

Keeping Rangelands Healthy and Productive



Research looks at grass seeding rates and nutrient impacts on rangeland health.

by **Dennis O'Brien**, Agricultural Research Service

They are grazed by livestock, serve as habitat and food for wildlife and pollinators, and filter runoff to help keep waterways clean.

Rangelands are critical resources, but in the United States and elsewhere they are being degraded by invasive weeds, wildfires, droughts, mining and other disturbances. Climate change is expected to increase the frequency and severity of droughts and wildfires, which may degrade rangelands even more and open the door to invasive plants.

“Rangelands provide key ecological services, but they are being threatened like never before,” says Philip Fay, an Agricultural Research Service (ARS) ecologist in Temple, Texas. Fay led one of two ARS studies focused on understanding the impacts of such threats to rangeland

health and finding optimal ways to restore degraded rangelands.

Conducting realistic, large-scale studies focused on restoring degraded rangelands can be prohibitively expensive. Matthew Rinella, an ARS rangeland management specialist in Miles City, Mont., reviewed restoration reports filed by mining companies on 169 former coal-mining fields that were subjected to various restoration efforts between 1992 and 2009. Rinella’s team also quantified shrubs on the fields. The approach allowed the team to identify effective shrub-restoration strategies while avoiding the expense of conducting large-scale studies.

Effects of seeding rates

Shrubs are important because they provide critical habitat for mule deer,

pronghorn, elk and the threatened greater sage-grouse.

“Additionally, in some ecosystems, shrubs are a critical source of livestock forage, so learning to restore shrubs is important for global food security,” Rinella says.

The results, published in *Ecological Applications* (June 2015), showed that grass-seeding rates were a critical factor. When grasses were sown at high rates, shrubs were rapidly choked out before they could become established. Conversely, sowing grasses at low rates allowed shrubs to persist and reach deep into soil layers, where they could access water and nutrients inaccessible to more shallow-rooted grasses.

The results also showed that grasses developed well in the long run whether their seeds, which can be expensive, were sown at high or low rates. The results should be useful



PHOTO COURTESY MATT RINELLA

► **Left:** ARS rangeland ecologist Matt Rinella assesses shrubs on coal-mining lands as part of a research project on restoring shrubs to degraded rangelands.

► **Below:** Healthy productive rangelands are critical to sage-grouse survival.



PHOTO BY STEPHEN AUSMUS

to mining companies, oil and gas companies, and government agencies working to improve degraded rangelands.

Nutrient impact

In his study, Fay developed a unique global snapshot of rangeland dynamics by examining the effects of nitrogen and other nutrients on rangeland productivity at sites around the world. He and his colleagues applied nitrogen, phosphorus and potassium mixed with micronutrients to 42 sites in eight countries on five continents. Each site received the same proportions of the nutrients at the start of each growing season. The researchers harvested the grass each year, calculated the amount of biomass produced, and after five years analyzed the effects of the nutrients on the productivity of native and cultivated grasses and forbs.

The sites were part of an established “Nutrient Network” of rangelands studied by international teams of scientists. They were located across a broad range of elevations, temperatures, precipitation patterns, soils and growing seasons.

“Giving the same treatments to such diverse sites allows us to see implications that are global in scale, which means the results are that much more robust and significant,” Fay says.

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65%. Why nutrients were not limiting factors at 11 sites may be the focus of future studies, Fay says. They also were surprised to find that phosphorus and potassium were major

factors in rangeland productivity on all five continents.

“We didn’t expect to see such widespread effects from nutrient combinations that included phosphorus or potassium, because these two nutrients have been less well-studied than nitrogen,” Fay says.

Previous studies have demonstrated the effects of applying nitrogen fertilizers on rangelands, but the results of Fay’s study were among the first to show the importance of phosphorus and potassium in rangeland health at such widely diverse sites. The results, published in *Nature Plants* (July 2015), should lead to a better understanding of the factors that influence rangeland health and the potential impacts of future land use changes.



Editor’s Notes: Dennis O’Brien is a writer on the ARS information staff. “Keeping Rangelands Healthy and Productive” was published in the December 2015 issue of *AgResearch Magazine*.