

Short-Duration Grazing: The Facts in 1999

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Short-duration grazing (also called rapid-rotation, time-controlled, Savory grazing, holistic resource management) was conceived in Zimbabwe by Allan Savory in the 1960's and later introduced into the United States by Goodloe (1969). When Savory came to the United States in the late 1970's, he made further refinements discussed by Savory (1978), Savory and Parsons (1980), Savory (1983), and Savory (1988). During the 1980's short-duration grazing attracted much attention based on the claims it would accelerate range improvement while at the same time accommodating higher stocking rates. On many ranches it was contended that stocking rates could be doubled or even tripled while at the same time improving both range and livestock productivity.

Common conception of Savory grazing typically involves a wagon-wheel arrangement of fences with water and livestock handling facilities located in the center of the grazing area. However, it can be applied without the wagon-wheel design. A key feature is that a single herd of livestock is rotated through no fewer than 8 pastures (paddocks). Typically, the grazing period during active forage growth should be 5 days or less followed by 4 or more weeks of nonuse. It is recommended that livestock be moved more quickly during periods of active forage growth than in dormancy.

According to Savory and Parsons (1980), Savory (1983), and Savory (1988), short-duration or time-controlled grazing can do the following if properly implemented:

1. Improve water infiltration into the soil as a result of hoof action.
2. Increase mineral cycling.
3. Reduce the percentage of ungrazed plants.
4. Improve livestock distribution (more uniform use of range).
5. Increase the period when actively growing forage is available to livestock.
6. Accelerate plant succession.

Savory's ideas generated much controversy among the range science academic community. Later Savory (1983) emphasized that holistic resource management (his grazing management approach) is not the same as short-duration grazing. He expressed doubt that holistic resource management could be validated experimentally because of its flexibility in animal numbers, length of grazing periods, number and arrangement of pastures, and various other management factors. Nevertheless, researchers at 13 locations in North America have attempted to evaluate the validity of Savory's ideas. They have generally been careful to use the term short-duration grazing rather than Savory grazing method or holistic resource management in describing the particular rotation scheme they evaluated. Still, they generally have related their findings to Savory's ideas and theories.

We will summarize present knowledge on short-duration grazing, focusing on a few recent studies that are fairly complete in terms of evaluating soil, vegetation, livestock, and financial responses over time and space. The managerial implications of these studies and their relevance to Savory's ideas will be given particular emphasis. Reviews of various grazing studies from Africa will be included in our discussion.

Research Descriptions

Most of the scientific information available on short-duration grazing is from prairie rangelands in the Great Plains or seeded dryland pastures (Table 1). Considerable information is available on short term impacts (1–4 years) of short-duration grazing on soils, vegetation, and livestock. However, there are only 4 studies in North America that have evaluated longer term vegetation, livestock, and financial outcomes under short-duration grazing (Heitschmidt et al. 1990, Taylor

Table 1. Primary studies evaluating short-duration grazing in North America.

Rangeland Type	Location	Livestock Type Studies	Duration of study (years)	Primary References
Crested wheatgrass	Oregon	Yearling cattle	2	Daugherty et. al 1982
Smooth bronze grass	Nebraska	Yearling cattle	2	Jung et al. 1985
Northern mixed prairie	North Dakota	Cow-Calf	2	Kirby et al. 1986
Crested wheatgrass	Utah	Yearling cattle	3	Olson and Malechek 1988
Chihuahuan desert	New Mexico	Cow-yearling	2	Anderson 1988
Southern mixed prairie	Texas	Yearling Cattle	4	Bryant et al. 1989
Northern mixed prairie	Alberta	Cow-cal	5	Willms et al. 1990
Southern mixed prairie	Texas	Cow-calf	6	Heitschmidt et al. 1990
Shortgrass	New Mexico	Cow-calf	5	White et al. 1991
Southern mixed prairie	Texas	Cattle-Sheep	8	Taylor et al. 1993
Crested wheatgrass	Oregon	Yearling cattle	4	Angell 1997
Shortgrass	Wyoming	Yearling cattle	13	Manley et al. 1997
Tallgrass prairie	Oklahoma	Yearling cattle	6	McCollum et al. 1999

et al. 1993, Manley et al. 1997, McCollum et al. 1999). Generally, we consider these long term studies to be well designed and implemented.

Hoof Action and Soils

The best researched of Savory's claims is that short-duration grazing will increase water infiltration into the soil compared to continuous grazing. Several studies at different locations have been quite consistent in showing that hoof action from having a large number of animals on a small area for short time periods reduced rather than increased infiltration (McCalla et al. 1984, Thurow et al. 1986, Weltz and Wood 1986, Warren et al. 1986, Pluhar et al. 1987). These same studies have also been consistent in showing short-duration grazing increased erosion compared to continuous or season-long grazing. In the Warren et al. (1986) study, simulated short-duration grazing applied at progressively increased stocking rates progressively reduced infiltration and increased erosion compared to an ungrazed control (Table 2).

Table 2. Infiltration rate and sediment production in relation to stocking rate and soil water content at the time of trampling on the Edwards Plateau, Texas.

Stocking Rate	Trampled Dry	Trampled Moist
Infiltration Rate (mm hr ⁻¹)		
0	166	160
1x	140	133
2x	121	99
3x	117	96
Sediment production (Kg ha ⁻¹)		
0	976	2,007
1x	2,827	2,875
2x	3,438	4,274
3x	4,788	5,861

Source: Warren et al. 1986.

1x = moderate stocking rate, 2x = twice moderate stocking rate, 3x = triple moderate stocking rate.

In our search of the literature we could find no studies that substantiate Savory's claims on the benefits of hoof action on range soils. One of the most intensive studies of short-duration grazing impacts on range soils was conducted in Alberta, Canada over a 5 year period (Dormaar et al. 1989). In this study, short-duration grazing at twice or triple the recommended rate reduced soil moisture, increased soil bulk density, and reduced fungus biomass compared to an ungrazed enclosure. Hoof action did not significantly increase incorporation of litter into the soil. The hypothesis that controlled animal impact as recommended by Savory would improve soil health was rejected. Another study, conducted at 3 sites in Alberta, showed time controlled (short-duration) grazing reduced soil organic matter and nitrogen but increased phosphorus over ungrazed controls (Willms et al. 1990). It was concluded that using high animal density and stocking rates with time-controlled grazing would result in range deterioration.

Forage Production

Several studies now show that there is little difference in forage production between short-duration and continuous grazing systems if stocking rates are the same (Jung et al. 1985, Pitts and Bryant 1987, Anderson 1988, Thurow et al. 1988, White et al. 1991, Manley et al. 1997). In a 6 year study on blue grama rangeland in south-central New Mexico, total grass production averaged 828 lbs acre⁻¹ under continuous grazing compared to 724 lbs acre⁻¹ under short-duration grazing. In north-central Texas, Heitschmidt et al. (1990) reported forage production averaged 2,300 lbs acre⁻¹ for heavy continuous, 2,500 lbs acre⁻¹ for moderate continuous, 2,700 lbs acre⁻¹ for Merrill 3 herd/4 pasture, and 2,600 lbs acre⁻¹ for short-duration grazing. Only the heavy continuously grazed treatment differed significantly from the others. In the tall grass prairie of Oklahoma, standing crop of forage averaged 16% higher under short-duration compared to continuous grazing (3,200 vs. 2,760 lbs acre⁻¹) (Cassels et al. 1995). However, it was later reported that this was not due to greater plant vigor under short-duration grazing but rather higher forage intake by steers under continuous grazing (McCollum et al. 1999). In north-central Texas herbage growth dynamics did not differ between short-duration and continuous grazing (Heitschmidt et al. 1987b) or between 14 versus 42 paddock short-duration grazing (Heitschmidt et al. 1987a).

Plant Succession and Range Condition

Several studies have shown short-duration grazing to be similar to continuous grazing in effects on plant succession and range condition if stocking rates were the same (Pitts and Bryant 1987, White et al. 1991, Manley et al. 1997, Gillen et al. 1998). In a south Texas study, it was found that progressively increasing the stocking rate under short-duration grazing up 2.5 times the rate recommended by Merrill (1954) caused the frequency and composition of mid-grasses to decline but shortgrasses were not affected (Ralphs et al. 1990). Standing crop of all major forage classes declined as stocking rate increased under short-duration grazing. Another study at the same location (Sonora Research Station) showed short-duration grazing did not promote secondary succession from shortgrasses to mid-grasses as effectively as high intensity-low frequency grazing (Taylor et al. 1993).

The most complete study in North America on short-duration grazing in terms of replication in time and space was conducted on shortgrass prairie in southeastern Wyoming (Manley et al. 1997). They compared season-long, deferred rotation and short-duration grazing at 3 stocking rates. Over a 13 year period changes in bare ground and vegetation composition were primarily a function of stocking rate rather than grazing system. There were trends towards more bare ground and less western wheatgrass as stocking rate increased. During this study, deferred rotation, time-controlled (short-duration), and season-long grazing did not differ in their effects on either forage production or plant succession. In a 5 year New Mexico study, blue grama cover was slightly higher but other grasses (primarily mid-grasses) were lower under short-duration compared to continuous grazing (White et al. 1991). It

was concluded any differences in short-duration compared to continuous grazing in terms of plant productivity or succession were doubtful. In Alberta, Canada Willms et al. (1990) compared plant succession on time-controlled grazing and protected areas over a 6 year period. They used high stocking rates and high livestock densities. Utilization averaged about 80% of available forage over the study period. In this study time-controlled grazing caused a definite decline in range ecological condition on mixed prairie and rough fescue prairie sites. The hypothesis that time-controlled grazing with high stocking rates and high stock densities will improve rangeland condition was strongly rejected by the authors.

Harvest Efficiency and Livestock Distribution

Research does not support the Savory and Parsons (1980) contention that short-duration grazing will improve forage harvest efficiency (Kirby et al. 1986, Heitschmidt et al. 1987a, 1987b, Hart et al. 1989, Bryant et al. 1989, Walker et al. 1989). In North Dakota, Kirby et al. (1986) found that increased stocking rate and stock densities under short-duration grazing did not improve grazing distribution over season-long grazing. In Wyoming, Hart et al. (1989) found pasture subdivisions of equal sizes under short-duration and continuous grazing had the same utilization patterns. However, a large continuously grazed pasture was less uniformly used than small continuous and short-duration grazed pastures. It was concluded the benefit of short-duration grazing in terms of increasing grazing capacity was entirely from pasture subdivision rather than rotation of livestock.

Livestock Productivity

Findings on how short-duration grazing impacts livestock productivity show some inconsistency. Four studies have shown short-duration grazing has lowered individual livestock productivity compared to continuous or season-long grazing (Parker et al. 1987, Anderson 1988, Heitschmidt et al. 1990, McCollum et al. 1999). Another 5 studies showed no difference between short-duration and continuous grazing (Jung et al. 1985, Pitts and Bryant 1987, Olson and Malechek 1988, Taylor et al. 1993, Manley et al. 1997) while 1 study showed short-duration grazing increased livestock productivity (Daugherty et al. 1982). A careful analysis of these 10 studies indicates small or no difference in livestock productivity between short-duration and continuous grazing if stocking rates are equal with one exception. McCollum et al. (1999) found

live weight gains of yearling cattle were 11 to 20% lower under short-duration than season long grazing when averaged across six levels of stocking. This was caused by lower forage intake of cattle under short-duration grazing (McCollum and Gillen 1998).

Forage and diet quality under short-duration and continuous/season-long grazing have generally shown little difference if stocking rates were comparable (Jung et al. 1985, Anderson 1988, Olson and Malechek 1988, Heitschmidt et al. 1987b). One exception is Hirschfield et al. (1996) who found both cattle diet crude protein content and forage intake to be increased by short-duration grazing on mixed prairie rangeland in North Dakota. They attributed this to more growth opportunity through periodic rest under short-duration grazing. In contrast, McCollum and Gillen (1998) found diet quality and forage intake of steers were lower under short-duration than continuous grazing on tall grass prairie in Oklahoma.

Financial Returns

Limited research indicates that short-duration grazing has no financial advantage over continuous/season long grazing (Table 3). Lower individual animal productivity under short-duration grazing is the primary explanation why it gave inferior net returns compared to season-long grazing in south-central Oklahoma (McCollum et al. 1999).

Holechek (1992) discussed potential financial returns from a medium sized (250 animal unit) cow-calf operation under short-duration grazing in the Chihuahuan Desert of New Mexico. He modeled a best case scenario that assumed stocking rate could be increased 50% over recommended rates with no adverse impact on forage production, no decline in cattle productivity, no increase in fixed costs, and no interest rate cost would be incurred for capital investment. He used average cattle price and ranching costs for the 1986–1991 period. Total cost for the short-duration grazing program was \$190,400. He found best case return on investment from short-duration grazing was 8.1%, which was nearly the same as 30 year U.S. treasury bonds and below the historic return of the U.S. stock market (10%). Extended drought and lower cattle prices have occurred in the Chihuahuan Desert since 1992. The hypothetical short-duration operation Holechek (1992) discussed could easily have lost \$48,000 or 25% of its investment due to forced cattle liquidation at prices well below those in the 1986–1991 period. Further reductions in returns from the above short-duration grazing scenario are probable. Parker et al. (1987), in south-central New Mexico, found short-duration grazing at a stocking rate 25% above that for

Table 3. Financial returns from studies comparing short-duration and continuous grazing systems.

Study	Location	Type of Livestock	Net Returns	
			Short-Duration grazing	Continuous grazing
			(\$/acre)	
Heitschmidt et al. 1990	North-central Texas	Cow-calf	6.36	5.25
Taylor et al. 1993	South-central Texas	Cattle-sheep	7.39	7.20
Manley et al. 1997	South-eastern Wyoming	Yearling cattle	12.07	15.20
McCollum et al. 1999	North-central Oklahoma	Yearling cattle	2.83	8.50
Average across studies			7.16	9.04

moderate continuous grazing lowered calf crops about 14% compared to moderate continuous grazing. Calf weaning weights were also depressed under short-duration grazing.

Studies from Africa

Two comprehensive reviews are available that consider African experiences with short-duration grazing (Skovlin 1987, O'Reagain and Turner 1992). Over 50 grazing experiments are evaluated by these reviews. Authors of both reviews drew essentially the same conclusions that are as follows:

1. Stocking rate has a major impact on range condition and animal production.
2. Continuous and short-duration grazing systems differ little in their effects upon range condition and livestock production.
3. Multi-camp (8 or more paddocks) rotation systems have no advantage over 4 paddock systems in either vegetation or livestock productivity.
4. Continuous grazing at moderate stocking rates does not cause rangeland degradation.
5. Herd effects from grouping large numbers of animals together lower water infiltration and increase erosion.
6. Grazing intensity rather than rotation system is the primary factor determining long term grazing outcomes on vegetation, livestock, and financial returns.

North American grazing studies strongly support these conclusions (Holechek et al. 1999).

Some Analysis and Conclusions

We find it interesting that government agencies so readily accepted Savory's theories and aggressively encouraged use of short-duration grazing. Grazing research that was available by the late 1970's already refuted much of what Savory contended but it received little consideration by many ranchers and government employed range managers. History shows that it's human nature to believe a good story rather than pursue the truth. Many ranchers undoubtedly found the prospect of much higher profits through use of Savory grazing methods most appealing. However, scientific investigation has disproven many of the early claims for short-duration grazing. This is particularly true regarding hoof action and accelerated range improvement from increased stocking rates and densities.

What led to such a widespread acceptance of the high intensity grazing concept without scientific proof? Initial programs in the early 1980's came at the end of a period of low cattle prices and low precipitation. From the middle 1980's through the early 1990's both cattle prices and rainfall drastically increased. Precipitation for the 1984–1993 period was 27% above the long term average across New Mexico (Holechek 1996). This more than doubled forage production. Wondrous tales were told regarding the effects of short-duration grazing on vegetation and livestock productivity. However, nature also taketh away. From 1993 to the present drought has prevailed across northern Mexico, Texas, and New Mexico. The hard lessons learned in Africa about short-duration grazing and drought in the early 1980's (Gammon 1984) are now being learned by many southwestern USA/Mexican ranchers

(Holechek 1996, Molinar et al. 1998). No grazing approach, including that of Savory, will overcome the adverse effects of drought and/or chronic heavy stocking on forage production (Pieper and Heitschmidt 1988). Conservative stocking has been scientifically proven to be the surest grazing approach to maximizing plant productivity under drought, and improving rangeland condition (Klippel and Costello 1960, Paulsen and Ares 1962, Martin and Cable 1974, Holechek et al. 1994).

It is our view that the U.S. and Mexican governments should never have aggressively spent money on training range personnel on unproven theories or provided cost sharing for implementation of short-duration grazing until it had been fully evaluated. We can only wonder what the outcome might have been if government agencies had spent this money on educating their personnel and ranchers on scientifically proven range management practices and principles. We agree with O'Reagain and Turner (1992) who stated range managers should adopt a more critical attitude so as to prevent the assimilation of untested hypotheses into accepted management practices.

Ranchers across the southwestern USA and Mexico have suffered severe financial losses since 1994 (Holechek 1996, Molinar et al. 1998, Torell et al. 1998). Part of their problem centers around using high risk management strategies involving heavy stocking rates (Molinar et al. 1998, Ward 1998, Ward 1999). This may also have intensified rancher/environmentalist conflicts as rangeland ecosystem sustainability depends heavily on maintaining adequate levels of standing vegetation biomass (Heitschmidt and Walker 1996).

Short-duration grazing can facilitate improved management of livestock, and it gives ranchers more control over how specific parts of their ranch are grazed than continuous grazing. We believe it can be a useful grazing system for some ranchers if applied at conservative to moderate stocking rates. In closing, we hope the scientific information we have identified in this article will be more widely read and lead to better informed decisions on the use of short-duration grazing. Controversy generated by Allan Savory has, without doubt, lead to more thorough investigation of various grazing processes. This research should now be put into practical application.

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