Study compares recent drought to 1950s on woody plant dieback

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COLLEGE STATION – Scientists with Texas A&M University and Texas A&M AgriLife Research had a unique opportunity to compare recent patterns of drought-induced woody plant mortality on the Edwards Plateau in Texas to the extended drought of the 1950s.

Dr. Bill Rogers, an associate professor in the Texas A&M ecosystem science and management department, said it is important to understand how climatic extremes such as drought cause shifts in vegetation.

These shifts can alter semi-arid ecosystems, potentially affecting the abundance of forage and browse available for livestock and wildlife, as well as land/atmosphere feedbacks, carbon and water cycles, and disturbance dynamics, Rogers said.

A recently completed study led by two doctoral students from Rogers' research lab, Dirac Twidwell and Carissa Wonkka, examining the effects of severe drought on woody plants in Texas will be featured in the international journal, Applied Vegetation Science.

"This is one of the first assessments of the effects our recent drought has had on native vegetation," Rogers said. "It is also particularly novel because we are able to compare our findings to a study that was conducted at the same research site during the drought of the 1950s."

The research site was the Texas A&M AgriLife Research Station in Sonora, managed by Dr. Charles "Butch" Taylor. Following the drought from 1951-1957, a study was conducted at the site to quantify rates of dieback for various woody plant species.

In 2011, during the most severe drought on record since the 1950s, the study was repeated in the same long-term grazing treatments established in 1948. The primary species they looked at were southern live oak, scrub oak or sandpaper oak, persimmon, and Ashe juniper or blueberry juniper.

Twidwell said the study, in addition to comparing the patterns of drought-induced woody plant dieback to that from the extended drought of the 1950s, was designed to determine if composition of the woody plant community shifts consistently across the landscape following dieback, or if shifts depend on differences among species, soils, land use and plant demography.

The study showed the recent severe droughts across Texas resulted in high levels of woody plant dieback in areas that have for decades experienced woody encroachment, he said. Periodic drought events since 2000 killed nearly 25 percent of woody plants and decreased woody plant cover 18 percent.

However, measurements taken after the 1950s drought ended showed woody plant cover had decreased

44 percent compared to pre-drought estimates taken in 1949, Twidwell said.

"Based on weather records from the research site dating back to 1919, the drought of the 1950s was more prolonged and severe than any other period from 1919-2011," he said. "While recent droughts have been severe, historical records at this site show the seven-year drought of the 1950s was worse and lasted considerably longer.

"Woody plant die-off was almost three times worse in the 1950s than in our 2011 study. This gives us an indication of how vegetation may continue to change on the Edwards Plateau if the current drought continues for a number of years."

Neither drought, however, resulted in widespread shifts from one woody plant community to another, Wonkka said.

"Even with reductions in cover of 44 percent and 18 percent following the droughts of the 1950s and 2000s, respectively, woody plant communities did not transition to a grassland or savanna or an alternate woody-dominated plant community," she said. "Rather, the system remained as an oak savanna following the 1950s and a juniper woodland interspersed with clusters of oak in 2011."

A unique finding in this study is that long-term livestock management practices have the potential to influence the direction of vegetative change following drought, Twidwell said.

High mortality rates of mature juniper trees in deep soils, combined with the recruitment of oak species where cattle, goats and deer had been excluded on the research site for the last 60 years, caused shifts in vegetation from a juniper woodland to a live oak-dominated overstory with a diverse understory, he said.

Because many areas on the Edwards Plateau have been heavily browsed by goats and deer for decades, the study suggests that drought-induced shifts on deep soils away from juniper woodland and toward a plant community more similar to the oak savanna occurring prior to juniper encroachment is unlikely to be realized unless the drought becomes worse.

"Juniper will likely continue to dominate the woody plant community on both shallow and deep soil areas on much of the Edwards Plateau following the most recent drought, albeit at lower densities," Twidwell said.

He said the widespread changes in land management on the Edwards Plateau from mostly livestock production to wildlife and hunting enterprises may sufficiently decrease browsing pressure in some areas to cause the shift from juniper woodland to a diverse shrub understory.

"To improve our understanding of climate-induced vegetation change, modeling projections need to be down-scaled to a finer spatial resolution that is relevant to land managers," Twidwell said. "Many regional planners rely on predictive climate-vegetation models to understand potential shifts in vegetation that may result from short- and long-term changes in climate."

In this study, specialized responses to drought were observed as a result of complex localized interactions, such as ecohydrological differences among soil types, plant water-use strategies, density-dependent relationships among plants, and legacy effects of livestock management, he said.

"Studies such as this play an important role in improving these models and projecting how drought will impact the types of vegetation important to land managers," Twidwell said.