Applying Knowledge of Traditional Pastoralists to Current Range Management

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ABSTRACT

Pastoralism is an ancient form of subsistence that is still in wide use today throughout the world. While many traditional pastoral regions are the focus of current desertification studies, the long history of sustainability by these cultures is of great interest nonetheless. Numerous studies suggest that the land degradation observed in these areas today is a recent phenomenon attributable to changes in land tenure, management, and treatment, in addition to changes in the environment. This paper explores the suggested causes of land degradation and focuses upon applied land management and grazing treatments common to traditional pastoral cultures. Comparisons are made with western livestock ranching and numerous similarities noted. Historical observations suggest that desertification is the result of both climatic and anthropic factors with specific emphasis recently placed upon the effect of sedenterization and the subsequent negative feedback cycle initiated through partial-rest and total rest found across nearly all continents, societies, and grazing cultures today.

KEYWORDS:Grazing, pastoralism, desertification

INTRODUCTION

Pastoralism is an ancient craft which on the surface, appears to demand only minimal skills. The shepherd or herdsman is simply tasked with keeping his stock alive so that he may subsist on the animals' milk, blood, wool, meat, and value in trade. Just beneath this thin veneer however, rests a myriad of complexities involving forage, animal health, reproduction, predation, weather, and the social and cultural fabric within which the pastoralist functions. Over time, pastoral cultures have developed and these complexities have been mastered, with learned animal husbandry skills and the wisdom of experienced pastoralists handed down through generations[1].

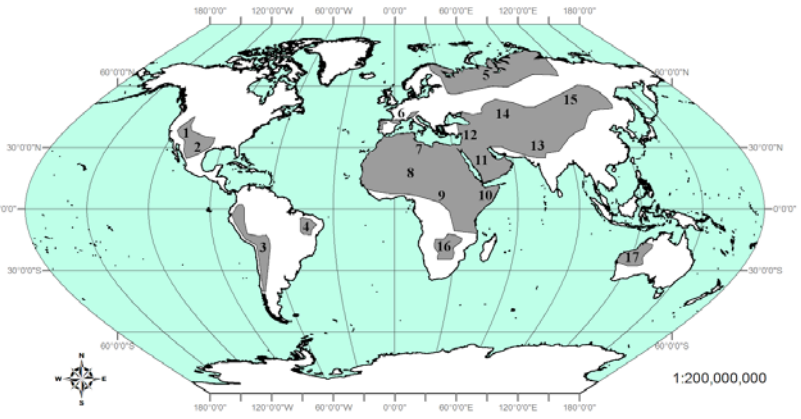
It is not without debate that pastoralism developed after agriculturalism (Khazanov 1994). By 7000 BCE pastoralism was well established (Flannery 1965) and most likely developed as people migrated into areas of low productivity and/or regions of unreliable rainfall (i.e., the arid and semiarid regions of the world). As a result, these people came to rely upon domesticated animals for subsistence instead of agricultural crops (Salzman 2004; Cummins 2009). Over time, three unique forms of pastoral production took hold: 1) sedentary production, 2) transhumance, and 3) nomadism (Yalcin 1986). Sedentary pastoralism involves keeping livestock near farms and villages year-round while transhumance includes the seasonal movement of animals and people from valley bottoms to mountain pastures (Yalcin 1986; Ott 1993; Cummins 2009). Nomadic pastoralism may have developed in response to recurring and wide-spread drought (Salzman 2004) or widespread and erratic rainfall and is typified by livestock being moved in constant search of forage. Nomadism differs from transhumance in that no permanent base (home or village) is developed and likewise, no pre-defined series of movements is used. Of all the forms of pastoralism, nomadism is least systematic.

Much of what is considered rangeland today (Bedell 1998) falls within the arid or semiarid regions of the world. These areas support grasses, forbs, and shrubs which are managed without cultivation, irrigation, herbicides, pesticides, or fertilizers. The primary management tools of the traditional pastoralist are his livestock (principally sheep, goats, cattle, horses, donkeys, and camels) and fire (Savory 1999).

Within arid and semiarid rangelands, water is the limiting factor (Niamir-Fuller and Turner 1999; Hill 2006) and precipitation is highly variable both spatially and temporally. In seasons of increased precipitation, forage availability improves dramatically (Niamir-Fuller and Turner 1999; Gregory et al. 2008) whereas in years of drought grass becomes scarce. Unfortunately, contemporary grazing systems can create less effective water cycles (cf. rain use efficiency) resulting in increasingly frequent and severe droughts events (Savory 1999). As a result, some pastoral cultures (e.g., the Herero of Namibia and the Samburu of Northern Kenya) have degraded their environments to the point where temporary abandonment was required (Hill 2006), and all have altered their environment to some degree (Wilson 2007). Still, numerous pastoral cultures (e.g., Rashayada Bedouin of the Sudan, Mongolian and Chinese herdsman, and Pyrenean herders) (Figure 1) have survived for thousands of years despite various complexities, hardships, and challenges. Herein lies an important point for consideration and an equally important question; that is, how have these traditional pastoral cultures managed to sustain themselves for thousands of years? This is not meant to imply that the landscapes used by all pastoral cultures are pristine as many are desertifying. There is evidence to suggest that pastoral landscapes were in better

[1] This is not to imply that ancient pastoralists developed a utopian society as perfect long-term ecological sustainability of arid and semiarid landscapes has yet to be achieved (Khazanov 1994).

condition throughout the 1800's and early 1900's (Niamir-Fuller and Turner 1999) and that the observed rapid degradation is a relatively recent phenomenon that has accelerated during the latter parts of the 20th and current centuries (Waller 1985; Gritzner 1988; Smith 1992). This raises a second, interrelated and perhaps more intriguing question; what changed to cause these declines?



1. Native American (e.g., Navajo)
2. Mexican herders
3. Andean pastoralists
4. Brazilian vaqueiros
5. Laplanders
6. Pyrenean herders
7. North African pastoralists
8. Saharan nomads
9. Sahelian pastoralists
10. Pastoralists of the Horn of Africa
11. Arabian peninsula pastoralists
12. Middle eastern pastoralists
13. Afghani, Pakistani, Nepali, and Tibetan pastoralists
14. Turkmen and Kazakh pastoralists
15. Mongolian and Chinese herders
16. Botswanan and Zimbabwe hunter-gatherers
17. Australian Aborigene hunter-gatherers

Figure 1. Map of general distribution of traditional pastoralists worldwide (note: the terms pastoralist, herders, and hunter-gatherers and general region map from Niamir-Fuller 1999).

To address these questions, one must first understand what is meant by the term desertification. Desertification is a term first used by Auberville (1949) which refers to the severe degradation of the arid, semiarid, and sub-humid areas of the world due principally to climatic and anthropic forces (UNCCD 1995; Arnalds 2000). The term implies a nearly irreversible condition (Dougill and Cox 1995; Niamir-Fuller and Turner 1999) of the landscape in contrast to a less severe perturbation reserved for the term degradation. Desertification was also used by Savory (1999) to refer to the manifested symptom of biodiversity loss in arid and semiarid environments. The universal remedy for degraded rangelands has been the removal of livestock (i.e., de-stocking). Under the most systematic grazing regimes, *rest* is deliberately used as a temporary de-stocking that serves as much as a pre-determined scheduling process as it is a land management technique. Under less systematic regimes, the term *recovery* is applied, inferring an active management decision that allows plants to recuperate before additional grazing is allowed. The length of the *recovery* period is not pre-determined (Voisin 1988) but rather, decided upon by the pastoralist based upon his/her knowledge, experience, and goals. Rest then, as part of a grazing system, may or may not have any relationship to actual leaf and root recovery.

The most extreme form of de-stocking is *abandonment*. In western cultures, *abandonment* is equated with failure, while in other pastoral cultures, *abandonment* is viewed as part of the normal process of good management (Stone 1993; Hill 2006). In essence then, all pastoral cultures have applied intervals of no-grazing (rest, recovery, and abandonment) along with periods of grazing as part of their historic and traditional grazing practices. The only real difference --apart from semantics-- is the duration of the

abandonment (cf. rest or recovery) which is a function of the particularities of the season (Voisin 1988), brittleness of the environment (Savory 1999), and so forth. Regardless of the term used, rest, recovery, and abandonment all involve periods of total or near total absence of grazing throughout a growing season or grazing cycle.

It may seem a logical conclusion then, that the period of rest or recovery constitutes an entirely positive influence on the environment. Such a conclusion however, is paradoxical, as just like too brief a recovery period degrades the environment, so too does a prolonged recovery period. This is because arid and semiarid grass species have co-evolved with herbivores and the prolonged absence of herbivory tends to lead to excessive standing litter accumulations called moribund grass. Moribund grass breaks down through a gradual physical weathering process rather than rapid biological decay and is particularly detrimental to grazing-dependent bunchgrasses. With sufficient time, this condition can kill individual plants leaving only exposed soil in its stead (Savory 1999; Figure 2). Savory (1999) draws a clear distinction between the recovery period required by individual plants --to minimize or avoid overgrazing-- and the episodic, yet high levels of disturbance the plants and soil surface requires to maintain the health of its biological communities through the trampling of moribund material to ensure rapid biological decay, increase soil organic matter, and provide soil-covering litter to promote improved rain use efficiency. Furthermore, Savory observed that while livestock are grazing, much of the range is essentially rested as the livestock are scattered and produce inadequate disturbance-- to describe this effect, Savory used the term *partial rest*.

Figure 2. An example of excessive litter accumulation degrading through oxidative rather than biological means.

Under conditions of partial rest, livestock are grazed at low density (i.e., few animals graze a large pasture in an unbunched manner) and when herds remain relatively sedentary over long periods of time (e.g., a month or more) overgrazing of plants occurs. This, combined with the adverse effects of partial rest, exacerbates an already declining rain use efficiency trend through both increased run-off and soil surface evaporation (Savory 1999; Huxman et al. 2004). While some plants will be grazed repeatedly others may

remain un-grazed and over time, moribund grass accumulations form just as they do in over-rested areas. The moribund grasses present a less palatable option to the herbivore, which tend to select the same individual grass plants resulting in over-grazing of these plants. As a result, over-grazing damages or kills grazed plants while un-grazed plants are weakened, and the rangeland enters a negative feedback cycle of slow but progressive degradation. Recent studies support these observations and suggest that partial and total rest have remarkably similar affects on arid and semiarid grassland environments (Gomez-Ibanez 1975; Cummins 2009; Weber et al. 2009a; Weber et al. 2009b).

The cause of rangeland desertification has been attributed repeatedly to a combination of climatic and anthropic factors (UNCCD 1995; Geist and Lambin 2004; Hill 2006; Lambin et al. 2009) with specific emphasis placed on overgrazing and drought (Bedell 1998; Puigdefabregas 1998). Climate theories have focused upon changes that have occurred over the past ten thousand years of the current Holocene and note several periods of increased aridity (drought) and still other periods of increasing humidity. In addition, some changes were localized (Stebbing 1935; Niamir-Fuller and Turner 1999) while others were global in nature. Some changes persisted over long time periods while others were much shorter in duration (Brooks 1949; Khazanov 1994). In essence, changes in the earth's climate since the last Ice age have not been progressive in any sense but rather oscillatory. Indeed, it has been suggested that the periods of increased aridity have led to the emergence and increased prevalence of nomadic pastoralism and not the inverse, nor a global increase in desertification due to pastoralism (Khazanov 1994). This is because nomadic and transhumant pastoralism is a successful adaptation for survival within highly variable semiarid and arid environments (Niamir-Fuller 1999; Khazanov 1994; Salzman 2004; Cummins 2009).

One reason for the success of nomadic and transhumant pastorlism in semiarid and arid ecosystems in contrast to cultivated agriculture relates to effective rainfall, rain-use efficiency or soil moisture storage capacity. Thurow (2000) described various hydrologic effects on rangelands and noted that soil structure, soil texture, and organic matter content are key factors governing soil moisture storage capacity. While the particular soil type or soil association does not change with treatment, a soil's structure and organic matter content can be affected. In the absence of large herbivores, organic matter inputs will be dramatically reduced and the surface of soils tends to become capped (Khazanov 1994). Both of these factors degrade a soil's ability to retain water (Thurow 2000) and lead to a reduction of plant production. Similar to, and often compounded upon the effects of prolonged rest, these rangeland ecosystems enter a negative feedback cycle which ultimately leads to desertification (Le Houerou 1984; Thurow 1991).

While literature from the 1980's and early 1990's repeatedly linked livestock to the degradation and desertification of rangelands (Lamprey 1983; Sinclair and Frywell 1985; Wolfson 1990) more recent studies have refuted this by suggesting that prolonged rest leads to even more serious degradation than overgrazing (Seligman and Perevolotsky 1994; Olaizola et al., 1999; Cummins 2009). And so it seems that neither climatic or anthropic factors are solely to blame for the desertification of the earth's rangelands. It stands to reason then, that some interactive or combinatory explanation may be most agreeable. Indeed Hill (2006) arrived at a similar conclusion when he examined the arid rangelands of the Transjordan plateau. His conclusion was that climate change was a major factor explaining the disappearance of surface water and changes in vegetation due to increased aridity (Bar-Matthews et al. 1999; Hill 2006). This, however may also be attributed to reduced soil moisture storage capacity,

increased surface runoff and increased soil surface evaporation because too *few* animals were present on the rangelands for too *long* a period of time (Savory 1999).

A second major factor cited by Hill was human ignorance regarding the consequences of mismanagement (McGovern et al. 1988) (i.e., land use decisions and practices). The third causal factor was the role of politics (i.e., land management or land tenure [Lundsgaard 1974]) and the hypothesis that environmental sustainability is inversely related to the levels of hierarchy and dissociation present in the governing/managing body (Hill 2006).

What is most interesting amongst all these studies is the clear admission of the substantial role played by humans (albeit not a solitary role) in shaping and altering the environment and the inseparability of humans and nature (Goldman and Schurman 2000). It seems reasonable then, to consider what humans may be able to do to improve the environment instead of focusing solely upon what they have done to degrade it or on oscillating climatic conditions.

Land use, and specifically pastoral land use is highly variable both temporally and spatially across the rangelands of the world (Niamir-Fuller 1999). To enable modern scientific inquiry, some means of quantifying and classifying land use is required (Funtowicz and Ravetz 2003). In range science, various specific types of grazing are recognized and in terms of management, grazing is typically classified as either intensive or extensive relative to the degree of management effort involved (Bedell 1998). A second set of terms (stocking density or stocking rate) describes the number of animals grazing an area relative to the size of the area (density) or the amount of time allocated to an area (rate). While a plethora of terms are applied to specific styles of grazing (rest-rotation, deferred-rotation, high intensity-low frequency, short-duration, etc.[Holechek et al. 2001]) they differ in the proportion of time spent grazing relative to the proportion of time spent for recovery of the plants in that same area and in how each views and applies disturbance or a lack thereof. In western societies, extensive or semi-extensive management has become the norm, and graziers typically apply a single grazing system for their herd/herds which is repeated on an annual cycle. A problem with this approach is that it places the focus of livestock management upon the herd and in essence, the "herd" *is* the management unit. In contrast, the "season" is the management unit for transhumant pastoralists and as a result, the latter is less systematized and more variable. In neither case, however, is "time" (the period over which plants are exposed to a grazing animal and the range experiences a disturbance through the effect of the herd) the focal management unit even though numerous studies have stressed its importance to ensuring long-term sustainability (Voisin 1988; Savory 1999). Voisin, for instance, points out that promoters of the rotational method "overlooked the necessity for the periods of occupation being sufficiently short" and instead emphasized "dividing the pasture into a greater or smaller number of paddocks...and then shifting the herd from one paddock to the next".

Range scientists have recommended and tested a great many “grazing systems” varying from continuous grazing through a plethora of rotational grazing practices designed without taking into account the full complexity of cultural/social issues, wildlife, alternative uses, market forces, etc. Both pastoralists and ranchers attempt to address these complexities using a myriad of grazing systems. To effectively address complexity requires a planning process that embraces complexity, rather than a pre-determined management system designed for simplicity (Savory 1999).

Niamir-Fuller and Turner (1999) note the importance of mobility within highly variable environments (i.e., arid and semiarid areas) and while they opt to focus upon *mobility* itself, the reason why mobility is so important is intimately tied to Voisin's emphasis on time. Behnke (1999) echoes these same concerns and the importance of highly mobile herds in his study of the Etanga pastoralists of Namibia. In both cases, mobile pastoralism (e.g., transhumant and nomadic pastoralism) is considered an ideal adaptation within arid and semiarid rangelands especially in contrast to the alternative, sedenterization (Salzman 2004). Sedenterization is the process by which once highly mobile pastoral cultures are converted to less mobile ones and concentrated near major trade routes, villages, and other communities. As a result, the pastoralist no longer needs to rely upon himself and his livestock for subsistence, but upon his ability to purchase goods and services using money gained through the sale of his livestock. In such emerging market economies lessons in business acumen are quickly learned and the adage of "location, location, location" is proven true again. The consequence of such change is that the pastoralist's herd may spend nearly the entire year within a relatively small area and in response to market demands --instead of personal needs or the carrying capacity of the land-- may increase the number of animals in his flock or herd placing further stress upon a brittle arid or semiarid environment.

In a study of nomadic cultures, Khazanov (1994) describes a worldwide trend in which nomadism is being replaced by market-oriented ranching (cf. sedenterization). In these cases, the result is the prolonged occupation of livestock within a given area and the subsequent impoverishment and desertification of the landscape. Keohane (2008) reports a similar transition of Bedouin tribes where livestock were traditionally moved every three to five days to one of increased sedenterization around settlements. Again, the result was an observed decline in rangeland condition.

If sedenterization leads to the overgrazing of plants, a loss of biodiversity, and ultimately desertification, it seems reasonable to expect the opposite treatment (nomadism) to yield opposing results upon the landscape. However it does not (Savory 1999) and what has been observed is that both nomadism and more sedentary grazing practices can lead to desertification, albeit at different rates of degradation. Pastoralism, given adequate land area and freedom to move, simply leads to more gradual desertification than sedentary practices.

Hence, mobility alone is not the key and simply describing nomads as mobile does not adequately capture the essence of the grazing practices followed by the nomadic pastoralist. To look at it another way, would a grazier who moves his livestock to fresh pasture twice each year be considered a nomadic pastoralist? What if he moved his herd or flock 12 times per year, or 150 times per year covering hundreds of kilometers in the process? Only in the latter example would one consider the hypothetical grazier a nomadic pastoralist. In terms of land management, the effective difference between the former examples of punctuated sedenterism and nomadism is the amount of time spent grazing one area before moving to another and the amount of time allowed for recovery of the plants (Voisin 1988).

While Voisin (1988) advocated that overgrazing of plants was the greatest influence in land degradation and desertification, only more recently have the effects of partial-rest and total rest been more fully understood (Behnke 1999; Niamir-Fuller and Turner 1999; Cummins 2009) as factors that tend to override the influence of overgrazing and may consequently be the principle factors driving rangelands

toward desertification. In addition, it was Savory (1999) who observed that "Since about two-thirds of the earth's land surface is brittle [e.g., arid or semiarid rangelands]... and since the dawn of agriculture it has carried livestock under management that paradoxically produces both partial-rest and overgrazing of plants, the remorseless growth of deserts is no mystery".

The western rangelands of North America are little different than many rangelands where traditional pastoralism has been practiced for thousands of years. Both are typically arid or semiarid environments dominated by grasses and shrubs, grazed by domesticated cattle, sheep, and goats. The primary and perhaps only difference is that traditional pastoralism is a means of subsistence whereas ranching is a market-oriented business (Cummins 2009). As noted earlier, shifts towards market-oriented grazing leads to sedenterization (cf. partial-rest of rangelands) which in turn leads to a more rapid overgrazing of plants, loss of biodiversity, and accelerated desertification. This market-oriented shift has also changed land tenure as significant acreages are now held in "public lands" all of which are managed, by policy, under regimes of partial-rest or total rest. Is this the future of the world's rangelands? Could a change be made to reduce the latency of livestock within a pasture or paddock while eliminating the negative impact of partial-rest to thereby improve rangeland ecosystems?

The latter is a very large and important question and certainly some will argue that the suggested change will not yield the expected results in spite of the historical observations referenced throughout this paper indicating otherwise. This then becomes both a dilemma and a challenge for the future of rangeland ecosystems, range science, range managers, and graziers across the globe.

SUMMARY

While numerous pastoral cultures have subsisted for thousands of years and continue to survive today, nearly all are facing great difficulties as their landscapes deteriorate. Historical observations suggest that desertification is the result of both climatic and anthropic factors with specific emphasis recently placed upon the effect of sedenterization and the subsequent negative feedback cycle initiated through partial-rest and total rest found across nearly all continents, societies, and grazing cultures today. As a result, it is suggested that "management systems" be re-considered and supplanted by more inclusive planning processes focusing upon improving arid and semiarid rangeland ecosystems through the use of livestock as a solution to the problem of desertification. Savory (1999) made the point that for all of human history, mankind has tried to manage the environment using only three "tools" (technology, fire and resting land). He further pointed out that none of these tools can achieve what is required to reverse desertification, and that as long as humans continue to use fire as a surrogate for grazing animals and the management of moribund grass, desertification will only continue to worsen across the globe.

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