RESOURCE NOTES

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Landscape Stability Indicators for Sagebrush Steppe Ecosystems

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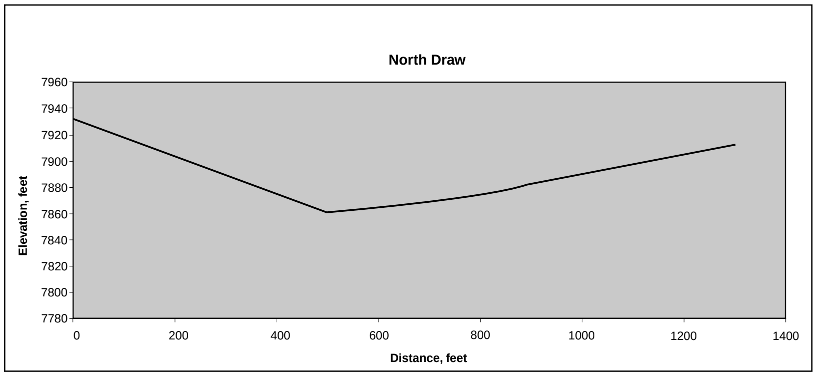

Figure 1. Valley profile for North Draw, North Fork of Savery Creek, southcentral Wyoming

Background

Sagebrush steppe ecosystems are found primarily within the Intermountain Semidesert Province (Bailey, 1995). It is nearly impossible to find examples of pristine sagebrush steppe. Most of these areas are small relict areas, topographically isolated from human disturbance or protected within special-use areas. West (2000) suggests that none of the original pre-Euroamerican sagebrush steppe remains. Only about one percent of the sagebrush steppe is in late seral stage, consisting of sagebrush-grass communities dominated by sagebrush with a healthy understory of grasses and forbs (Laycock 1991; West 2000). Another 25 to 30 percent of the original sagebrush steppe is in a stagnant late seral stage, close to a threshold of site change. This stage is characterized by relatively high densities of sagebrush (canopy cover >25%), large areas of bare soil in the shrub interspaces, and decreased grass and forb composition. West (2000) claims that most of the land area of the sagebrush steppe has experienced threshold-exceeding changes. Once a threshold is crossed, it becomes very difficult and expensive to move a sagebrush steppe community back across the threshold to a late seral stage. Indicators are needed that will help land managers identify these thresholds.

Discussion

An ecological indicator is a characteristic of the environment, both abiotic and biotic, that may provide quantitative information on the status of ecological systems. An indicator may be a single environmental variable or an aggregation of variables expressed as an index. The indicator concept is related to the concept of landscape sensitivity, the capacity of a landscape to resist or absorb impulses of change. Abiotic system stability, as applied to landscapes, is an example of a parameter that can be used to help quantify the ecological condition of wildlands. A recent National Science and Technology Center (NSTC) project identified abiotic indicators of upland landscapes in the Intermountain Semidesert Province, with an initial focus on sagebrush steppe ecosystems.

Success in managing and restoring upland components of landscapes hinges on the ability to read and react to the ecological clues, both biotic and abiotic, that such landscapes reveal. Ecologically responsible land managers seek early warning signals of change on the landscape. They want to identify land-use thresholds or endpoints of ecological condition, they want to know where a watershed or ecosystem lies with respect to those endpoints, and they wish to learn whether the ecological trend is moving towards or away from the endpoints. They need to know when a landscape, such as a headwater basin, is stable or close to a threshold of change or whether it is moving in a downward or upward ecological trend. An example of such an indicator for the sagebrush steppe is hydrologic cover. Hydrologic cover is defined as the sum of live vegetal cover and litter cover (Sturges, 1986). It is very closely related, in an inverse manner, to bare ground (Van Haveren, 2000). It is also inversely related to runoff potential, in that a high hydrologic cover value would indicate low runoff potential. Based on numerous studies on a variety of plant communities around the western United States, we know that hydrologic cover must be at least 70 percent to reduce runoff from rainfall and to protect soils from erosion. It turns out that hydrologic cover is an excellent indicator of upland watershed stability for sagebrush steppe and is very easy to measure. A review of ground cover studies in sagebrush steppe revealed that litter consistently is the dominant cover component (Van Haveren, in press). This suggests that land managers should pay particular attention to the litter balance on sagebrush steppe rangelands.

Steep headwater basins in the sagebrush steppe are often close to a threshold of geomorphic instability. The presence of gullies in these basins is an indication that the threshold was crossed. The threshold of instability appears to be a function of valley slope, drainage area, and valley width (Patton and Schumm, 1975; Elliott, 1989).

My observations of headwater areas in sagebrush steppe suggest there are two principal valley-floor types that illustrate the importance of valley width to geomorphic instability. Type I valleys are V-shaped, as shown in Figure 1

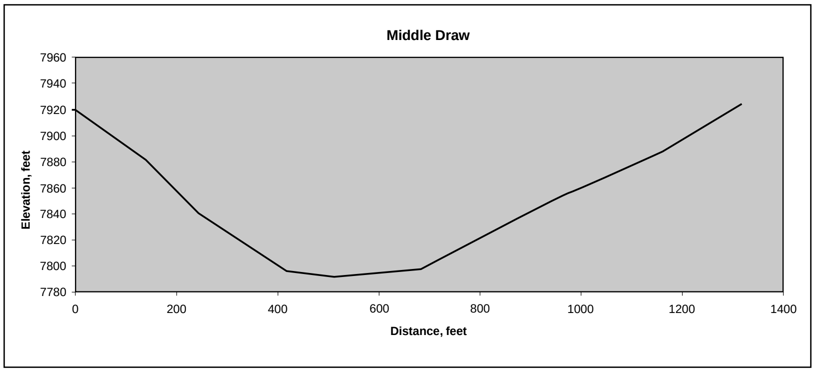

Figure 2. Valley profile for Middle Draw, North Fork of Savery Creek, southcentral Wyoming

for a headwater basin in southcentral Wyoming. Valley floors are very narrow and hydrologically connected to the adjacent hillslopes. Type II valleys, illustrated in Figure 2, are characterized by an inflected-U shape and often have wide, swale-like bottoms. Because of the slope breaks, the valley floors are hydrologically disconnected from the hillslopes. Type I valleys tend to be more unstable than Type II valleys. This classification is similar to that proposed for alluvial valleys by Bisson and Montgomery (1996), who differentiated between confined and unconfined valleys.

Conclusion

Landscape analysis and classification hold considerable promise as tools for land managers concerned with the integrity and health of ecosystems. It may be possible, within a landscape classification system, to identify landform units that are susceptible to ecological change, or close to a threshold of change, and to combine this information with indicators of ecological condition.

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