Comparing Effects of Management Practices on Rangeland Health with Geospatial Technologies

Executive Summary

- The treatments used to manage rangelands are simple and remain unchanged over thousands of years of development and progress. These treatments or tools are grazing, fire, and rest. The application of these treatments can have profoundly different effects on an ecosystem based upon how and when they are applied. The effects of grazing, for example, vary relative to the grazing animal and the density at which they are grazed. Even more importantly, is the effect of time or the duration of grazing relative to the amount of time the plants are allowed for recovery. The results of the research conducted over the past several years indicate that 1) the effect of grazing with partial-rest is little different than total rest as both lead to varying rates of desertification (cf. chapters 8 and 14), 2) the sedenterization of once nomadic herders has led to increased rates of land degradation and accelerated desertification (cf. chapters 10 and 14), and 3) improvements in rangeland condition can be made through the use of planned grazing that minimizes animal latency (approximately 3-5 days per pasture) through high herd density and high animal impact.

- The presence of bare ground is a primary indicator of rangeland health and areas with high proportions of bare ground are nearly always associated with degraded ecosystems. While the juxtaposition of bare ground patches relative to patches of vegetation is an important consideration at fine scales, the overall percent bare ground exposure is a critical measure of rangeland health, ecosystem function, and biotic integrity at the landscape scale.

  Using remotely sensed imagery it is possible to estimate bare ground over large regions of the earth. The accuracy of such estimates is important and challenges/limitations exist relative to the ability of remote sensing techniques to reliably detect bare ground. In this study, bare ground was accurately modeled (85% overall accuracy) with classification tree techniques and SPOT-4 (20mpp) satellite imagery along with various topographic/morphometric datasets. This research (cf. chapter 8) improves upon previous results achievable only through the use of high-resolution satellite imagery (Quickbird [2.4mpp]).

- Rangelands are dynamic ecosystems experiencing multiple "green waves" each year. The first tends to occur when ephemeral grasses (typically annual grasses like cheatgrass [*Bromus tectorum*]) and forbs germinate in early spring, while the second "green wave" occurs when other grasses (perennials like Bluebunch wheatgrass [*Pseudoroegneria spicata* (Pursh) A. *Löve*]) initiate active growth later in the spring and summer. During mid-summer photosynthetic activity declines, but given sufficient autumn precipitation, a third "green wave" may occur in late summer/early fall.

Quantifying rangeland productivity has always been challenging and employing satellite imagery to address this question generates additional challenges. The observed inter-annual variation in productivity precludes the use of single-date imagery to estimate productivity. Results of this study (cf. chapter 9) indicate that multi-date imagery and composite NDVI may be much better suited to estimate rangeland productivity in semiarid ecosystems.

- Long-term/continuous, semi-extensive grazing can negatively impact arid and semiarid rangeland ecosystems through reduced productivity and changes in vegetation patch patterns. The effect of continuous animal impact, such as that seen near water holes and shelters, results in lower NDVI (cf. chapters 10, 14, and 15). These characteristics translate into areas of low vegetation cover/high bare ground resulting long-term overgrazing of plants without sufficient recovery periods.