Is your brush-control dollar better spent on some soils than others?

Kay Ledbetter for *Progressive Cattleman*

Mapping the resilience of woody plant encroachment to brush-control techniques can help landowners prioritize management and restoration actions to maximize the effectiveness of costly brush reduction, according to a Texas A&M AgriLife Research study.

Determining the relative resilience of a shrubland across a gradient of soil textures can help achieve the best use of funds for increasing the effectiveness and duration of brush removal, says Bill Rogers, a Texas A&M AgriLife Research professor in College Station.

"Shrubland resilience varies across soil types: implications for operationalizing resilience in ecological restoration," is the title of the study published in the journal *Ecological Applications*.

The paper is authored by Carissa Wonkka and Dirac Twidwell, both former graduate students of Rogers now at the University of Nebraska – Lincoln, and Jason West and Rogers, both in the Texas A&M University Department of Ecosystem Science and Management.

"We believe this has the potential for being a game-changing contribution that will make the important, yet often intractable, concepts of ecological resilience and threshold transitions 'operational' for landowners and natural resource managers seeking to maximize restoration efforts while minimizing costs associated with ineffective and expensive approaches to reducing woody plant encroachment in rangeland ecosystems," Rogers says. "We believe it is a novel approach to making these scientific ideas, which heretofore have largely been abstract and theoretical in nature, relevant to real-world problems."

Rogers says scientists and land managers have been trying to use scientific principles for brush control, "but it's all been kind of arm-wavy with terms such as thresholds, transitions and alternative steady states being discussed but with limited success applying them to real-world problems."

The difficult reality is: Land managers need to be able to identify when a threshold – the transition between two different vegetative states – is about to be crossed and also figure out how to intervene using various management efforts to return the ecosystem to the more desired state, he says.

For instance, Rogers says, if grassland existed in a steady state for many years until junipers began encroaching from canyon breaks nearby, eventually crossing the threshold where the acreage is transitioned to shrubland, this alternative state becomes exceptionally difficult to restore to the former, more desirable grassland and can affect the value and use of that property.

"We haven't quantified these thresholds yet to be able to say what is required to effectively restore encroached rangelands," Rogers says. "We want to take these ideas and find a way to make them more useful and prescriptive, but it's really hard to do."

The study approached the situation from a more operational standpoint and looked at using traditional brush management techniques but assessing their effectiveness across different soil types.

Wonkka said they designed an experimental manipulation to assess the contribution of soils to differences in the relative resilience of a shrub-invaded state.

"In this large-scale experiment, we repeated perturbations across a gradient of soil textures to inform restoration practitioners of differences in the relative resilience of shrubland occurring on different soil types to common rangeland restoration practices," she says.

"On each soil type, we compared

> “The results showed brush removal is more effective at restoring grasslands in shrub communities on fine-textured clay soils than on coarse-textured sandy soils, which are more resistant to brush removal techniques.”

the relative ability of the shrubland state to withstand chemical and mechanical brush-control treatments, commonly employed in this study region, to untreated controls. While the shrubland community composition did not differ prior to the study, its capacity to absorb and recover from brush removal treatments depended on soil type.

“By looking at the trajectory of the plant community following brush management techniques across different soil types, we were able to identify the resilience of shrub communities on certain soils to those management efforts,” Wonkka says.

Knowing the resilience of shrub communities on different soils will allow land managers to determine where to invest the time and money on brush management in order to get the most out of their expenditure, Rogers says.

The study was funded by the Wintergarden Groundwater District, with West as the principal investigator. West was studying how different brush management strategies influenced groundwater recharge of the Carrizo-Wilcox Aquifer.

“We were able to set up on a private ranch and look at how different treatments affected not only groundwater recharge but also at the plant community dynamics and how they responded to the various management practices,” Rogers says.

To test for differences in resilience to treatments across soils, they selected three soil types common in the study area that represented a range of soil textures from fine clays to coarse sands: Antosa-Bobillo sand, Webb fine sandy-loam soils and Chacon clay-loam soils. Three pastures were identified that included each of the three soil types.

Brush-control methods were randomly assigned to plots within each pasture or soil combination and completed in early spring 2011. This resulted in a randomized complete block design with three brush removal treatments: control, cut-herbicide and mechanical (replicated twice in each pasture-soil combination). In control treatments, no brush removal occurred.

The results showed brush removal is more effective at restoring grasslands in shrub communities on fine-textured clay soils than on coarse-textured sandy soils, which are more resistant to brush removal techniques.

“Shrubland resilience to chemical and mechanical brush removal was highest on coarse soils,” Wonkka says. “On these soils, brush removal temporarily restored grassland dominance, but woody plants quickly regained pretreatment levels of dominance.

“However, shrublands on fine soils did not recover following treatments, continuing to be grass-dominated for the duration of the study.”

Wonkka said this study highlights a simple approach for prioritizing restoration actions by mapping the locations of different soil attributes that support shrub-dominated areas with differing levels of resilience to brush control.

“We believe this study will provide scientific insights that will translate into management improvements that will help rangeland restoration and eventually food production,” Rogers says.

The full research study can be found at onlinelibrary.wiley.com/doi/10.1890/15-0066/full

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