SELECTION OF APPROPRIATE GRAZING SYSTEMS--A VITAL PART OF RANGELAND RESOURCE MANAGEMENT PLANNING

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The selection of an appropriate grazing system is one of the most important aspects of an adequate resource management plan on rangeland. To be effective, a grazing system must be tailored to the life cycle and physiological requirements of the desirable plants, the nutritional needs of the livestock, with due regard, as necessary, for watershed, wildlife, and other values. Too often a particular grazing system has been applied because it has worked elsewhere, because an agency is committed to using the systems everywhere, or for no real reason at all.

Rest-rotation systems have been widely applied by both the BLM and Forest Service in the last two decades. This system originally was designed for an Idaho fescue (Festuca idahoensis) bunchgrass-type range but it has been widely expanded into other vegetation types with varying success. Rest-rotation systems have been proposed or applied to vegetation types where the physiology or life cycle of the vegetation makes such a system inappropriate, such as ranges dominated by cheatgrass brome (Bromus tectorum) or seeded to crested wheatgrass (Agropyron cristatum or A. desertorum).

Few studies have been made to determine the effects of rest-rotation systems on vegetation and livestock responses in comparison with other grazing systems. The same is true of some of the "newer" systems now being proposed and implemented such as "HILF;" short duration grazing," etc.

The comparison between a rest-rotation and a season-long grazing system reported here was part of a larger study designed to test practical and efficient systems of managing livestock on high elevation ranges in the Intermountain Region. Only part of the study is reported here. More details are reported by Laycock and Conrad (1980).

EXPERIMENTAL AREA

The study was conducted on the Diamond Mountain Cattle Allotment approximately 25 miles north of Vernal, Utah, on the Ashley National Forest. The allotment is on the plateau on the east end of the Uinta Mountains. Elevations on the allotment vary from 7,000 to 8,200 feet. Soils are loams to clay loams. Average annual precipitation is approximately 24.0 inches.

The allotment is representative of the upper sagebrush-grass and lower aspen zones through the Intermountain area. The allotment covers approximately 11,000 acres and is divided into seven pastures of units. Five of the units contained native vegetation and were in fair to good range condition at the start of the study.

Two of the units were seeded with introduced grasses in the mid-1950s one unit to crested wheatgrass and the other to a mixture of crested wheatgrass and smooth brome (Bromus inermus).

METHODS

Grazing Treatments

During each year of the study, about 500 adult cattle (6 months old and older) and approximately 350 calves (under permit by the National Forest) grazed on the allotment for an average of 126 days--June 2 to October 5. Entering the allotment in the spring, all the cattle grazed in one of the seeded units for approximately 34 days.

In early July, cattle were moved to the native units and the comparison I will make is between continuous summer-long grazing every year and a three unit rest-rotation. Both systems had well-distributed natural or artificial water sources and had good riding and salt distribution. The animals in the three unit rest-rotation system grazed for approximately 45 days in one unit and then were moved to the other unit which was to be grazed for another 45 days. The early summer, late summer, and rest treatments were rotated each year. Cattle assigned to summer-long systems remained in the same unit the entire summer.

Cattle Response

To determine the responses of cattle to the various systems of grazing, approximately 40 nursing cows and 30 yearlings were weighed during each of the five grazing seasons from 1961 to 1965. An average of 20 calves were weighed during each of four seasons from 1961 to 1964. No calves were weighed in 1965. The same, marked animals were weighed four times during the grazing season: 1) when the cattle entered the allotment (about June 2); 2) when cattle were removed from the seeded pastures and divided into three groups (about July 4); 3) when the cattle in the three-unit rest-rotation system changed units (about August 11) and 4) just before the cattle left the allotment (about October 4) just before the cattle left the allotment (about October 4). Weighing dates varied somewhat from year to year because of range readiness and degree of forage utilization. Cattle were weighed immediately after gathering without a shrinkage period.

The weighed cattle mostly were registered Herefords and were representative of about 60 percent of the cattle on the allotment. The cows averaged about six years of age. The calves were 3 to 4 months old and the yearlings were 15 to 16 months old when they entered the allotment.

Vegetation Samplings on Study Plots

Several study plots were established in each unit in 1959, each consisting of an exclosure (33 feet x 33 feet) and an adjacent (within 50 feet) 50 feet x 50 feet marked area open to grazing. The vegetation on study plots located throughout each unit was sampled near the beginning of the study in 1961 and in 1967, the year following the end of the study. Weight (peak aboveground standing crop) was determined for each species within square foot quadrats. Each time a study plot was sampled, 50 quadrats were estimated, 25 in the exclosure and 25 in the grazed area. Crown cover of shrubs also was estimated on the same quadrats.

Herbage Production and Utilization Surveys

Before grazing each year, total grass production in each unit was mapped by production classes using a reconnaissance method. This was done independently from the more detailed sampling of the study plots previously described. The total acreage covered by each production class multiplied by the midpoint of that production class enabled us to estimate total pounds of grass available for grazing in the unit excluding any growth or regrowth that took place during the grazing period.

The percentage utilization of each grass species was ocularly estimated immediately after cattle grazed in each unit each year. The entire unit was also surveyed by a reconnaissance method after grazing to estimate the total pounds of grass removed and to calculate a weighted average percent utilization for the unit. Because production of regrowth during the grazing period was not taken into account, the total utilization figures for each unit probably are slightly too low.

RESULTS AND DISCUSSION

Native Range

Utilization

In the native units, average utilization in the years grazed was the same (37 percent) for both the rest-rotation and the summer-long every year systems. When years of rest were included in the average, the system grazed summer-long every year received the heaviest grazing rate (37 percent) while the rest-rotation system averaged 25 percent.

Trends in Production, 1961 to 1967

Patterns of herbage production changes generally were similar for the two grazing systems (Table 1). The differences that did occur are difficult to explain and seem to be caused by factors other than the grazing system. Total grass production remained the same in the exclosures in the rest-rotation system and in the grazed areas in the summer-long system while grass production increased in the grazed areas in the rest-rotation system and decreased in the exclosures in the summer-long system. This might indicate some response to grazing but forb production followed the same pattern except for an increase instead of a decrease in the exclosures in the summer-long system.

Shrub cover

Shrub cover (mainly sagebrush) remained constant at 12 to 15 percent in the rest-rotation system but increased from 8 to 16 percent in the exclosure and from 5 to 13 percent in the grazed area in the grazed summer-long system. Some sagebrush control (probably railing) was done in the early 1950s in the unit grazed summer-long. The increase in sagebrush cover in this unit is a natural recovery of the sagebrush following control. This finding agrees with that of Hughes (1980) who found that sagebrush return after removal is independent of presence or absence of grazing and type of grazing system.

Cattle Weights

Before a comparison of weight gains between systems can be made we need to look at the pattern of gain for cattle for the entire time they were on the allotment (Table 2). Average weight gains for the entire season did not differ significantly among years for any class of cattle (Conrad and Laycock, 1968). Over all years, the weight gain for cows was not significantly different between the spring (June) and early summer (July-mid August) for any class of cattle. However, weight gains of cows and yearlings were significantly less in late summer than in the earlier periods. The reduction in gain was less for heifers than for cows. This reduction in gain undoubtedly is a reflection of a decline in the quantity and quality of forage in late summer.

For both cows and yearlings, significantly higher gains occurred in the spring in some individual years and in early summer in other years. This probably is related to both the condition of vegetation at the time the cattle entered the allotment each year and also the condition of the cattle. Calves maintained relatively uniform weight gains all summer every year.

When all years was averaged there were no significant differences between the rest-rotation and the summer-long grazing system for any period--either early summer, late summer, or the combined data for all summer (Table 3). For cows and yearlings, some differences did occur between systems in specific years but no pattern was present. For example, in late summer in 1962, cows gained significantly less in the summer 1962, cows gained significantly less in the summer-long system than in the rest-rotation system. However, in 1963, cows gained significantly more in the summer-long system than in rest-rotation system and actually lost weight during the late summer period in the rest-rotation system.

Relatively few studies have been made of cattle gains on high elevation rangelands. The daily gains from this study were similar to those reported by Smith et al. (1967) for cattle on high elevation summer ranges in the Big Horn Mountains in Wyoming. They also found no differences in daily gains of steers on units grazed under season long use and gains on units grazed under a rotation system. In this study, calves gained the same and cows gained about double the amounts reported by Harris and Driscoll (1954) on ponderosa pine summer range in Oregon.

Total Gain Per Acre

The only statistic indicating any differences between the two grazing systems was gain per acre summed for all classes of cattle (Table 4). However, gain per acre figures can be misleading unless careful comparisons are made that include stocking rate and amount of utilization. When just the units grazed each year were used in the computation, the two grazing systems on native range had similar gains per acre. When the units rested were included in the computations, the gain per acre in the unit grazed summer-long every year was almost twice that of the rest-rotation system.

This comparison was confounded by differential grazing pressure (as indicated by utilization) in the two systems. Average utilization over all years in the unit grazed summer-long every year was 48 percent higher than utilization in the rest-rotation system. If stocking had been such as to achieve the same average utilization and if gain per head had been the same under the heavy stocking, the gains per acre in the various systems would have been much closer.

However, studies in other areas (Frischknecht and Harris, 1968; Hargrave, 1949, McIlvain and Savage, 1951) have reported that moderate to heavy summer-long grazing can produce greater daily gains than rotation grazing.

Discussion

Based on the available data, trends in production or composition of vegetation showed no consistent differences between rest-rotation grazing and grazing summer-long every year. Earlier studies indicated that grazing on the allotment caused no measureable increases in soil bulk density (Laycock and Conrad, 1967).

Daily weight gains of all classes of cattle were the same for all grazing systems. However, weight gain per acre, based on all the area assigned to a grazing system including areas not grazed, indicated a superiority of the system grazed summer-long every year. Gain per acre figures can be misleading because high gains per acre resulting from too-heavy grazing can lead to deterioration of the range. However, neither of the grazing systems tested significantly affected either the vegetation or the soil. This indicated that, for the area and degree of forage utilization studied, grazing native ranges summer-long every year will produce more beef per acre than rest-rotation system with no damage to the soil or vegetation resource. The cost of the additional fencing needed for a rest-rotation system, and not needed for a summer-long system, also must be considered in an economic analysis of the systems. In other areas or under equal or heavier grazing intensities, the results might be different.

In many situations when a rest-rotation system is to be applied, fences are built, water is developed, and salting, riding, and other management is intensified. Then, if a favorable response in the vegetation is detected, the tendency is to say--"Look what rest-rotation has done for this range." In reality, the proper statement is--"Look what good range management has done." In this study, units in all systems had adequate and well-distributed water, good distribution of salt, and adequate riding at the same intensity for all systems.

In spite of the fact that rest-rotation systems have been widely applied, especially on federally owned land in the western United States, few controlled studies comparing rest-rotation with other systems have been made. The only attempt at evaluation of a rest-rotation system on mountain rangelands found in the literature was published by Johnson (1965) on mountain grassland and shrub vegetation in the Medicine Bow Mountains of southeastern Wyoming. Rotation (4 units) and rest-rotation (4 units) grazing during the summer were reported to have significantly reduced utilization of grasses. The biggest reduction resulted from the rest-rotation system where utilization during treatment was about one-half that during pre-treatment summer-long grazing. No explanation was given for the great reduction in utilization. After four years, plant cover was about the same under the rotation system but increased under the rest-rotation system. Stocking rates were much lighter in the rest-rotation system than in the rotation system.

Evaluation of the original rest-rotation study at Harvey Valley, California, contained many inconsistencies and the results are not as significant as might be expected (Horman, 1970, Horman and Talbot, 1961, Hormay and Evanko, 1958, Ratliff et al., 1972). Evaluations of other rest-rotation systems have been equally unconvincing. Ratliff et al. (1972) cited an example of "A 10 percent increase in the allowable number of cattle after only one year of rest-rotation grazing. This was on a range grazed yearlong and with only nine inches of precipitation annually." After only one year no system can be evaluated to determine if it has increased carrying capacity, especially in a low rainfall area where vegetation responses tend to be slow. Hughes (1979) found that rest-rotation systems in the Arizona strip caused undesirable changes in species composition if average utilization exceeded 55 percent. Use exceeding this caused deterioration regardless of the management system. In the same area, Hughes (1980) found that grazing systems, including rest-rotation, failed to prevent return of sagebrush after removal.

Range managers should apply grazing systems that produce the most red meat in the most economical manner, while preserving the productivity, watershed, open space, wildlife values, and other attributes of ranges in good condition. If the best system for a given range type is a relatively complex system, like rest-rotation, then it should be used. If a simpler system gets equally good or better results, then it should be used.

Seeded Range

The seeded units dominated by crested wheatgrass will be referred to as the "crested wheatgrass unit." The other seeded unit had a mixture of crested wheatgrass and smooth brome on upland sites and almost pure smooth brome on swale sites. This will be referred to as the "crested-brome unit." Both units were grazed heavily in the spring (June) in alternate years. Some cattle were left in the crested-brome unit for the remainder of the summer after the majority were moved to the native units.

Utilization

The seeded units received much heavier use in the years they were grazed than most of the native units. Average utilization of the total grass production in the seeded units was 44 to 55 percent in the years grazed but 22 to 28 percent when averaged over all years. However, average utilization was considerably higher in swale study plots than in upland plots (Table 5).

Before the study, rather low utilization of crested wheatgrass had been a problem in the crested-brome unit. Under moderate grazing on upland sites in 1959, 40 percent of the smooth brome was utilized; only 20 percent of the crested wheatgrass was used. In the swales, brome was heavily utilized (80 percent). Under heavy grazing in alternate years, heavy utilization of brome (75 percent) continued. On upland sites, however, use of crested wheatgrass (48 percent) was about 2½ times greater than it had been in 1959 and use of brome (58 percent) was only moderately higher. Thus, the heavy grazing resulted in much better utilization of the crested wheatgrass on upland sites than under moderate grazing.

Grass Production

Total grass production in the seeded units increased considerably between 1961 and 1967 on almost all plots (Table 7 and 8). The increase was statistically significant ($P \leq .05$). Much of this increase undoubtedly was caused by more precipitation in 1967. Precipitation for the preceeding July-June period was 17.1 inches in 1960 to 1961 and 28.1 inches in 1966 to 1967. It is interesting to note that production of the native grasses in 1967 was not statistically significantly different from 1961 production.

On upland sites, the production increased as much or more in the grazed areas as it did in the exclosures (Table 7) indicating that the heavy use in alternate years was not detrimental to grass production. On upland in the crested wheatgrass unit, little change in composition occurred. However, in the crested brome unit, smooth brome made up only 16 percent of the total production on upland sites in 1961 and increased to 42 percent of total production by 1967. On swale plots, smooth brome also increased in the crested wheatgrass unit (Table 8). In the crested-brome unit, smooth brome was the dominant species in the swales both in 1961 and 1967.

Shrub Cover

Sagebrush was beginning to reinvade the upland areas in the crested-brome unit at the start of the study. By 1967, cover of sagebrush had increased from 8 to 11 percent in the grazed areas but not in the exclosures, indicating that grazing may create conditions favorable for the return of sagebrush. This would be expected on cattle ranges regardless of the grazing system because cattle do not eat sagebrush even under heavy grazing pressure.

Cattle Gains

As indicated earlier (Table 2), cattle gained more on a per-head basis in the seeded units grazed in the spring and the native units grazed in early summer than in the native units grazed in late summer. When only those units actually grazed are considered, the average gain per acre on the seeded units was more than twice as high as those on the native units for the entire summer (Table 4). However, when all years, including the alternate years of rest in the seeded units, were included in the average, the gain per acre of the seeded units was only slightly higher than gain on the native range grazed summer-long every year.

Discussion

The heavy grazing in alternate years maintained or increased production of the introduced grasses in both seeded units. Earlier studies indicated that this heavy grazing in the spring failed to cause measureable increases in soil bulk density in the seeded units (Laycock and Conrad, 1967). In the crested wheatgrass unit, grazing systems that have been used successfully in other areas and that call for moderate to heavy use more frequently than every other year, probably could have been used. In Utah, New Mexico, and Saskatchewan 65 to 70 percent use of crested wheatgrass annually maintained the stands and produced satisfactory cattle gains (Springfield, 1963; Frischknecht and Harris; 1968, Lodge, Smoliak, and Johnston, 1972). Fifty percent annual use of crested wheatgrass in Idaho likewise produced favorable results (Sharp, 1970).

The high-producing crested wheatgrass stand on the Diamond Mountain Cattle Allotment probably could withstand reasonably heavy grazing more often than every other year.

In the crested-brome unit, the heavy grazing in alternate years not only increased grass production but it also solved the problem of poor utilization of crested wheatgrass that occurred with moderate grazing. When the gain per acre figures for the combined spring (20 lbs/A) and summer (9 lbs/A) grazing periods are added, the average amount of beef produced per year in this unit was almost 30 pounds per acre, even when the alternate years of rest were considered. This was much higher than the gain per acre figures for any other unit or system in the study and was accomplished with increased production and improved composition of the vegetation. Some system similar to that studied probably should be recommended for high elevation pastures with a mixed smooth brome-crested wheatgrass composition.

SUMMARY

Several grazing systems were compared on the Diamond Mountain Cattle Allotment of the Ashley National Forest in Utah. The area is about 8,000 feet in elevation and received 20 to 25 inches of precipitation annually. On native sagebrush-grass range, a comparison of summer-long (July to September) grazing every year and three-unit rest-rotation systems revealed no differences between systems in production or species composition of vegetation after seven years of grazing. Average daily gains of cattle over the entire period were the same for all systems. During the period of study on this range, which was in fair to good condition and grazed at a moderate intensity, rest-rotation was not a better system than summer-long grazing. The key to this lack of difference was management. Rest-rotation systems require intensive management of water, salt, riding, etc. All units in both systems in the study had good distribution of water and salt and adequate riding to insure uniform cattle distribution. The unit grazed summer-long every year received the same degree of management and thus remained as productive as ranges under rest-rotation management. On seeded units of the allotment, heavy grazing in June in alternate years increased production on areas dominated by crested wheatgrass and smooth brome.

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Table 1. Herbage production (lbs/A)--rest-rotation and summer-long grazing Diamond Mountain Cattle Allotment

			Stipa comata	Total Grass	Total Forbs	Total Herbage
REST-ROTATION	Exclosure	1961	88	399	417	816
		1967	114	407	584	991
	Grazed	1961	65	281	385	666
		1967	106	390	508	898
SUMMER-LONG (Every year)	Exclosure	1961	370	750	157	907
		1967	285	487	284	771
	Grazed	1961	262	497	239	736
		1967	251	478	277	755

Table 2. Average gain (lbs) per day. All animals, 1961-1965, Diamond Mountain Cattle Attlotment

	COWS	CALVES	HEIFERS
Spring (June)	2.38	1.83	1.81
Early Summer (July-mid-Aug.)	2.16	2.01	1.84
Late Summer (mid-Aug.-early Oct.	.51	1.85	1.27

Table 3. Average gain (lbs.) per day. 1961-1965. Diamond Mountain Cattle Allotment

		Early Summer	Late Summer	All Summer
Cows	Rest-rotation	2.29	.68	1.48
	Summer-Long	2.28	.44	1.36
Calves	Rest-rotation	2.00	1.86	1.91
	Summer-Long	2.00	1.89	1.93
Heifers	Rest-rotation	1.86	1.23	1.47
	Summer-Long	1.93	1.29	1.54

Table 4. Average gain (lbs) per acre of all animals, Diamond Mountain Cattle Allotment

	Years Grazed	All Years
SEEDED-spring grazing	41	20
NATIVE-summer grazing		
Rest-rotation	17	11
Summer-long, every year	18	18

Table 5. Average % utilization of total grass production, seeded units, Diamond Mountain Cattle Allotment

		Years Grazed	All Years
Crested Wheatgrass Unit	Upland	40	23
	Swale	70	37
Crested Wheatgrass & Smooth Brome Unit	Upland	53	27
	Swale	73	37

Table 6. Average % utilization of seeded grasses, moderate vs. heavy grazing, Diamond Mountain Cattle Allotment

	UPLAND		SWALE
	Crested	Brome	Brome
1959 (Moderate grazing)	20	40	80
1961, 1963, 1965 (Hvy. grazing in altern. yrs.)	48	58	75

Table 7. Seeded units, grass production on upland (lbs/A) 1961-1967, Diamond Mountain Cattle Allotment

			Crested Wh. gr.	Smooth brome	Total Grass
Crested Wheatgrass Unit	Exclosure	1961	1227	37	1,338
		1967	1542	9	1,579
	Grazed	1961	911	24	947
		1967	1596	34	1,724
Crested & Smooth Brome Unit	Exclosure	1961	124	278	653
		1967	97	993	1,291
	Grazed	1961	194	131	512
		1967	207	651	1,177

Table 8. Seeded units, grass production in swales (lbs/A) 1961-1967, Diamond Mountain Cattle Allotment

			Crested Wh. gr.	Smooth brome	Total Grass
Crested Wheatgrass Unit	Exclosure	1961	635	66	1,028
		1967	718	342	1,356
	Grazed	1961	417	120	903
		1967	57	319	702
Crested & Smooth Brome Unit	Exclosure	1961	3	1009	1,129
		1967	2	2735	2,864
	Grazed	1961	0	354	537
		1967	0	1124	1,932