assume relationships which do not necessarily exist.

A rational means for avoiding the confusion associated with range condition rating has been proposed by Smith (1979). A measure of site condition based primarily on soil characteristics should be developed to indicate the success of management in maintaining the site and indicating whether present condition is satisfactory or unsatisfactory. An additional rating should be made for each possible use of interest based on how nearly the present community approximates the community needed for the proposed use.

Range managers have struggled with the controversy created by our current system of condition classification for several years. But we seldom realize the impact that it has had on public officials, the courts, and the concerned publics who must make decisions about how public lands are managed. As stewards of the rangelands, public and private, we should be certain that Congress, the courts and concerned environmentalists understand the limitations of range condition classes as a measurement of management success.

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Southern Africa's Experience with Intensive Short Duration Grazing

Jon Skovlin

Having returned from 3 years of consulting in sub-Sahara Africa, I am amazed by the interest in and wide acceptance of intensive short duration grazing as popularized by Mr. C.A.R. Savory and his Holistic Resource Management (HRM) (Savory 1983). Mr. Savory had his beginning in southern Africa and first proposed his theories and put them into practice in Zimbabwe (formerly Rhodesia). In promoting HRM to North America, he has often referred to these early trials (Savory 1978, Walter 1984).

Unfortunately political unrest has disrupted the flow of information out of southern Africa for nearly 2 decades—about the same period that various forms of short duration grazing (SDG) have been popularized (Acocks 1968, Savory 1969a). During this period numerous studies were conducted in southern Africa on the performance of SDG, including the Savory Grazing Method (SGM). The results of these studies are important for those considering adopting various forms of SDG such as SGM in North America.

The Problem

The major concerns with SGM in southern Africa[1] include (1) claims for range improvement; (2) stocking rate; (3) duration of grazing and rest; (4) number of pastures or paddocks[2]; (5) "herd effect" which involves (a) hoof chipping of crusted soil, (b) laying of litter, (c) seed planting, and (d) dunging effects; and (6) paddock configuration. The suggestions that SGM is a solution to degradation of communal reserve or trust lands has more recently come under scrutiny. The following review of literature addresses each of these six areas.

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[1]Southern Africa includes Botswana, Lesotho, Southern Mozambique, Namibia (formerly South West Africa), the Republic of South Africa, Swaziland, and Zimbabwe.

[2]Terms have been standardized according to those of Edwards (1981) and Booysen (1967).

Range Improvement

Barnes (1979:49) reviewed SGM in a comprehensive paper on cattle ranching in east and southern Africa and stated, "Claims that intensive rotational grazing provides a unique means of favorably modifying veld (range) composition have not been substantiated by the results of multi-paddock grazing trials in Rhodesia."

Restoration was one of several topics discussed in a review of intensive SDG by Gammon (1984), the Chief of Veld and Pasture Extension in Zimbabwe. In regard to claims for range improvement under SGM (Vaughan-Evans 1978), Gammon (1984:54) said, "Veld specialists of AGRITEX (Department of Agriculture Technical and Extension Services) have conducted veld condition assessments on a number of properties that have operated 'intensive' SDG with up to 42 paddocks per herd for periods of up to twelve years. Paired comparisons were made between...less intensive management." He continued, "In these comparisons the areas under intensive SDG were not markedly or consistently superior to adjacent less intensively managed areas in terms of basal cover, litter cover, and species composition."

Gammon (1984) also critiqued the current situation on the frequently heralded "success" of the 32 paddocked cell on the Liebig's Ranch (Savory 1978) that was stocked at 100% in excess of the recommended rate beginning in 1972. Eight years of high rainfall (50% above normal) provided good herbage yields and acceptable animal performance. However, 2 years of normal rainfall brought progressive deterioration in range and animal performance. Gammon (1984:60) continued, "The area was thus destocked before the effects of the 1982/83 drought were felt and has carried no stock

through this drought (1983/84)."

Other range specialists (Maclaurin 1984) have observed that neighboring ranches with more conservative stocking have fared much better. Botanical checks between the 32 unit cell and adjacent continuous grazed pastures showed no real changes in plant composition during the above period of normal rainfall (World Bank 1982).

Three grazing rotation trials of 12 to 16 paddocks per herd at moderate to heavy stocking were conducted at the Matopos Research Station in southwest Zimbabwe for periods up to 6 years (Denny and Barnes 1977, Denny and Steyn 1977). Counterpart conventional systems with the same stocking were used for comparison. Conclusions arising from these trials were that grazing systems were much less important than level of grazing for both pasture and animal performance. Ward et al. (1979:10) said, "It is significant that botanical measurements in all three trials showed that the grazing systems applied had virtually no differential effects on composition, plant density and basal cover." They also found that different range types had critical stocking rates for animal performance, and, where that critical point had not been reached, performance was similar, ..."irrespective of the number of paddocks used per herd."

Stocking Rate

With use of intensive SDG, proponents widely advise at least doubling the normally recommended stocking rates (Savory 1978, 1983; Savory and Parsons 1980). The conclusion of Gammon (1984) in regard to stocking rates for cell layouts, however, was that under normal weather patterns stocking rates should be no more than 30% higher than that recommended for less intensive management schemes.

Professor Tainton (1985), head of the Department of Grassland Science at the University of Natal, discussed stocking rate and intensity in terms of recent changes in grazing philosophy in southern Africa. He noted (Tainton 1985:4), "the assumption...is that, if adequate resting is incorporated in grazing schedules, the intensity...is unimportant." And, "...veld cannot be detrimentally affected by overutilization if effective rotational grazing programmes are used." In practice, he said, however, such programs as adequate resting and effective rotational grazing are not used.

Tainton (1985) suggested that current thinking leans more toward high animal performance grazing (controlled selective grazing) with less emphasis on high utilization grazing (non-selective grazing). He said (Tainton 1985:5) "In discussing these issues the writings of Savory and Parsons were unclear." He showed (Savory 1978, 1983; Savory and Parsons 1980) where they had recommended High Utilization Grazing (HUG) to halt patch over-resting and at the same time High Performance Grazing (HPG) to improve average daily gain, but, he said these objectives are mutually exclusive.

Assessment of cell grazing (called "cartwheel" in Zimbabwe and "wagonwheel" in South Africa) under heavy stocking in the eastern Cape Province of South Africa pointed up localized over-use. Bransby (1983:10), in an article "Facts about wagonwheels", affirmed, "So far, an important problem that has been identified is excessive utilization of the veld in each paddock as one gets closer to the 'hub' of the wheel. This is likely to be worse as the number of paddocks in the cell increases." He contends there is no justification for more than 8 paddocks under any form of SDG.

Duration of Grazing and Rest

The biological constraints to SDG are: (1) rest periods should be long enough to restore plant vigor between grazing periods and (2) grazing periods should be sufficiently short to prevent regrazing of recently bitten plants. The number of days that cattle are in a unit and the required days of rest from grazing, therefore, set the total number of units. Rate of key species growth is important in determining the number of grazing days.

Studies by Tainton et al. (1977) compared variable days of grazing and rest (9 combinations) on grass yield for 6 years. In general, highest yields came from the lowest days of grazing and highest days rest. However, the 7 paddock rotation (10 days graze and 60 days rest) yielded as well as the 21 (2 days graze and 40 days rest) and 31 (2 days graze and 60 days rest) paddock systems. From results of this study more than 7 paddocks would be unjustified.

Tainton (1985) said, "However, having advocated a flexible approach to periods of occupation and absence, Savory (1978) has set an upper limit of 60 days to the period of absence in areas ranging from deserts to high rainfall areas. Such a limit is clearly inappropriate...." Many range types and forage conditions call for a full season rest to restore vigor, allow for seeding, burning and other such requirements (Barnes 1960).

Recent growth studies (Danckwerts and Aucamp 1985) of two key forage species, common to semi-arid range for most of sub-Sahara Africa, showed that 90 days was the appropriate period of rest. The optimum grazing period was between 15 and 20 days for both species, *Themeda triandra* and *Sporobolus fimbriatus*. A grazing rotation of 5-7 pastures was indicated. If a rancher wanted to drought-proof range for long-term forage plant well-being, which is the local recommendation, at least one-fourth of the grazing land should receive a full growing season's rest. Such a practice with the recommended rotation would then require 7 to 9 grazing units.

Apart from grazing constraints for plant well-being, animal welfare must also be considered. On the animal side, one must compromise between high performance grazing (HPG—also called controlled selective grazing) to optimize livestock daily weight gain and high utilization grazing (HUG—also called nonselective grazing) to force use of less palatable plants (Booysen 1969). Tainton (1985) stated that HPG is now more widely accepted as an approach than is HUG.

In Zimbabwe, Jackson (1972) pointed out the need for flexibility in SDG with respect to cattle stress and reproduction performance. He suggested, as did Pratchett (1983) in Botswana, that cattle under SDG are more sensitive to heavy stocking than those under continuous systems. Movement of cattle to the next paddock must be accomplished before stress lowers conception rates. He also emphasized the complexity of obtaining proper forage utilization and animal welfare using SDG.

Number of Paddocks

Early thinking on SDG suggested short grazing periods be used to (1) eliminate regrazing based on expected plant defo-

liation patterns and (2) provide high density stocking. To meet both objectives required 12 or more paddocks (Acocks 1966). More recently with SGM the number has expanded and its main advocate (Savory 1983:101) said, "...I routinely recommend 30 or more paddocks in a grazing cell...."

Gammon (1984:61) stated, "It is generally assumed that there are wide differences in defoliation between continuous grazing and rotation grazing and between (among) systems of rotation grazing. Research on veld at Matopos Research Station (Gammon and Roberts 1978b) indicates this is not so." He continued, "For example...it was found that even at moderately high stocking intensities with grazing periods of 6 to 12 days, not more than 30% of tillers were grazed in successive grazing periods (Gammon and Roberts 1980)." He suggested this as another reason for limited range response difference between grazing systems. Based on their investigations, (Gammon and Roberts 1978a, 1978b, 1980) involving marked tillers throughout various systems, Gammon (1984:63) summarized, "...it is concluded that restrictions of the grazing period to approximately 7 days and allowing a rest period of approximately 35 to 60 days...is, for practical purposes, sufficiently close to ideal management."

In a state of the art paper on grazing management in southern Africa, Barnes (1982:649) said, "The weight of evidence, therefore, is that accurate control of defoliation patterns in savanna by means of rotational grazing is an unattainable ideal. Thus, there is good reason to question claims that intensive rotational grazing procedures, including so-called advanced short-duration grazing, involving the use of 30 or more paddocks per herd, will result in very large increases in carrying capacity."

Barnes (1979:49) earlier observed in review of cattle ranching that, "The experimental evidence available indicates that there are no advantages, and that there may be disadvantages in using a large number (in excess of six or eight) of paddocks per herd. Consideration of the relation between periods of stay and absence and increasing numbers of paddocks per herd leads to the same conclusion."

Based on trials reported from Zimbabwe (Gammon 1976, Gammon and Roberts 1980, Denny and Steyn 1977) and South Africa (Booysen et al. 1974, Tainton et al. 1977) there is little justification for providing more than 8 units in a rotational grazing layout. In this regard, Booysen and Tainton (1978:553) said, "...there seems little justification for developing systems involving more than eight paddocks." Gammon (1984:63) also concluded, "there is no established justification for recommending more than six to ten paddocks per herd...."

Bransby (1983:10) critiqued the wagon-wheel layout in a popularized article and summarized, "So, from both the biological and economic point of view, there appears to be absolutely no justification in having more than eight to ten camps (paddocks) for each group of animals."

Herd Effect and Stocking Density

According to some proponents (Savory 1979, Savory and Parsons 1980) the presumed improvement from high density stocking is attributed to increase in hoof action which chips crusted soil to improve infiltration, aeration, etc. Other benefits alleged to result are increased seed planting, laying of litter, and dunging effects.

This concept has perhaps produced more objection than other ideas. Tainton (1985:5) said, "...the mythical herd effect which supposedly develops when large numbers of animals are grouped together remains a contentious issue...." Although few studies have investigated the effects of trampling on watershed characteristics in southern Africa, those in east Africa (Mbakaya 1985, EAFRO 1979) substantiate findings in North America in this regard, i.e., trampling lowers infiltration and aeration, increases runoff and contributes to higher sediment production (Blackburn et al. 1982, Branson et al. 1981). What is not known in terms of intensive SDG is the length of rest needed for adequate recovery following damage by higher stocking (Blackburn 1986, pers. comm.).

With regard to greater litter accumulation under intensive SDG, Gammon (1984:63) pointed out, "Such an effect was not apparent in litter measurements at Matopos Research Station (Gammon and Roberts 1978a) nor in comparisons on farms of veld under intensive SDG with less intensive managed veld." Studies in North America also substantiate these findings (Balph and Malecheck 1985).

Herd density and number of paddocks has little to do with dunging effect. What does influence dunging effect, however, is forage intake and defecation rates per day. Defecation rates are quite constant regardless of stocking rate unless high stocking has lowered intake and, therefore, fecal output.

Paddock Configuration

In a review of SDG systems "with particular reference to the wagon wheel layout" in the eastern Cape Province of South Africa, Trollope (1981:14) said, "...there is an opinion within the 'wagon wheel' school of thought that it is not necessary and/or important to separate different veld types when using a multi-camp (many paddocked) system." His opinion, however, was that, "Area selective grazing can be a potentially greater problem in a 'wagon wheel' layout than in a conventional arrangement of camps." This is because it is nearly impossible to isolate range types where spoke-like fences converge to a central hub.

Wagon-wheel grazing requires that all types receive the same grazing prescription. For example, communities on well-drained uplands that dry quickly get the same treatment as valley lowlands that retain moisture: variation in soil drainage is a very common condition of the African landscape. Working in southern Zimbabwe, Denny and Barnes (1977) found that each veld type had a critical stocking rate in terms of animal performance and needed separate management consideration.

Like ignoring range types, ignoring variation in plant communities and species composition can also contribute to the loss of valuable grazing (Ivy 1969). For instance, in mixed shrub-grasslands late moderate use of woody species is not detrimental, but with cell grazing, seasonal utilization cannot be controlled. One long-time observer of cart-wheel layouts suggested that "time control" is much easier when paddocks conform to ecological subdivisions than when spoke-like fences cut across them (Ivy 1983, pers. comm.).

On the other hand, the wagon-wheel layout has attributes in provision for water, labor conservation, and stock-handling (Trollope 1981). In tropical and subtropical Africa where diseases and parasites of cattle often require weekly inspec-

tion or dipping, the wagon-wheel layout can provide immense savings of labor. It is also perhaps well suited to humid and subhumid climates with gentle topography and uniform range site characteristics. When used at moderate stocking, with no more than 8-10 paddocks, it seems to perform well even in some semiarid climates.

Background Reviews

Much information is available on intensive SDG in southern Africa varying from emotional debates in popularized farming magazines to objective evaluations by the World Bank. It is helpful for one to have some familiarity with the author and the author's experiences to recognize bias whenever SGM is evaluated.

Short Duration Grazing Introduced

A state of our knowledge paper on the new SDG system was provided by Roberts (1969) at a landmark grassland conference in Bulawayo, Zimbabwe, in which he reviewed the scientific, political, and economic situation with regard to the then raging controversy over SDG including SGM. He concluded (Roberts 1969:50) that the success of conventional systems is not impressive and that so long as "realistic stocking rates are used" the multi-camp layouts hold advantages that cannot be attained under conventional systems. His final conclusion from the paper which cited 267 references was: "Illumination of problems of veld management recommendations is unlikely as long as scientific issues are clouded by the interests of individuals."

At the same Bulawayo conference, Savory (1969b:83), who was then a member of Parliament, technically aired the basic tenets of his "...so called Savory system of land management." That same year in a *Journal of Range Management* article Goodloe (1969) introduced to North America early thinking on SDG and marked its evolution in Zimbabwe. The article (Goodloe 1969:372) summarized, "The short graze-long rest approach to range management is not entirely new nor has the Rhodesian system had time to prove itself absolutely reliable."

Goodloe (1969) and others (Booysen and Tainton 1978, Trollope 1981) credit the late John Acocks (1968) with the concept of SDG, which was developed by several pioneering ranchers such as L. Howell and E. Mathews (Trollope 1982). Acocks (1966) was first to advocate advances beyond the 3 herd, 4 paddock conventional system by suggesting up to 12 paddocks under certain conditions. Others (Savory 1969a) later widely publicized the system in Zimbabwe.

The Charter Trial

The Charter Estate Trials (Saunders 1976) were set up in 1968 to compare two treatments of the conventional system of 4 paddocks in prolonged grazing which incorporated a spring burn every 3rd or 4th year with two treatments of the SDG. The latter two were supervised by A. Savory and the former by estate manager, D. Worthington.

One SDG treatment, labeled the Richman Savory, contained 15 paddocks and the other, the Poorman Savory contained 7 paddocks. Government researchers were to evaluate the trial. The experimental design and several early changes in grazing intensity and numbers of paddocks, however, complicated subsequent evaluation.

Conclusions concerning range and livestock response at that time showed no real changes in plant composition after the 7-year trial despite more cattle being carried under SDG (Clatworthy 1984, Oates 1976). Though each animal gained less, the added number of animals produced an overall greater yield using SDG. The Richman Savory (15 paddocks) produced the lowest gross margin per dollar invested. The Poorman Savory (7 paddocks) produced the highest margin which was only slightly better than the two conventional systems.

Based on a recent summarization of this trial, a series of technical papers has been published (Clatworthy 1984, Parsons, 1984, Worthington 1984). Using this original information, current research, and rancher experience, Zimbabwe government policy (AGRITEX) encouraged SDG but insisted there was no justification for more than 8 to 10 paddocks (Ivy 1983, pers. comm.).

Changing Views

A criticism often leveled against SGM is that the methods are constantly changing. Savory told Goodloe (1969:370), "Details of the system keep changing because we are still learning." This is not surprising with new technology developed largely on observations. Changing ideas also made it impractical to test and compare methods in a research context. Eventually, results of several studies in which Savory did cooperate were repudiated because his own thinking had changed in the meantime (World Bank 1982).

These changes centered on ecological concepts such as the role of fire and bush (brush) control as well as techniques such as number of paddocks and length of stay or rest. Savory continues to modify his thinking as he has attempted to transfer concepts conceived through examination of tropical ecology to the temperate zones of North America (Vaughan-Evans and Mariti 1984). At a workshop Savory conducted in Zimbabwe in July, 1985, many former colleagues were shocked to hear him confess, "I had not designed a satisfactory grazing scheme by the time I left Africa (in 1978)."

Evaluation in Zimbabwe

The World Bank (WB) commissioned a study of SGM in Zimbabwe in late 1982 as a possible alternative to generally failing range livestock programs throughout Africa (WB pers. comm.). The bank officer met with a Director for Extension Services in Harare and heard that "The issue was clouded by a dense emotional fog engendered by Mr. Savory's personality and approach."

The last broad evaluation of SGM involved interviews with client ranchers and others who had many years of SGM experience with cart-wheel configuration including government extension specialists, research officers, and university faculty.

The WB findings were:

1. Very few stock farmers use any form of SDG and there is no use of SDG in the communal areas.

2. There is considerable support for SDG by AGRITEX and progressive ranchers using 8 paddocks with 1 week graze and 7 weeks rest. Undoubtedly, Savory has influenced adoption of SDG but there is now (5 years after Savory left) little support for large numbers of paddocks.

3. Claims of long-term doubling or tripling of stock numbers are not substantiated in practice with various forms of SDG. Little, if any, change in vegetative composition is evident even with intensive systems. Bush and noxious plant control remain a costly problem.

4. The use of SDG and the associated cart-wheel layout has greatly facilitated range and livestock management through better utilization.

5. Savory contends, and perhaps rightly so, that few rancher clients are now using his method as prescribed and the system therefore cannot now be judged. However, if progressive ranchers and a committed extension officer (Vaughan-Evans 1978) cannot successfully operate the method properly after 15 years of close association and supervision, then this system has very limited application.

The report showed that most former clients had returned to conservative stocking levels. Of the 90 some ranchers using SGM in the Midlands region, only 20 were then using some form of cell type grazing. Selective grazing was continuing in the sour veld types in which certain species become stemmy and unpalatable in the dry season. Bush encroachment was a serious problem in the absence of fire. The extension officer and former colleague from the midlands suggested that perhaps 30-40% of increases in stocking resulted from better forage utilization. Greater increases were attributed to other possible factors.

Critiques of SGM in other areas have been less charitable. For example, in the eastern Cape Province of South Africa, one authority (Bransby 1983:9) said, "I honestly believe that for every stock farmer who is happy with this cart-wheel system, there are at least two who are in doubt about the money they have spent as a result of it."

Summary and Conclusions

Claims for range improvement in southern Africa through intensive SDG at double conventional stocking rates are not founded in fact. To the contrary, evidence in literature from Zimbabwe and elsewhere in southern Africa indicates that it is impossible to have both heavy stocking and improvement in range condition. In fact, studies of SDG involving 12-16 units at only medium rates of stocking have shown no greater range improvement than conventional systems. Moreover, there are numerous cases where double stocking (with cart-wheel systems) on a long-term basis has led to severe degradation.

The assumption that stocking rate or level of vegetative use is unimportant if an appropriate rotational system is employed is flawed. Studies at Matopos, Zimbabwe and elsewhere have shown that even 60 days rest following intensive grazing periods may not be sufficient to fully restore plant reserves. New research on key species in South Africa suggests 90 day rest periods as optimal. Also, rest periods encompassing entire growing seasons may be required to accomplish aspects of restoration even under intensive SDG.

Apparently the extent of regrazing on grazed plants within units is not so severe as earlier presumed. Recent studies indicate that a 7 day grazing period using 6 to 8 paddocks (35 to 60 day rests) provided ample protection from significant regrazing. Moreover, grass yields from 7 paddocks with 10 days in and 60 days out performed as well as those from 21 to 31 paddocks, using 2 days in and 40 and 60 days out, respectively.

In a 7 year economic comparison among conventional and intensive rotational systems, the 7 unit intensive system performed slightly better than the conventional ones, but the 15 unit intensive system was poorest. There were no real differences in plant frequency or basal cover between systems. Though more animals were carried on the intensive systems, their individual weights were much lower due to heavy levels of stocking.

Emphasis on SDG from southern Africa is now away from high stocking rates to accomplish non-selective grazing with preference toward higher animal performance. Current findings show considerable selectivity even under intensive wagon-wheel SDG. The stress factor on animal performance, both weight gain and reproduction, can be disastrous under intensive SDG because incipient weight loss is very hard to detect under rapid grazing rotation.

That the "herd effect" results in various supposed benefits on soil, soil moisture, litter, etc., to improve rangeland characteristics has been termed a myth by some authorities. Studies in Africa as well as North America refute the claim of better infiltration, aeration, or laying of litter. Rather, increased trampling due to increased stocking, stock density, or vegetation use increases soil compaction, which reduces infiltration and increases sediment.

Selective grazing by areas and species is a real problem even with a many-spoked wagon-wheel cell configuration. Unfortunately, the wheel design must ignore natural subdivision of range types which are very important ingredients to "time-controlled" range rehabilitation in southern Africa. The wheel, it appears, is also prone to concentrate excessive utilization and trailing at the hub.

Those considering the use of SGM should carefully examine the hard data that is available on both the ecological response to the method and on the associated costs and benefits. In southern Africa where SGM had its beginnings, many ranchers are disillusioned and most rangeland specialists contend there are too many shortcomings to recommend it as prescribed.

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Allan Savory saw a copy of the above paper before it was printed and had an opportunity to comment.