Case Study

Application of Ecological Site Information to Transformative Changes on Great Basin Sagebrush Rangelands

By C. Jason Williams, Frederick B. Pierson, Kenneth E. Spaeth, Joel R. Brown, Osama Z. Al-Hamdan, Mark A. Weltz, Mark A. Nearing, Jeffrey E. Herrick, Jan Boll, Peter R. Robichaud, David C. Goodrich, Philip Heilman, D. Phillip Guertin, Mariano Hernandez, Haiyan Wei, Viktor O. Polyakov, Gerardo Armendariz, Sayjro K. Nouwakpo, Stuart P. Hardegree, Patrick E. Clark, Eva K. Strand, Jonathan D. Bates, Loretta J. Metz, and Mary H. Nichols

On The Ground

- The utility of ecological site descriptions (ESD) in the management of rangelands hinges on their ability to characterize and predict plant community change, the associated ecological consequences, and ecosystem responsiveness to management.
- We demonstrate how enhancement of ESDs with key ecohydrologic information can aid predictions of ecosystem response and targeting of conservation practices for sagebrush rangelands that are strongly regulated by ecohydrologic or ecogeomorphic feedbacks.
- The primary point of this work is that ESD concepts are flexible and can be creatively augmented for improved assessment and management of rangelands.

Keywords: adaptive management, ecological site, erosion, Rangeland Hydrology and Erosion Model, resilience, runoff.

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Major Land Resource Area 23, the Malheur High Plateau, is representative of the northern Great Basin (Fig. 1), both in terms of the defining biophysical factors and the management challenges. Land managers across the Great Basin Region are challenged with addressing broad-scale existing and looming transformative ecological changes caused by plant community transitions and altered fire regimes. In particular, the sagebrush (***Artemisia*** spp.) ecosystem occupying much (~40%) of the Great Basin (~380,000 km^2) is considered one of the most imperiled ecosystems in the United States due to native woody and introduced annual weeds.[1,2] At mid-elevations (300-400 mm annual precipitation), grazing practices, climate conditions, and associated periods of reduced fire activity have promoted range expansion of pinyon (***Pinus*** spp.) and juniper (***Juniperus*** spp.) conifers. Encroachment of sagebrush rangelands by these species has formed extensive wooded shrublands and woodlands throughout much of the Great Basin. In recent decades, dense woody fuel loading in wooded shrublands has increased the occurrence of high severity fires. Burned woodland sites are also subject to invasion by cheatgrass (***Bromus tectorum*** L.) and a subsequent increase in fire frequency. At lower elevations (<300 mm annual precipitation), extensive cheatgrass invasion has converted sagebrush–bunchgrass communities to annual grasslands with a 10-fold increase in fire frequency. Collectively, these plant community transitions and altered fire regimes reduce biological diversity, wildlife habitat, and livestock forage; amplify runoff and soil loss; limit potential ecosystem goods and services; and increase the likelihood of permanent site degradation.

The utility of ecological site descriptions (ESDs) in the management of these systems hinges on their ability to

Figure 1. Geographic location of the Great Basin (bold black outline) and Major Land Resource Area 23 (MLRA 23, red outline) Malheur High Plateau, which contains the South Slopes 12-16 PZ (R023XY302OR)[11] Ecological Site. MLRA and Great Basin spatial data obtained from SAGEMAP (http://sagemap.wr.usgs.gov). Basemap of United States obtained from National Geographic and ESRI (http://www.arcgis.com/home).

characterize and predict plant community change, the associated ecohydrologic consequences, and ecosystem responsiveness to management. Plant community transitions commonly induce changes in vegetation structure that alter hydrology and erosion processes that, in turn, perpetuate a new stable state.[3,4] Plant community transitions that increase vegetation and ground cover promote infiltration and soil stability and an increase in soil water recharge and nutrients that further enhance vegetation productivity. In contrast, transitions that increase bare ground can facilitate runoff and erosion that further reduce soil water availability, remove critical soil nutrients, and limit vegetation productivity. Encroaching pinyon and juniper on sagebrush rangelands commonly outcompete shrubs and grasses for limited soil water, resulting in decreased understory vegetation and increased bare ground, runoff, and soil loss.[3,5,6] Increased fire frequency following cheatgrass invasion may also perpetuate a degraded, annual-dominated stable state. Burning increases erosion, and frequent occurrences of burned conditions may amplify soil loss over time.[7,8] Plant community dynamics are generally well documented for Great Basin sagebrush rangelands following woodland encroachment, cheatgrass invasion, and various management practices.[9] Likewise, the general hydrologic trends and erosion effects of these disturbances and management actions are documented in the literature.[8,10]