cattle go hand-in-hand; brush control makes the cattle more docile and easier to handle. Also, none of the ranchers noted any perceptible change in death losses of cows or calves associated with brush control. Some indicated that brush control facilitates location and treatment of sick and crippled animals. Additionally, several indicated that ranch production is also enhanced by brush control through an increase in calf weights. One rancher suggested that weaning weights may be 100 pounds greater with brush control in addition to being able to carry 30–40% more livestock.

References

Ethridge, D.E., B.E. Dahl, and R.E. Sosebee. 1984. Economic evaluation of chemical mesquite control using 2,4,5-T. J. Range Manage. 37:152-156.

Steuter, A.A., and H.A. Wright. 1983. Spring burning effects on redberry juniper—mixed grass habitats. J. Range Manage. 36:161-164.

VanTassell, L.W., and J.R. Conner. 1986. An economic analysis of brush control practices and grazing systems in the rolling plains of Texas. Tex. Agr. Exp. Sta. MP-1619.

Grazing Systems in Wyoming—Impacts of Grazing Pressure and Livestock Distribution

Richard H. Hart, Marilyn J. Samuel, James W. Waggoner Jr., and Michael A. Smith

"The conventional or government-prescribed stocking rates can safely be doubled in the first year of operation. There is never a need to reduce numbers." These are the rather startling claims made by Allan Savory (1983) for short-duration rotation or time-controlled grazing as applied in the Savory Grazing Method (SGM). Such claims are highly attractive to ranchers struggling to stay in business, but many range scientists have concluded that these claims are not supported by data.

Short-duration rotation grazing is a form of grazing management in which the time that grazing animals spend in each pasture and the time that each pasture is rested vary with the growth rate of the forage and the amount of forage in the pasture. When grass is growing fast, animals spend fewer days in each pasture, with correspondingly shorter rest intervals. Animals are moved to another pasture before they graze the new regrowth and before gains are seriously reduced by a shortage of forage.

Concentrating the herd in one small pasture at a time is claimed to produce "hoof action" (Savory 1983, 1988) which breaks up surface crusts, helps water soak into the ground, and incorporates dead plant material (litter) and manure into the soil to release plant nutrients. However, trampling slows the rate of water infiltration and increases erosion (Blackburn 1984); this happens regardless of grazing system. Savory (1983, 1988) claims that hoof action buries seeds and helps new plants become established, but seed and seedlings play little part in maintaining stands of important perennial range plants in short- and mixed-grass prairie (Hyder et al. 1975).

In short-duration rotation grazing, any arrangement of pastures can be used which allows easy movement of livestock. With suitable pasture arrangement and training of animals, most of them will move themselves when the proper gates are opened. If animal movement can be controlled by herding, controlling water, or some other method, extensive fencing may not be necessary.

Grazing Systems and Stocking Rates

Beginning in 1982, we compared the effects of an 8-paddock short-duration rotation system, a 4-pasture rotationally deferred system, and continuous grazing on animals, plants, and soils, at a range of grazing pressures. The study was done on blue grama-western wheatgrass range in high good condition at the High Plains Grasslands Research Station near Cheyenne, Wyoming.

Each system was stocked at a moderate and a heavy rate. Each system-stocking rate combination was duplicated. In 1983, a very light stocking rate under continuous grazing was added but not duplicated. Light, moderate, and heavy stocking rates were applied on pastures of 202, 30 and 22.5 acres, respectively. Grazing seasons, precipitation, forage production, and stocking rates are shown in Table 1 and are described in more detail by Hart et al. (1988).

We determined forage production on four exclosures in each pasture. In 1982 and 1983 we clipped in late July or early August, when standing crop was near maximum. In 1984–1987 we clipped some quadrats and estimated production on the rest with a capacitance meter. We moved exclosures each year, but they remained on the same soil type. Bare ground, litter cover, or plant cover was deter-

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Table 1. Grazing seasons, precipitation, forage production, and stocking rates, 1982-1987.

Grazing season	Precipitation	Forage	Stocking rate Light	Mod.	Heavy
	% of normal*	lb/A	Steer-days per acre		
24 June-19 Oct 1982	107	1050	--	11.5	20.8
16 June-27 Oct 1983	151	1490	10.3	17.7	23.6
12 June- 2 Oct 1984	131	1020	9.8	14.9	19.9
29 May-16 Oct 1985	94	930	9.5	23.3	31.1
10 June- 8 Oct 1986	113	1020	8.7	20.2	27.0
3 June- 8 Oct 1987	138	780	8.6	21.4	28.6

*Based on 1871-1986 average for 12 months (September-August) before forage clipping.

mined at 1,000 points in each heavily and lightly stocked pasture.

All pastures were grazed by steers of Hereford-Angus-Simmental or Hereford-Angus-Charolais breeding. Initial weights were 657, 644, 540, 549, 650, and 483 lb in 1982 through 1987, respectively. Steers were weighed every two weeks after being held overnight in a corral without water or feed.

Under short-duration rotation grazing in 1982 and 1983, steers grazed each paddock for 3 days at the beginning of the grazing season. To compensate for the decrease in rate of forage growth, the length of the grazing period was increased gradually to 7 days by the end of the season. In 1984 thru 1987, true time-controlled grazing was practiced, with each grazing period on each paddock determined by forage growth rate and forage supply. Grazing periods ranged from 2 to 11 days.

Under rotationally deferred grazing, one of the four subdivisions of each pasture was deferred from grazing until about 1 September. Thereafter all four subdivisions were open to grazing. The deferred subdivision was rotated each year.

In 1983 and 1984, before grazing in the spring and after grazing ended in the fall, we measured soil bulk density and water infiltration in each moderately or heavily stocked pasture. Twenty soil cores, 2 in. deep and 2 in. in diameter, from each pasture were dried and weighed to determine bulk density. At the same time, we measured water infiltration rates with a double-ring infiltrometer at two locations per pasture. A 4 in. head of water was maintained for 2 hours, and the infiltration rate was measured for the last 30 minutes.

Results

Neither grazing systems nor stocking rates had significant effects on soil bulk density (Abdel-Magid et al. 1987). In the spring, water infiltration rate was the same at both stocking rates (3.5 in./hr). In the fall, infiltration rate was significantly higher under moderate stocking than under the heavy stocking rate (4.0 vs 3.1 in./hr). The higher stocking rate, with associated heavier trampling, produced a temporary decline in the infiltration rate, which was restored by freezing and thawing of the soil during the winter. Grazing systems had no consistent effect on infiltration rate.

The average daily gain (ADG) of steers over the entire season remained high and constant at low stocking rates, then declined at high stocking rates. Because forage production varied among years, stocking rate was expressed as steer days per ton of forage dry matter produced (Fig. 1). The average daily gain remained constant at 2.1 lb per

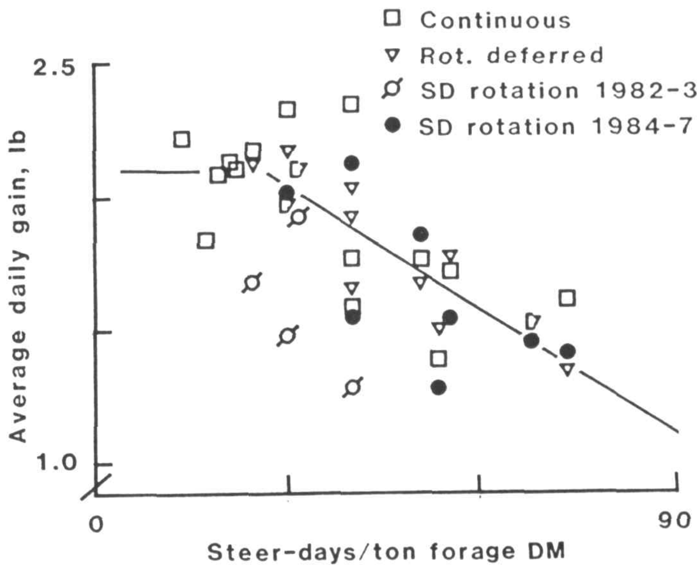

Fig. 1. *Response of steer average daily gains to stocking rate under three grazing systems, 1982--1987.*

day until grazing pressure exceeded the critical grazing pressure of 26 steer days per ton of forage. Gain then declined at a rate represented by

ADG (lb) = 2.49 - 0.0152 (steer days/ton).

About two-thirds of the variation in ADG could be accounted for by stocking rate.

The effect of grazing pressure was the same for all three grazing systems. Gains under short-duration rotation grazing in 1982 and 1983 were omitted from calculations of the stocking rate response, because management was less than optimum. These gains were substantially less than those under the other two systems, showing that the consequences of mismanagement under short-duration rotation grazing can be severe.

Increasing the stocking rate above the Soil Conservation Service recommendations of 15 steer-days per acre (SCS 1981, Stevenson et al. 1984) could increase profits to the cattleman. The most profitable stocking rates and net returns to land, labor and management were calculated for forage production of 955 lb dry matter per acre, steers weighing 550 lb initially, a 150-day grazing season, and prices prevailing in 1986 and 1987 (Table 2); see Hart et al. (1988) for details of calculation. At 1986 prices, the optimum stocking rate was 60% higher than the SCS-recommended stocking rate, but returns were only 16% higher than returns at the SCS rate (Fig. 2). At 1987 prices, the optimum stocking rate was 77% higher than SCS recommendations and returns were 23% higher.

Table 2. Optimum (most profitable) stocking rates and returns to land, labor, and management at 1986 and 1987 prices.

Identification	1986 prices	1987 prices
Purchase price of steers, $/lb	$0.72	$ 0.78
Selling price of steers, $/lb	0.62	0.72
Carrying cost of steers, $/head/day	0.70	0.71
Optimum stocking rate, steer-days/A	23.4	25.8
Return at optimum stocking rate, $/A	$9.85	$13.96
Return at SCS stocking rate (15 steer-da/A) $/A	$8.46	$11.32

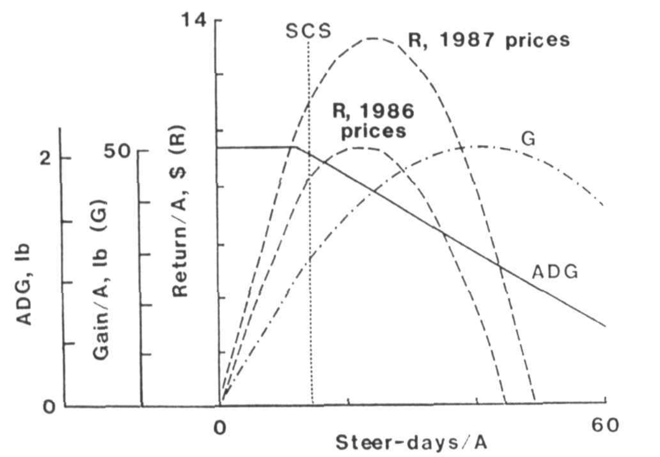

Fig. 2. *Response to stocking rate of steer gains and net return per acre to land, labor and management at forage production of 955 lb/acre ("SCS" indicates stocking rate recommended by Soil Conservation Service).*

Under existing climatic conditions, such increases in stocking rate are not likely to reduce forage production or range condition. In the first two years of this grazing study, forage production in the grazed pastures was 81% of production in an adjacent ungrazed area. In the last two years, production in the grazed pastures was 87% of production in the ungrazed area. Production was the same in both the moderate and heavy stocked pastures, which were stocked at 130% and 175% of the SCS-recommended rate. Botanical composition was similar on all pastures in each year, with no significant differences among grazing systems or stocking rates. By 1987, litter cover was significantly less under heavy than under light stocking (59 vs 74%) on all three systems.

Grazing Systems and Cattle Distribution

To separate the effects of livestock distribution from those of rotation, we started a new study in 1986 comparing short-duration rotation grazing on a 480-acre pasture divided into eight 60-acre paddocks to continuous grazing on two 60-acre pastures and a 512-acre pasture. To further aggravate distribution problems in the 512-acre continuously grazed pasture, it was "wrapped around" the rotation paddocks so it was approximately 3.4 miles long by 0.25 miles wide (Fig. 3).

All pastures were grazed in 1986 and 1987 by Hereford cow-calf pairs and yearling heifers. Some dry cows grazed in the large continuous and short-duration rotation pastures, but not in the small continuous pastures.

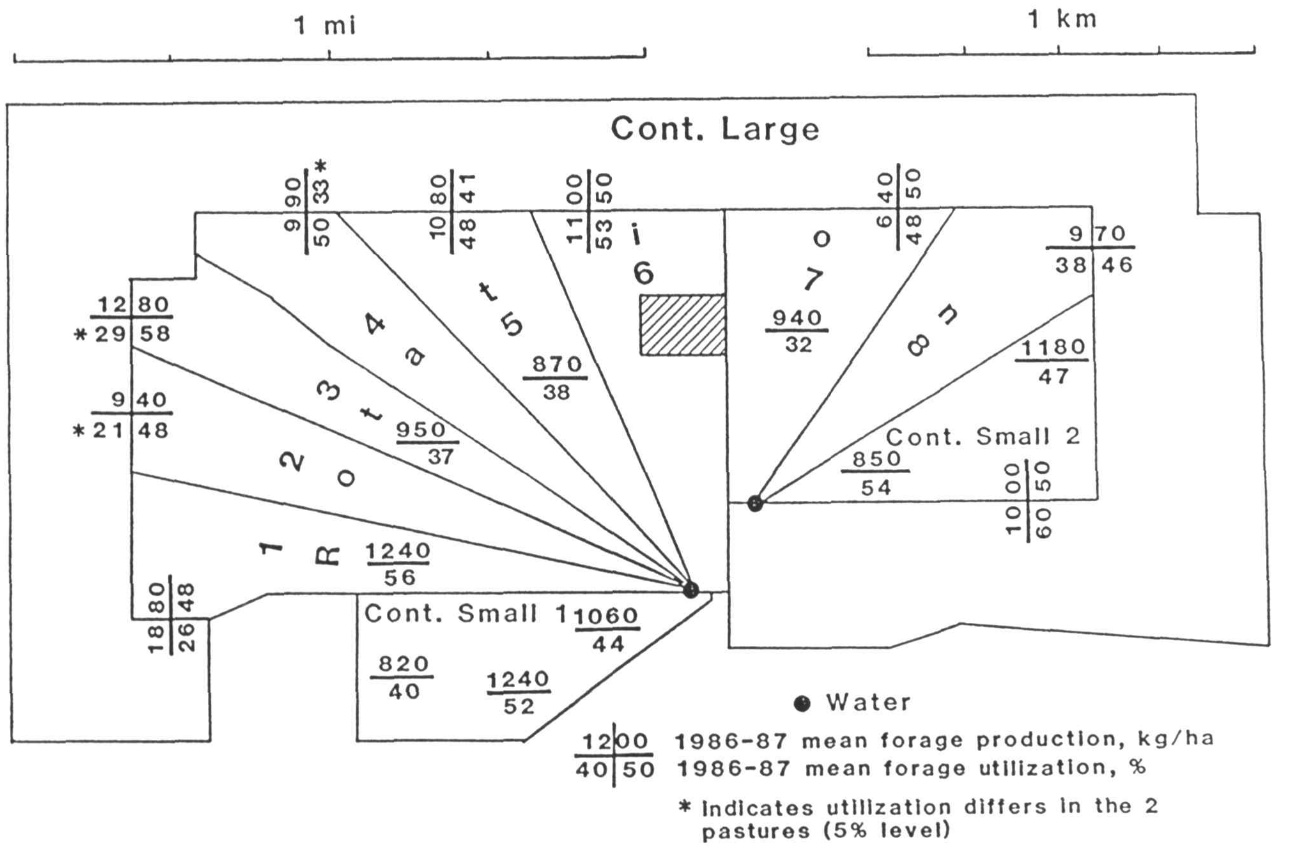

Fig. 3. *Peak standing crop and utilization of forage at exclosures in 60-acre rotation paddocks and in 60-acre and 512-acre continuously grazed pastures, 1986–1987.*

Calves were weaned and removed from the pastures on 30 September 1986, but remained with the cows throughout the 1987 grazing season.

Nine exclosures in the continuous large pasture were paired with exclosures just across the fence in the end of either a rotationally grazed paddock or small continuously-grazed pasture. Each continuously grazed small pasture contained three exclosures, one near water, one near the center and one at the far end. Odd-numbered rotation paddocks, in addition to the exclosure at the far end, also contained an exclosure near the center. Peak standing crop of forage was estimated in the exclosures in late July, and forage left outside the exclosures was estimated at the end of the grazing season, using the same methods used in 1984–1987 on the grazing systems and stocking rates study. Utilization was calculated as peak standing crop minus remaining forage, divided by peak standing crop.

Cattle were weighed every two weeks, as in the grazing systems and stocking rates study. We assumed that differences in gain between the large and small continuous pastures would be caused by differences in distribution; differences between the short-duration rotation and the small continuous pastures would be caused by rotational grazing and/or other factors.

Results

Gains of calves, nursing cows, dry cows, and yearling heifers did not differ significantly between the short-duration rotation and the continuously grazed small pastures (Table 3). Gains of all classes of cattle were less on the continuously grazed large pastures (Table 3). Differences among pastures in gains of dry cows and yearling heifers were not significant, primarily because only a few of these animals were in each pasture (no dry cows were in the continuous small pastures). The benefits of short-duration rotation grazing appeared to be produced entirely by pasture subdivision and its benefits to livestock distribution.

Table 3. Average daily gains of cows, calves, and heifers on a large continuously-grazed pasture (512 A), 2 small continuously-grazed pastures (60 A each), and an 8-paddock (60 A each) short-duration rotation system, 1986–1987.

Dates and pasture	Stocking rate	---- Average daily gain ---- Cows with calves	Calves	Heifers	Dry Cows
	Acres/AU*	---------- lb ----------			
27 Jun–29 Oct 1986					
Continuous large	9.8	0.18 b	1.50 b#	1.12 a	0.95 a
Continuous small	10.0	0.53 a	1.72 a	1.43 a	- -
SD rotation	9.9	0.46 a	1.70	1.30 a	1.12 a
10 Jun–14 Oct 1987					
Continuous large	9.4	0.68 b	1.61 b	1.37 a	1.52 a
Continuous small	8.3	1.19 a	1.87 a	1.57 a	— —
SD rotation	9.3	0.97 a	1.83 a	1.57 a	1.57 a

*Cow-calf pair, dry cow and heifer = 1.0, 0.9 and 0.75 AU, respectively.
#Calf gains 27 Jun–30 Sep 1986

Utilization data supported this conclusion (Fig. 3). In the continuous large pasture, average utilization was 60% near water, but decreased to less than 30% at distances greater than 3 mi from water. The amount of forage produced ranged from 640 to 1,880 pounds per acre, but this had very little effect on percent utilization. On the continuous small and rotation pastures, distance from water had no detectable effect on utilization; average utilization was 47%.

Discussion and Conclusions

It appears from our study that much of the success of short-duration rotation grazing systems arises from increases in stocking rate on ranges which are stocked too lightly for maximum profits. Savory (1983) noted that doubling stocking rates on SGM reduces individual animal performance but this effect is offset by higher gains per acre. However, our study indicates this will happen under other grazing systems as well.

The high level of management required under time-controlled grazing also may aid in increasing livestock gains. When a new intensive grazing system is applied, fences are built, water is developed, and salting, riding, and other management are intensified (Laycock 1983). All this improves livestock distribution and results in more uniform use of the range. Laycock said, "When a grazing system is put on the ground, the level of good range management is increased substantially. (This) may be why so many range managers are happily surprised at the positive results they get when they institute a grazing system."

In another study of twelve grazing systems on western Nebraska ranches, stocking rates were increased by over 30% without reducing ADG. This was done even though short-duration rotation grazing was not used on any of the ranches (Lehnert 1985). Most of the grazing systems studied had only two to four pastures and most of the pastures were grazed only once each year. This indicates that even minimal pasture subdivision with increased stocking rate and improved management can potentially increase livestock production substantially.

On mixed-grass prairie, stocking rate or grazing pressure and livestock distribution are far more important than the type of grazing system in determining cattle gains and the effects of grazing on plants and soils. Steer gains decreased with increasing stocking rates under all three grazing systems evaluated (8-paddock short-duration rotation grazing, 4-pasture rotationally deferred grazing, and season-long continuous grazing). The rate of decrease was the same under all three systems. Maximum profit per acre would be achieved at stocking rates 60 to 80% above the rate recommended by the Soil Conservation Service. Stocking rates and grazing systems did not significantly affect forage production, range condition, or soil bulk density after six years of grazing. Heavy stocking rates reduced water infiltration rates in the fall, but the following spring infiltration rate had increased to the same rate as under moderate grazing. Cow and calf gains were the same on 60-acre continuously grazed pastures as on short-duration rotation grazing on 60-acre paddocks, but were significantly less on a 512-acre continuously grazed pasture. Forage utilization decreased with distance from water in the large pasture but not in the small pastures, regardless of grazing system. Utilization in the large pasture, at distances from water greater than 2.25 miles, was significantly less than that in the small pastures.

References Cited

Abdel-Magid, A.H., G.E. Schuman, and R.H. Hart. 1987. Soil bulk density and water infiltration as affected by three grazing systems. J. Range Manage. 40:307-309.

Blackburn, W.H. 1984. Impacts of grazing intensity and specialized grazing systems on watershed characteristics and responses. p. 927-983. *In:* Developing Stategies for Rangeland Management. Nat. Res. Council/Nat. Acad. Sci. Westview Press, Boulder, Colo.

Hart, R.H., M.J. Samuel, P.S. Test, and M.A. Smith. 1988. Cattle, vegetation and economic responses to grazing systems and grazing pressure. J. Range Manage. 41:282-286.

Hyder, D.N., R.E. Bement, E.E. Remmenga, and D.F. Hervey. 1975. Ecological response of native plants and guidelines for management of shortgrass range. USDA Tech. Bull. 1503.

Laycock, W.A. 1983. Evaluation of management as a factor in the success of grazing systems. USDA For. Serv. Intermtn. For. Range Sta. Gen. Tech. Rep. INT-157, p. 166-171.

Lehnert, E.R. 1985. Seven years of planned grazing systems data on twelve Central and North Central Nebraska ranches. SRM Abstr. 38:24.

Savory, A. 1983. The Savory Grazing Method or Holistic Resource Management. Rangelands 5:155-159.

Savory, A. 1988. Holistic Resource Management. Island Press, Covelo, California.

Soil Conservation Service. 1982. Technicians guide to range sites and range condition with initial stocking rate: 15"-17" precipitation zone Southern Plains. USDA Soil Conserv. Tech. Guide Sect. II E.

Stevenson, A., R.E. Baumgartner, and G.E. Schuman. 1984. High Plains Grasslands Research Station, Cheyenne, Wyoming: Detailed soil survey. Wyoming Agr. Exp. Sta. Pub. 1-84/1C/3.62.

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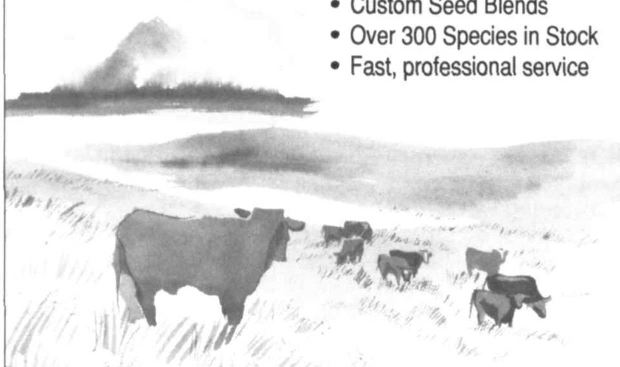

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