Estimating Effects of Targeted Conservation on Nonfederal Rangelands

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Estimating the effects of conservation practices on rangelands is extremely challenging, compared with cropland, because rangelands consist of a mosaic of plant species with highly diverse landscapes of mixed land ownership and management objectives. The checkerboard pattern of land ownership on rangelands in the West, a legacy of 19th century government homestead and railway construction policies, makes conducting assessments and estimating effects of conservation at landscape or watershed scale a challenging endeavor. This is complicated by the interaction of climate, topography, plants, soil parent material, and land management that interact to yield a mosaic of plant communities over time. Rangeland communities are further influenced by episodic disturbances, such as insect outbreaks, fire, drought, and flood.[1] The most-developed quantitative indicators of conservation effects currently on rangelands are 1) modeled soil erosion, and 2) the number and types of invasive plant species. These indicators can be used to infer impacts on water availability and quality, wildlife habitat quality or suitability for target wildlife species, forage availability for domestic livestock and/or wildlife, and vulnerability to wildfire, which will directly influence sustainability of the plant community.

A partnership comprising the Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS), Bureau of Land Management (BLM), and US Geological Survey has worked since the early 1990s to develop a monitoring and assessment system to track the status and health of rangelands. Through this effort, this partnership has developed new on-site data protocols, called the National Resources Inventory (NRI), for assessing the status of rangelands.[2,3] These protocols, which were initiated by the NRCS in 2003 on nonfederal lands and by the BLM in 2011 on the federal lands it administers, will provide unified monitoring data in the near future for the western United States. Between 2003 and 2006, NRCS sampled more than 10,000 NRI, on-site field segments on native rangelands. The rangeland NRI on-site study follows a national, statistical-sampling strategy, with geographic information system (GIS)–referencing of locations, which makes reporting information simple and powerful for targeting areas that can benefit from conservation.

The ARS and NRCS have recently developed a new process-based model for assessing soil-erosion rates on rangelands, which can provide estimates of soil erosion risks at national, regional, and local scales. The Rangeland Hydrology and Erosion Model (RHEM) was developed from more than 25 geographically distributed, rangeland-erosion experiments across the western United States, representing native grassland, shrubland, and woodland sites.[4] The RHEM was designed to operate using data available from the NRI and many rangeland-monitoring efforts. Model inputs are surface soil texture, slope length, slope steepness, slope shape, dominant plant life form, percentage of canopy cover, and percentage of ground cover by component (rock, litter, basal area, and microbiotic crusts). Climate (precipitation intensity, duration, and frequency) is estimated for the site with the Cligen[i] stochastic weather generator included in the model. The Cligen model is run to provide 300 years of daily precipitation records, and RHEM uses that information to estimate the average annual soil loss during a 300-year time span. The model also estimates the 2-, 10-, 25-, 50-, and 100-year return runoff events to provide an assessment of the vulnerability of the site to accelerated soil loss from raindrop splash and sheet-flow soil-erosion processes.

The NRI data were used to parameterize RHEM to estimate hillslope-scale soil loss for the western United States. Soil erosion reporting regions were defined by using a combination of Common Resource Areas (CRAs), Major Land Resource Areas (MLRAs), and Land Resource Regions to form a unique geographic region. Interpretation of quantitative estimates of soil erosion is based on statistically weighted aggregations of NRI sample points collected into polygons

[i] For more on Cligen, see http://www.ars.usda.gov/Research/docs.htm?docid=18094.