REBOUNDING FROM EXTREME DROUGHT

A first-of-its-kind global drought study evaluates effects of intense dry periods.

By Diane Meyer

April showers bring May flowers...and grasses, shrubs and forbs. The landscape transforms as greenery takes hold. Armed with rainfall, a select few species exert dominance, while others recede. When precipitation fades, competition escalates over limited resources.

For generations, stewards have relied on grazing animals to help maintain plant diversity and productivity. In times of moisture, which can be rare across the Southwest, it remains critical to monitor the rangeland health. What is growing now could offer an advantage when the next dry spell comes around.

With extremes in weather patterns expected to escalate, a multinational team of researchers embarked on a groundbreaking endeavor to unravel the impacts of limited rainfall and severe droughts.

An ecology team from Texas A&M University contributed to this global study. Their findings reveal a narrative of setbacks and resilience, offering valuable insights as a looming La Niña foreshadows a transition to dry weather patterns later this year.

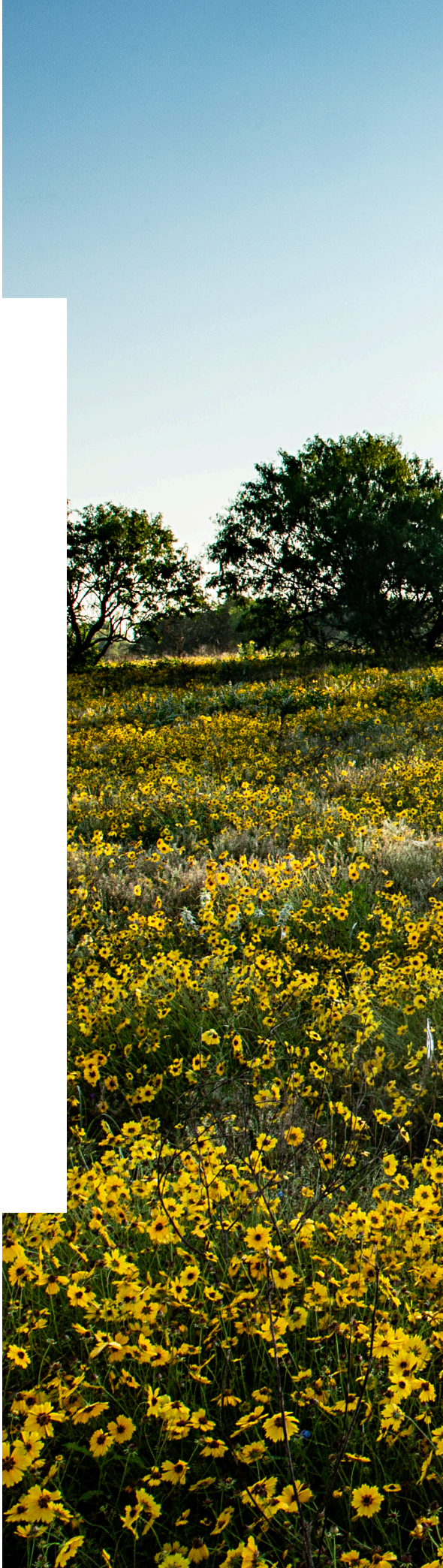


Photo by Wyman Meinzer

UNDERESTIMATED EFFECTS

On the western edge of the Edwards Plateau, nearly 30 miles south of Sonora, Texas A&M professor William Rogers, Ph.D., has led multiple ecology studies at the Sonora Station, part of Texas A&M's AgriLife San Angelo Research and Extension Center.

In 2017, this site became one of 100 participating locations spanning six continents, dubbed the International Drought Coordinated Network.

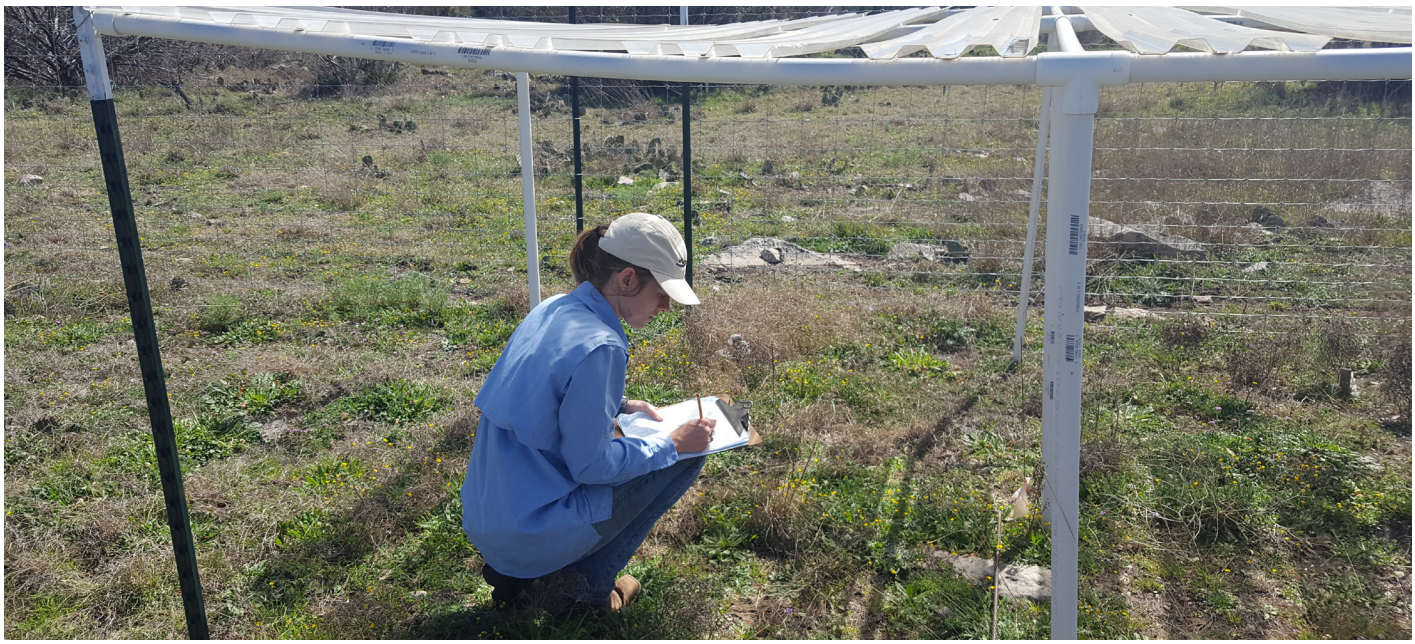
Initiated by Colorado State University professors Melinda Smith and Alan Knapp, the study aimed to standardize experimental protocol across diverse environments to make inferences on widespread effects of extreme drought conditions.

"Too often when we're trying to assess the role of drought in these grass and shrubland ecosystems, we're not comparing apples to apples with our studies," Rogers says. "Historically, it was very difficult to look for broad generalities."

Participating research teams were solicited to implement the same experimental design — all 100 sites had identical plot dimensions, data collection procedures and shelters that excluded rainfall to the same degree.

Careful consideration was given to simulating drought conditions across all plots so that each ecosystem was similarly stressed. A percentile-based drought approach was adopted to gauge the maximum stress these ecosystems could endure. Researchers sought to simulate a 1-in-100-year drought event tailored to each site's climatic history, and then assessed how vegetation responded.

The first wave of the study evaluated productivity — or biomass — of herbaceous species, and results published in the Proceedings of the National Academy



As the first graduate student facilitating the global drought research at Sonora Station, Heather Hannusch, pictured, was responsible for setting up each plot according to the study's established protocols. Now with Texas Parks and Wildlife as a habitat conservation specialist, she uses similar research methods in her restoration projects. Courtesy photo.

60%

GLOBAL AVERAGE DECLINE IN HERBACEOUS SPECIE BIOMASS DUE TO DROUGHT EVENTS

To better understand the implications of extreme drought events, a global team of researchers formed the International Drought Coordinated Network. Using identical experimental procedures across 100 sites and spanning six continents, researchers found previous research greatly underestimates grassland and shrubland responses to drought. Courtesy photos.

of Sciences show surprisingly consistent consequences across the board.

"After a full growing season of control plots that received ambient rainfall and experimental plots that had reduced rainfall, results show that we've been vastly underestimating the negative impact of these kinds of drought events on grassland productivity," Rogers shares.

WHY SO SERIOUS?

Globally, a substantial 60% average decline in biomass productivity was measured, but the Texas A&M team discovered more to the story.

With an arid climate, rangeland at the Sonora Station is characterized by dry, rocky soils and is home to cool and warm-season grasses, as well as annual and perennial forbs. When drought was applied, the heterogeneity of those plant communities significantly decreased, but demonstrated an encouraging amount of resilience .

Then-graduate student Heather Hannusch, now a natural resources coordinator with Texas Parks and Wildlife, was surprised to discover that certain species bounced back considerably better than others, a phenomenon called asynchronous response and compensation.

"We found that the amount of biomass from live grass had been decreased by drought, but live forb biomass was increased by drought," she says. "As the cover and the resource competition by these grasses declined, the forbs were able to take advantage of that and respond more quickly to resource availability and actually increase their biomass."

The different responses to changing precipitation patterns point to the importance of species diversity, Hannusch notes. Similar to a diverse investment portfolio in a financial retirement account, strong biodiversity enhances the likelihood that an ecosystem will thrive during changing environmental conditions — often called the portfolio effect.

"There's a greater risk of losing a monoculture during a drought," she says. "Not having some sort of diversity there is going to leave the soil open to erosion, and exotic and woody plant invasion, too."

PROACTIVE PROTECTION

Safeguarding species diversity and rangeland productivity is complex.

"For decades, land managers have struggled with woody encroachment, historically thought to have been driven by fire suppression and overgrazing," Rogers says. "That led to the loss of grasses and an increase in woody plants like juniper, mesquite and prickly pear cactus." These challenges and transformations are threats to rangeland ecosystems globally, particularly in arid regions.

These invasive woody plants drive problems like allergic asthma and increase wildfire risk. Unexpected wildfire can be devastating, as seen recently in the Texas Panhandle fires. In this scenario, fire led to substantially more harm than good.

Even so, as an ecologist, Rogers researches fire ecology and how prescribed fire can be effectively used to reduce woody encroachment and increase grass productivity. "In addition to the positive effects on plant communities

The Texas portion of the global drought study was led by a team from the Texas A&M Department of Ecology and Conservation Biology. Research was conducted at Sonora Station in western Texas Hill Country. The area is home to cool and warm-season grasses, and annual and perennial forbs. Courtesy photos.

and ecosystem processes, the use of prescribed fire to mitigate against future wildfire events is a well-established management activity," he says.

In addition to the plots that were part of the International Drought Coordinated Network, his team set up experimental plots to see how herbaceous communities responded to prescribed fire and nitrogen deposition in the face of drought. Hannusch, who led set-up efforts, says the application of prescribed fire benefited live forbs production long-term.

These findings are on par with another recently published study, where Rogers reports rangeland restoration was achieved after setting hot fires that reduced woody density without negatively impacting herbaceous grasses or soils. Many historical grasslands and savannas, he observes, are being transformed to woody dominated landscapes because of anthropogenic interventions of these critical processes.

"Prescribed — or controlled — fire can not only rejuvenate and enhance the productivity of the grasses that livestock and many wildlife prefer, it can reduce woody encroachment and fuel buildup that may eventually drive an unintended catastrophic wildfire," he says.

Hannusch and her colleagues at Texas Parks and Wildlife proactively conduct prescribed burns to protect the state's parks, natural areas and surrounding communities. She adds that for cattle raisers, patch burn grazing is an opportunity to rotate cattle due to their instinct to graze recently burned areas where plant tissue tends to be higher in nutrients.

Likewise, Rogers cites peers who are researching the inherent link between fire and large animal grazing.

Grazers generally seek recently burned areas because vegetation grows back more nutritiously and with fewer digestive inhibitors or other chemical deterrents. When another area burns, animals move on, allowing the grazed area to recover.

"It creates a dynamic shifting equilibrium on the landscape through that cycle of fire and grazing," Rogers says.

Lately, livestock are in competition with other species over natural resources.

Non-native axis deer, originally imported from India for private hunting operations, have become naturalized over time after escaping fenced hunting lands. These axis deer prefer to graze grass, whereas white-tailed deer are mostly browsers and eat woody plants and forbs.

This is problematic, Rogers shares, because axis deer are competing directly with livestock for fine fuels and herbaceous forage.

"It's altering the ability of landowners and managers to utilize fire to manage their landscapes, because of this nonnative ungulate that's become increasingly abundant on the landscape," he says. "And that's going to feedback to some of these drought phenomena and woody encroachment concerns that degrade rangeland ecosystems and threaten the livelihoods of landowners."

If these intense weather patterns manifest as predicted, researchers like Rogers and Hannusch are eager to contribute to efforts to protect ecosystems and the ranching way of life.

"Let's find ways to be ready to act accordingly in a more proactive, as opposed to reactive, manner," Rogers encourages. "Developing a culture of preparedness that will allow us to adapt to and mitigate against the challenges ahead is one of the greatest contributions those of us committed to the understanding and management of natural resources can provide."

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Photo by Cami Froneberger