairly closely with the weighing dates. Weight gains during the spring under the switchback system paralleled those under heavy continuous stocking. Cows gained more during the spring on pastures that were closely grazed the previous year than they did on pastures grazed moderately. However, the cows did not winter as well under intensive grazing pressures.

Calf Production

Calves from the Merrill system were significantly heavier at weaning, averaged over the eight-year period, than were those from the other four grazing treatments, and calves from heavy continuous stocking were significantly lighter (Table 4). The average weaning weights of calves from both light stocking and the switchback system were 506 pounds. The average weaning weight from moderate continuous stocking was 501 pounds. The Merrill system of deferred-rotation increased weaning weights 20 lbs. above moderate continuous stocking, whereas, weaning weights from light continuous stocking were only 5 lbs. greater than from moderate continuous stocking. Average weaning weights from the switchback system were comparable to those from moderate and light continuous stocking.

In examining the average weaning weights from heavy, moderate, and light stocking on an annual basis it was found that they tended to decrease

Table 4. Calf production, stocking rates and longevity of cows for five grazing treatments averaged across eight years.

Treatment: Stocking rate	Treatment: Grazing system	Average birthdate of calves	Weaning weight,[1] (lb.)	Calf crop weaned, (%)	Calf production per AU, (lb.)	Stocking rate, (Acre/AU)	Calf production per acre, (lb.)	Ave. No. calf crops produced
Heavy	continuous	Jan. 17	490[a]	89.9	440	12.8	34.4	8.3
Moderate	continuous	Jan. 13	501[b]	88.2	441	20.8	21.2	8.8
Light	continuous	Jan. 19	506[b]	92.1	465	28.4	16.4	8.2
Moderate	switchback	Jan. 12	506[b]	90.5	458	20.7	22.1	8.3
Moderate	Merrill	Jan. 12	521[c]	93.7	487	19.8	24.6	8.2

[1] Weights not having the same superscript differ significantly ($P < .05$).

under heavy stocking as the study progressed while they increased under light stocking (Fig. 3). Weaning weights from light stocking varied less from year to year than those from moderate and heavy stocking. Apparently the annual fluctuations of climate had very little influence upon calf production from the lightly stocked pasture. However, heavy continuous stocking and the switchback grazing system were both greatly influenced by annual fluctuations of climate.

For five of the eight years, the Merrill system weaned the heaviest calves (Fig. 3). The switchback system had the heaviest calves in 1965 and light continuous stocking had the heaviest in 1964 and 1968. In 1965, the lightest calves were weaned from light continuous stocking. The initial response of the vegetation to deferment, when the rotation systems were started, may be responsible for their having heavier weaning weights than continuous grazing during the first 3 years of the study.

The greater concentration of livestock on one pasture under the switchback system would be expected to result in a slightly lower weaning weight than from the Merrill system. Drought conditions during the spring and summer of 1966 greatly reduced weaning weights from heavy continuous grazing and the switchback system during that year.

Grazing systems and stocking rates had little effect upon average calf weights from April through September (Fig. 4). In late March the average calf weights from the Merrill system were 28 lbs. heavier than from heavy continuous stocking. This difference was maintained with the calves from the Merrill system weighing 28 lbs. heavier in June and 31 lbs. heavier in September. Light continuous stocking, moderate continuous stocking, and the switchback system all produced

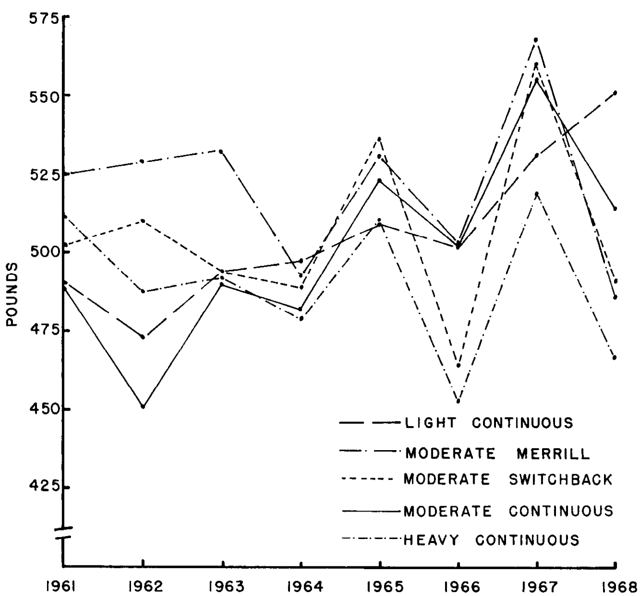

Fig. 3. Average weaning weights of calves from five grazing treatments from 1961 through 1968.

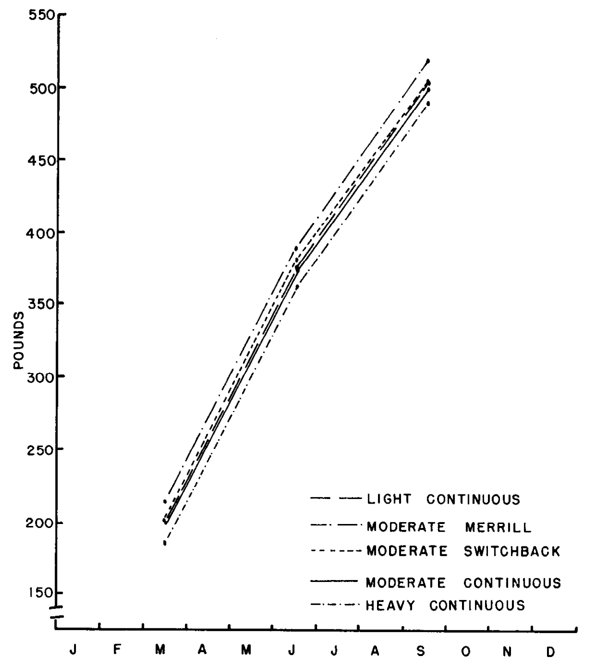

Fig. 4. Spring, summer, and fall calf weights from five grazing treatments averaged for the period 1961 through 1968.

at about the same level. This clearly indicates that the effect of grazing treatment upon calf weights occurred during fall or winter. It was during fall and winter that the greatest differences existed in quantity and quality of forage available under different treatments.

The eight-year average of percent calf crops weaned from the five treatments followed the same pattern as the weaning weights (Table 4). One discrepancy noted was that heavy continuous stocking resulted in a higher percent calf crop weaned than did moderate continuous stocking. Prior to 1968, the averages were 90% on moderate and 89% on heavy. However, in 1968 the cows on heavy stocking weaned a 95% calf crop and those on moderate stocking weaned a 75% calf crop. A possible explanation for this is that on the moderately stocked pasture more calves were born and died during the ice storms which occurred frequently that winter. Cows on all of the treatments apparently bred back at about the same rate as evidenced by the similarity of the average calving dates (Table 4). The longevity of the cows was not influenced by grazing treatment either as the number of calf crops produced per cow was about the same for all treatments.

Calf production per animal unit (weaning weight × percent calf crop) varied from 440 lbs. under heavy continuous stocking to 487 lbs. under the Merrill system (Table 4). Production from moderate continuous stocking was only 1 lb. greater than from heavy stocking, whereas the switchback system produced 18 lbs. more calf per animal unit than heavy stocking. Calf production from light continuous stocking was only slightly higher than from the switchback system and was 22 lbs. below the Merrill system.

Calf production per acre differed markedly among stocking rates (Table 4). Production per acre increased in direct proportion to the stocking rate with heavy stocking resulting in highest production per acre and light stocking the lowest. The Merrill system produced 3.4 lbs. more calf per acre than moderate continuous grazing and the switchback system produced .9 lb. more calf than moderate continuous grazing. Grazing systems affected production per animal unit more than stocking rates did, but the differences were not great enough to have a marked influence upon the production per acre.

In order to evaluate the effects of stocking rates and grazing systems, the data were plotted to show the relationship between stocking rates and production per acre and production per animal unit (Fig. 5) as suggested by Stoddart (1960). Stoddart suggested that the correct stocking rate would lie between maximum production per animal unit and maximum production per acre. From this

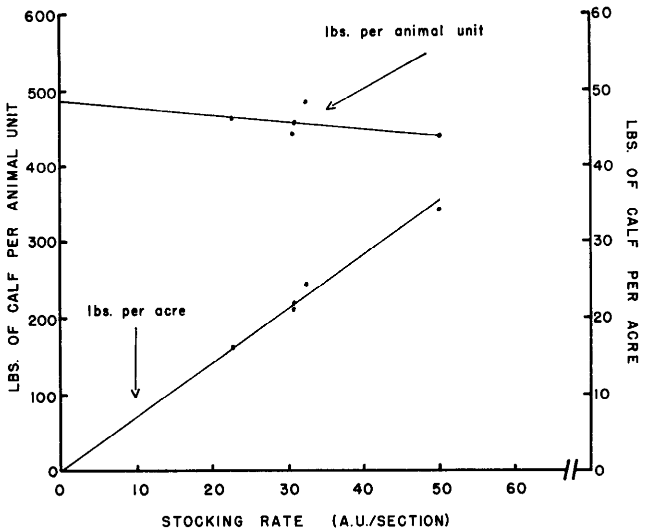

FIG. 5. Relationships between stocking rates and production per animal unit and per acre.

data it is not possible to determine the maximum production per acre. Maximum production per animal unit was obtained at stocking rates above 30 animal units per section. Production of 487 lbs. of calf per animal unit from the Merrill system corresponded to the theoretical maximum production at zero stocking rate. Stocking at 50 animal units per section reduced production per animal unit only slightly compared to moderate continuous stocking at 30 animal units per section. It would be desirable to have additional data so that the curves could be extended to heavier stocking rates. Livestock production from deferred-rotation grazing systems should be determined for heavier stocking rates as well as at the moderate rate. The Merrill grazing system stocked at 32 animal units per section was the only treatment to deviate significantly from the production lines drawn in Figure 5.

For this type of land with a cow-calf type of operation, the optimum stocking rate would appear to be between 40 and 50 animal units per section. Vegetation studies indicated that continuous grazing at the rate of 50 animal units per section caused undesirable changes in the vegetative composition (Mathis and Kothmann, 1968). Both deferred-rotation grazing systems produced as well or better than continuous grazing. Since deferred-rotation grazing was beneficial to the vegetation, it would be desirable to use a suitable deferred-rotation grazing system.

An economic analysis of these five grazing treatments revealed net returns of $73.64 per animal unit for the Merrill system (Kothmann and Mathis, 1969). Net returns per animal unit for the other treatments were heavy continuous $67.16, moderate continuous $62.06, light continuous $62.75, and switchback system $66.11. Net returns per acre for the treatments were heavy continuous $5.28, moderate continuous $3.03, light continuous $2.24, switchback system $3.22, Merrill system $3.81. Although returns per acre were highest from heavy continuous stocking it is doubtful that they could be sustained at this level. It appears that maximum sustained returns could be obtained by using the Merrill system of deferred-rotation and stocking at a rate between 40 and 50 animal units per section with adjustments based upon annual fluctuations of forage production.

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