

Applying Indigenous Pastoralist Experiences to Western Range Management

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ABSTRACT

Pastoralism is an ancient form of self-provisioning that is still in wide use today throughout the world. While many pastoral regions are the focus of current desertification studies, the long history of sustainability evidenced by these cultures is of great interest. Numerous studies suggesting a general trend of desertification intimate that degradation is a recent phenomenon principally attributable to changes in land tenure, management, and treatment. This paper explores the suggested causes of land degradation and identifies the land management and grazing treatments shared by many pastoral cultures. The singular commonality found in nearly all studies of degradation is the prevalence of partial or total rest. While historical observations suggest that desertification is the result of both climatic and anthropic factors, recent focus has been placed upon the effect of sedenterization. These studies suggest 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 land degradation.

KEYWORDS: Desertification, grazing, ranching, nomadism, transhumance

INTRODUCTION

This paper is the result of over a decade of research devoted to understanding land cover change in semiarid ecosystems, and the realization some years ago, that people can affect tremendous changes on the landscapes which we all rely for survival. The idea of course is not novel, but nonetheless, it initiated an investigation into the commonalities and differences among the many societies and cultures inhabiting the semiarid regions of the world. Of particular interest, were those commonalities in land use and most specifically, livestock grazing. The results revealed some surprising patterns while at the same time raised additional research questions that today are areas of active research by the author. The fundamental postulate explored in this paper is whether the changing face of pastoral societies, as a result of market integration and sedentization, has consistently lead to land degradation.

To discuss and appreciate the study of desertification or land degradation in arid and semiarid ecosystems, one must begin with an understanding of pastoralism as this has historically been the principal land use known in many of these regions. Pastoralism is an ancient craft which on the surface, may be perceived 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 generations¹ (Mapinduzi et al. 2003; Stock 2004). As a result, contemporary pastoralism is a dynamic form of subsistence.

What is Pastoralism?

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 are used. Of all the forms of pastoralism, nomadism is least systematic.

What are Rangelands?

More than simply a matter of semantics, the sometimes painstaking and critical use of language is very important to communicate the true meaning of a writer's thoughts. Especially within multidisciplinary fields of scholarship, defining key terms up-front can be very useful to avoid confusion later. One

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

important term used throughout this paper is rangeland, and due to the prominence of this term it is important that the reader understand it in the same way intended by the author.

Much of what is considered rangeland today (Bedell 1998) falls within the arid and semiarid regions of the world. These areas are typically dominated by grasses, forbs, and shrubs and are managed without cultivation, irrigation, herbicides, pesticides, or fertilizers. Indeed, the primary management tools of the traditional pastoralist are livestock (principally sheep, goats, cattle, horses, donkeys, and camels) and fire (Savory 1999). Through the use of these tools, the pastoralist has learned how to manipulate his/her flock (or herd) to graze or avoid certain patches of vegetation with subsequent changes in land cover over time.

While the term rangeland is a more inclusive term than "grasslands" (many savanna ecosystems are also considered rangelands), within the scope of this paper, rangelands are defined by land use (i.e., livestock grazing) and land management (i.e., non-irrigated, etc.) than by any geographic or environmental classification.

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 may create ineffective water cycles (cf. rain use efficiency [Le Houerou 1984]) resulting in increasingly frequent and severe pastoral drought events (Savory 1999; Neely et al. 2009). 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 subsisted on rangelands for thousands of years despite various complexities, hardships, and challenges. We are not intimating that the landscapes used by all pastoral cultures are pristine as many are the focus of on-going desertification research. There is evidence however, suggesting that pastoral landscapes were in better condition throughout the 1800's and early 1900's (Niamir-Fuller and Turner 1999) and that the observed degradation described in the literature today is a relatively recent phenomenon that has accelerated during the latter parts of the 20th and current centuries (Waller 1985; Gritzner 1988; Smith 1992). Based upon these reports, one wonders what caused this recent decline.

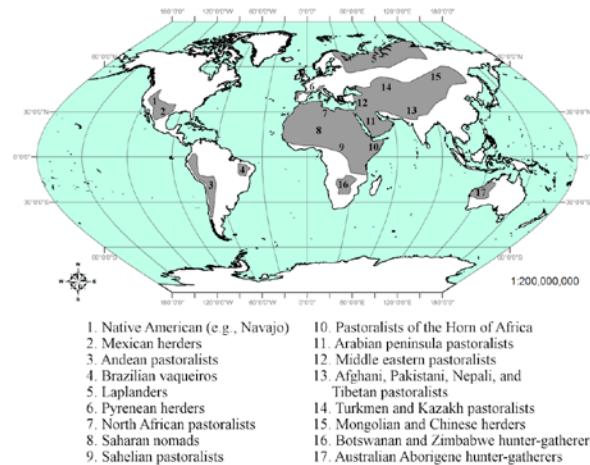


Figure 1. Map of general distribution of traditional pastoralists worldwide (note: the terms pastoralist, herders, and hunter-gatherers and general region map from Niamir-Fuller 1999).

Is Desertification Real?

Similar to the term rangelands, a working definition of desertification is necessary to properly construct this paper. 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 factors (UNCCD 1995; Arnalds 2000). The term implies a nearly irreversible condition (Dougill and Cox 1995; Niamir-Fuller and Turner 1999). Desertification was also used by Savory (1999) to refer to the manifested symptom of biodiversity loss in arid and semiarid environments while more recently, Reynolds (2001) defined desertification as a reduction in the productive potential of the land. A common thread throughout each of the many definitions is the concept of a degraded landscape which is no longer as productive as it once may have been. It is this concept that embraces the term desertification as it is used in this paper.

While most scholars will agree that substantial areas of the earth's surface have desertified (Prince et al. 2009), an active debate has emerged challenging the estimates and inferences made as a result of some earlier studies (Tucker et al. 1991; Hellden 1998; Prince et al. 1998; Veron et al. 2006). Whether all estimates of desertification ever published are wholly accurate or not is a moot point when one considers the belief by many decision-makers and land managers that rangelands are degrading and that some intervention or change of policy must be enacted to prevent further desertification.

Variability in Grazing Treatments

To improve degraded rangelands a common remedy 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 often serves dual roles as both a pre-determined scheduling process and conservation practice. Under less systematic regimes, the term *recovery* is often applied, inferring an active management decision that allows plants to recuperate before additional grazing is allowed. In contrast to rested pastures, the length of the *recovery* period is not pre-determined (Voisin 1988) but rather, decided upon by the pastoralist based on 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* though the recovery period is a more important consideration than the grazing period (Snyman 1998).

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 management process (Stone 1993; Hill 2006). In essence, all pastoral cultures have applied intervals of no-grazing (rest, recovery, and abandonment) along with periods of active grazing as part of their historic and traditional grazing practices. The only real difference --apart from semantics-- is the duration of the no-grazing period which may be a function of seasonality (Voisin 1988) and the resilience or brittleness of the environment (Savory 1999). Regardless of the term used, all grazing management involves periods of total or near total absence of use throughout a growing season or grazing cycle.

It may seem a logical conclusion, that the period of rest or recovery constitutes an entirely positive influence on the environment. Such a conclusion however, is paradoxical, because just as using too brief a recovery period degrades an environment, so too may a prolonged recovery period. This is because arid and semiarid grass species have co-evolved with herbivores and the prolonged absence of herbivory can lead to excessive standing litter accumulations referred to as moribund grass. Moribund grass breaks down through a gradual physical weathering process, rather than the more rapid biological decay process, and is particularly detrimental to grazing-dependent bunchgrasses (Sheppard et al., 2009) . With sufficient time, this condition can kill individual plants leaving only patches of bare soil (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 soil organic carbon (Follett 2001), and provide soil-covering litter to promote improved rain use efficiency (Snyman 2005). Furthermore, Savory observed that under most western livestock grazing management systems, the grazing period represents a period of near-rest as livestock are distributed in a fashion that typically yields inadequate animal impact/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.

The Concept of Partial Rest

Under conditions of *partial rest*, livestock are grazed at low density (i.e., few animals graze a large pasture in an un-bunched manner resulting in low stocking density). When herds remain relatively sedentary over long periods of time (e.g., a month or more) overgrazing of plants occurs. Overgrazing of plants, combined with the adverse effects of partial rest (bare soil, moribund grasses, etc), exacerbates an already declining rain use efficiency through both increased run-off and soil surface evaporation of water (Savory 1999; Huxman et al. 2004). While some plants within a pasture 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 further overgrazing. As a result, overgrazing damages or kills grazed plants while un-grazed moribund grasses are weakened, and the rangeland enters a feedback cycle of slow but progressive degradation. Today, numerous studies support these observations and demonstrate that 1) 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) and 2) few tangible differences can be identified among any of the rotational grazing schemes commonly used today (Jahnke 1982; Sandford 1983; Behnke 1999; Quirk 2002; Coughenour 2008; Homewood 2008) .

Causes of Rangeland Degradation

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 but rather oscillatory. Indeed, it is speculated 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 are successful adaptations 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 pastoralism in semiarid and arid ecosystems in contrast to cultivated agriculture, relates to effective rainfall, rain-use efficiency or soil moisture storage capacity. Thurow (2000) has 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 are dramatically reduced and the surface of soils tend 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 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). Thus, it seems that neither climatic or anthropic factors are solely to blame for the degradation of the earth's rangelands. It stands to reason then, that some interactive or combinatory explanation should be sought. 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 his 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 among 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 we have done to degrade it.

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 classifying and quantifying land use is required (Funtowicz and Ravetz 2003). The most fundamental grazing classification considers a rangeland either intensive or extensive relative to the degree of management effort involved (Bedell 1998). Quantifying land use requires other measurements such as stocking density or stocking rate, which describe 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, continuous, etc.[Holechek et al. 2001]) these differ only in the proportion of time spent grazing relative to the proportion of time allowed for recovery of the plants. 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 basis. One 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 systematic and more responsive to current conditions. In neither case, however, is "time" (the period over which plants are exposed to a grazing animal and rangelands experience disturbance through the impact of the herd) the focal management unit even though numerous studies have stressed its importance to ensuring long-term sustainability (Voisin 1988; Snyman 1998; 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 an abundance of rotational grazing practices which seem to have been designed without taking into account the full complexity of cultural/social issues, wildlife, alternative uses, market forces, etc. 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 upon *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 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 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-- the herder may increase his number of livestock adding further stress to the brittle environment.

In a study of nomadic cultures, Khazanov (1994) described a global 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 grazer 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 grazer 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 as well as the amount of time allowed for plant recovery (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.

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 self-provisioning 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 acreage is now held in "public lands" all of which are managed, by policy, under regimes of partial-rest or total rest.

Could a change be made to reduce the latency of livestock within a pasture or paddock and eliminate 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 the world's rangelands deteriorate. Historical observations suggest that desertification is the result of both climatic and anthropic factors with specific emphasis only recently placed upon the effect of sedenterization and the subsequent feedback cycle initiated through partial-rest and total rest prevalent across nearly all continents, societies, and grazing cultures today. As a result, the studies examined in this paper suggest 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 land degradation.

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