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# Better Maps Mean Better Rangeland Management

Brandon Bestelmeyer
*USDA-ARS*, brandon.bestelmeyer@ars.usda.gov

Ann Perry
*USDA-ARS*, ann.perry@ars.usda.gov

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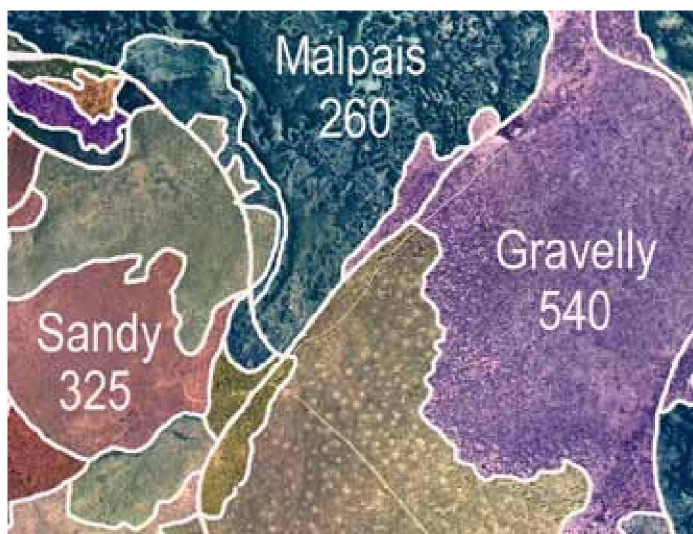


LAURA M. BURKETT (D2934-1)

Land managers are always hoping for the next best thing to help them figure out where they should spend their time and money restoring and maintaining healthy rangelands. Now Agricultural Research Service rangeland ecologist Brandon Bestelmeyer has one of the answers—an ecological-state map that identifies where rangeland is holding its own, where it could respond to restoration efforts, or where it's already past the point of no return.

"We wanted to find a way to turn existing field-level rangeland assessments into broader tools for comprehensively managing larger landscapes," says Bestelmeyer, who works at the ARS Jornada Experimental Range in Las Cruces, New Mexico. Working with U.S. Bureau of Land Management (BLM) rangeland specialist Philip Smith and others, Bestelmeyer began pairing time-tested soil data and vegetation maps with state-and-transition models (STMs) to generate science-based assessments of rangeland conditions across landscapes.

STMs describe the types of plant communities that can occur on a specific soil type and the shifts that occur among plant communities. Sometimes, beneficial plant communities have persisted through past events. Other times these plant communities have been so altered by invasive plants, soil degradation, or other processes that they require management interventions—reseeding, herbicide treatments, changes to grazing, or other approaches—to be restored, if they can be restored at all.

### A Worksite in the West

The team used around 6 million acres in southwestern New Mexico for the study. This area features large expanses of public and private land with desert grassland, savanna, and shrubland. Native shrubs have been encroaching on areas previously covered by perennial grasses, and erosion has degraded soils throughout much of the region.

The researchers started developing three ecological-state categories for plant communities by defining how woody-cover density varies among different soils. They determined this by identifying the vegetation they believed had historically dominated a particular soil. The categories were "little woody cover," "significant woody plant cover within a grassland matrix," and "dominated by woody plants."

Then the team developed ecological-state descriptors for different soils. They assessed factors such as USDA's Natural Resources Conservation Service (NRCS) soil data, STM soil characteristics, plant functional groups, responses to disturbance, and soil erosion patterns. Through this process, the scientists

Top map: Original soil survey map from the Soil Survey Geographic Database.

Middle map: Ecological-state map units delineated on the soil survey base map above.

Bottom map: Final ecological-state map designations with an example of coding. The three-number code within an ecological-state area means that there is more than one ecological state within that area. Each number represents one ecological state, and the numbers are listed in order of the extent of the ecological state within that area. For instance, "Gravelly 540" means that the area is characterized by a gravelly ecological state, 5 means that much of the site is covered with expanded shrublands/woodlands, 4 means that some of the site is shrub-dominated, and 0 indicates that this site does not have a third ecological state category.

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>
> **—Brandon Bestelmeyer**

identified eight distinct ecological-state categories that could be used to evaluate the overall condition of a specific site and decide whether restoration efforts could be successful.

Before the team mapped these ecological states, they paired soil-map boundaries with other site data and overlaid this information on fine-resolution photographic imagery. Geographic Information System analysts who were familiar with STMs and the regional terrain used this information to map ecological-state areas throughout southwestern New Mexico. Mapping at a range of sizes resulted in ecological-state areas that ranged from a few acres to 10,000 acres.

### A Good Map Makes All the Difference

The result? "Pretty good—on a scale of 1 to 10, we're at a 7," says Bestelmeyer. "For instance, we already knew that shrub encroachment on grasslands was a significant management problem, but now we also know where it's a fixable problem, based on how soils affect ecological potential and restoration likelihoods. We can see that grass recovery after shrub removal is happening at different rates on different soils, and we can use soil and ecological state maps to represent those differences. And these differences can be important when rangeland managers are trying to decide whether to remove shrubs as part of grassland restoration, whether the shrubs are elements of the historical plant community, or whether they are now the only plants that can exist in a site."

In its current form, says Bestelmeyer, the map is a good tool that can be used to guide range-management fieldwork—and information gathered during fieldwork can then be used to update map information. "The map can become more accurate the more it's used. We're also hoping to develop applications for mobile devices that will allow us to automatically upload field observations to verify or correct the map."

So far, the map has been used by resource managers working in BLM's "Restore New Mexico" grasslands program to target herbicide applications on shrubs in areas where the remaining grass cover is sufficient to support restoration efforts once the shrubs are gone.

BLM managers have also used the map to locate large areas of severely degraded rangeland that would probably not respond to plant restoration efforts but could be suitable for solar energy installations—part of a federal effort to encourage the development of the solar grid.

The team published their results in 2012 in *Rangeland Ecology and Management*.

"Rangeland managers like what we've done," says Bestelmeyer, particularly ranchers associated with the Malpai Borderlands Group in the "boot heel" of southwest New Mexico and southeast Arizona. "In fact, it's a challenge to keep up with the demand. In the future, we'd like to include a greater range of information in the maps, like variations in ecological states relevant to management needs. For instance, we think the map could be developed to identify NRCS land-management practices, like where to focus carbon sequestration efforts or to sustain wildlife habitat."—By **Ann Perry,** ARS.

*This research is part of Pasture, Forage, and Rangeland Systems, an ARS national program (#215) described at www.nps.ars.usda.gov.*

*Brandon Bestelmeyer is with the USDA-ARS Jornada Experimental Range, 2995 Knox St., Las Cruces, NM 88005; (575) 646-4842, brandon.bestelmeyer@ars.usda.gov.* *