



Fire and Follow-Through

Managing Land for the Long Term



Prescribed burn at Texas A&M's Ecology and Natural Resource Teaching Area. Sam Craft for AgriLife, 2023.

New research on prescribed fire shows that the full benefits take time—but they're worth waiting for.

Prescribed fire has been used for thousands of years to manage landscapes, improve habitat, and support healthy ecosystems. In the US, Indigenous communities used fire to encourage plant diversity and improve hunting grounds, especially in prairie regions like the Great Plains.

The historic understanding that fire plays a vital role in renewing the land continues to guide modern rangeland management practices. Today, prescribed burning is a key tool for controlling invasive species, boosting forage production, and reducing the risk of severe wildfires, particularly in areas where fire has been excluded for decades.

Prescribed fire helps native grasses by removing dead plant material, returning nutrients to the soil, and reducing competition from invasive plants. Many native species are adapted to fire and respond with stronger growth, making pastures more productive and resilient over time. Healthier pastures mean better forage for livestock and more reliable grazing across seasons.

A 15-year study by the United States Department of Agriculture (USDA) researchers in Montana explored how the timing and frequency of prescribed burns affect native grasses in mixed-grass prairie. The study found that burning every three years in the fall produced the greatest increase in growth—especially for needle-and-thread grass (*Hesperostipa comata*), an important native species for both forage and ecological health. These benefits didn't appear right away. They took years of repeated burning to become clear, showing that real results take time and consistency.

This research provides practical guidance for landowners, state agencies, and prescribed burn associations (PBAs) across the Great Plains. It shows that how and when you burn matters—and that long-term planning leads to stronger, more productive rangelands. With the right fire strategy in place, landowners can improve native plant growth, control invasive species, and protect their land from wildfire, all while supporting long-term agricultural success.

KEY POINTS

- **People have used fire for centuries** to manage grasslands and improve the land.
- Many parts of the Great Plains historically burned regularly—**fire is part of the natural cycle**.
- Prescribed fire can **improve forage, control brush and weeds, and support native grasses**.
- Regular burns (every 3 years in the fall) **protect your grazing land from wildfire damage** and preserve your investment.
- **Fire helps grasses regrow from their base**, making pastures stronger over time.
- **When you burn matters.** Season and timing affect what grows back.
- Benefits like improved grass growth **take time** to appear.
- **You don't have to do it alone.** Resources and support are available to help you burn safely.



For help planning your own burn, visit AgriLife Extension's prescribed fire digital resource hub at agrilife.org/rxburn/ or contact your county Extension Agent.



Prescribed burn at Texas A&M's Ecology and Natural Resource Teaching Area. Laura McKenzie for AgriLife, 2021.

WHY DO WE BURN?

Prescribed fire is a land management tool that has been used around the world for thousands of years to shape plant growth and maintain healthy landscapes. In the tallgrass prairie region of the United States, including present-day Montana, there is evidence that Indigenous communities used fire intentionally as early as 900 to 1750 CE (Roos et al., 2018). They burned grasslands to improve bison hunting and manage the land. These burns also had the added benefit of creating more diverse plant communities that were better able to recover from wildfire.

Research by Roos, Zedeño, Hollenback, and Erlick helps us understand how fire was used in the past and how those practices affected the land over time. Their work gives ecologists valuable insight into the long-term impacts of repeated fire on grassland ecosystems. Even before people began using fire purposefully, naturally occurring wildfires helped maintain healthy rangelands across North America. In 2012, a study by Guyette and others produced a nationwide map showing where and how often fires likely occurred in the past, based on climate data and fire history (Guyette et al., 2012).

Today, prescribed burning is still used for many of the same reasons. It helps control invasive species, improve plant diversity, increase forage production, and return nutrients to the soil. Fire can also help grasslands use water more efficiently and reduce the spread of woody plants like mesquite and juniper. However, the timing of a burn, how often it is used, and the specific conditions of the land all play a major role in how effective it will be (Sedivec, 2013). Alongside these ecological benefits, prescribed fire is now recognized as a way to reduce the risk of large and damaging wildfires. These wildfires have caused increasing losses of life and property across the United States in recent years (U.S. Forest Service, 2023). As a result, more landowners and agencies are using prescribed fire as a tool to protect both the land and the people who depend on it.

Curious about how different range plants interact with fire?

Check out [agrilife.org/howgrassesgrow/](https://www.agrilife.org/howgrassesgrow/) or talk to your county Extension Agent.

The How Grasses Grow website will help you better understand how grasses grow—and why not all rangeland grasses respond the same. Native perennial species vary in how they handle grazing, fire, and drought, and this site highlights those differences. It serves as a species-specific database for some of the most common and important grasses found across Texas rangelands.

Real-World Benefits of Prescribed Fire



Livestock Production

- Increases high-quality forage for cattle and other grazers
- Promotes native grasses with better nutritional value
- Controls woody brush that reduces pasture access
- Helps maintain open rangeland for easier herd movement



Wildlife Habitat

- Stimulates new growth that feeds deer, quail, and turkeys
- Increases plant diversity—more cover, more food
- Maintains open areas needed by ground-nesting birds
- Keeps out invasive species that reduce habitat quality



Safety

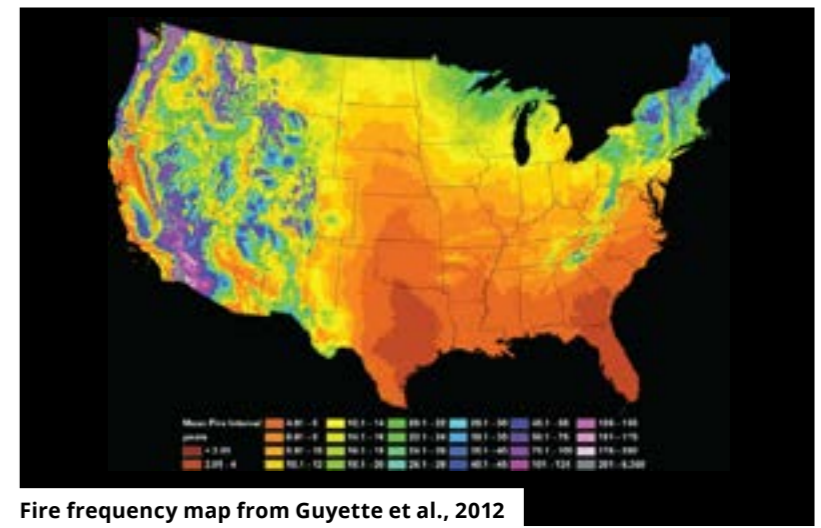
- Reduces fuel buildup that can feed dangerous wildfires
- Creates firebreaks and buffers near homes, fences, and infrastructure
- Makes wildfire easier to control when it does occur
- Protects livestock, wildlife, working lands, and homes from large-scale fire damage

WHO IS THIS FOR?

This study is rooted in the Great Plains, a fire-adapted region that stretches from the Canadian border to the Gulf of Mexico. While the primary research site for this study is a mixed-grass prairie in northern Montana, the challenges seen there—woody plant encroachment, disrupted fire cycles, and invasive species—are shared across grasslands throughout the Plains. These issues don't stop at state lines. From tallgrass to shortgrass, prairie systems across the region face similar pressures and share a common fire history.

By viewing the Great Plains as a connected landscape, we can apply insights from the Montana site to larger patterns of land degradation, forage loss, and declining plant diversity. The 15-year fire study by Vermeire et al. (2024) offers valuable long-term data on how fire timing and frequency shape plant communities—information that's directly relevant to landowners and managers across the entire region.

Our goal is for this science to reach landowners, ranchers, and natural resource professionals across the Plains, as well as for organizations like Prescribed Burn Associations, state wildlife agencies, and cooperative groups such as the Texas & Southwestern Cattle Raisers Association. At the center of these outreach efforts is the Great Plains Fire Science Exchange (GPFSE), a regional network that connects researchers, landowners, and educators to promote safe, effective fire use. GPFSE plays a key role in making fire science usable—offering workshops, trainings, and technical support that turn research into action. Their partnerships with land-grant universities and stakeholder groups help strengthen both the ecology and the economy of working rangelands.



Fire frequency map from Guyette et al., 2012

This map, created by Guyette et al., 2012, models historical fire frequency across the continental U.S. using climate data (precipitation, temperature, lightning strikes) and known fire history. The colors represent mean fire return intervals (MFIs)—how often, on average, fire occurred in a given location before widespread fire suppression.

What does that map mean for the Great Plains?

- Most of the Great Plains fall within the 4–12 year burn interval range. That means, historically, fire returned every 4 to 12 years in these grasslands—naturally or through Indigenous burning practices.
- Shorter intervals (red/orange zones) appear in wetter tallgrass areas or where Native fire use was especially frequent. These areas required more frequent burning to maintain open grassland and control brush.
- Longer intervals (purple/blue zones) are common in drier shortgrass regions (like parts of the Panhandle or western Kansas), where fire occurred less often but still regularly enough to shape plant communities.
- The Montana study site falls in an area of moderate to frequent fire return, reinforcing that prescribed fire is not only appropriate for that site—it's historically grounded.

Knowing your land's historical fire frequency helps you set realistic burn goals, make informed decisions about timing, and justify fire as a sound, evidence-backed practice.

I'm not in the Great Plains — is this research still relevant to me?

Yes! Even though this research was conducted in the northern Great Plains, its findings are highly relevant for Texas landowners managing rangelands from the Panhandle to the Hill Country and beyond. Many of the dominant grasses in Texas, such as blue grama, buffalograss, and little bluestem, are also found throughout the Great Plains and respond positively to regular fire intervals, with three-year cycles often supporting vigorous regrowth and improved forage. However, Texas rangelands also feature unique species and challenges, including more frequent woody plant encroachment from mesquite and juniper, and the presence of species like Texas wintergrass, which may require different fire timing or frequency to thrive (Ansley & Castellano, 2007).

The principles of consistent, well-timed prescribed fire remain the same: burns help control brush, maintain open grasslands, and promote healthy bunchgrasses, but results will vary depending on local rainfall, soils, and plant communities. Texas landowners can use these research-backed strategies as a foundation, adjusting fire frequency and timing to fit their specific ecological sites and management goals, while also taking advantage of resources like Prescribed Burn Associations and AgriLife Extension for local expertise and support.

HOW DOES FIRE TIMING AFFECT NATIVE GRASS GROWTH?

In a study entitled *Do Plants Respond to Multi-Year Disturbance Rhythms and Are We Missing the Beat?*, Vermeire et al. (2024) found that the right fire, at the right time, and with the right frequency can unlock the full potential of native grasses—leading to healthier pastures, better forage, and more resilient rangelands.

This study addressed a notable gap in long-term research investigating the impact of fire timing and frequency on plant communities, particularly within semi-arid grasslands. Previous work largely focused on the short-term or singular effects of fire events, potentially overlooking the full ecological “picture” of how plants respond to recurring disturbances.

The researchers wanted to understand how various combinations of fire seasonality (summer, fall, spring) and return intervals (2, 3, or 6 years) influenced the productivity of needle-and-thread grass (*H. comata*), a native, dominant C3 bunchgrass in a northern mixed prairie suspected to be sensitive to fire. This team implemented a 15-year experimental design incorporating nine distinct burn treatments (3 seasonalities crossed with 3 intervals), alongside unburned control plots for comparison. Fires were administered using standardized protocols and were timed in relation to plant phenology and seasonal conditions.

It's really important to understand how fire affects grassland plants, and it's not just about what happens right after a fire. The way plants and fire interact over time changes the number of buds and seeds in the soil. This then affects how the plants grow back after a fire (Vermeire et al., 2024). Some plants don't show their full reaction to fire right away, so we need to study them for a long time. If we only study them for a short time, we might miss the whole picture of how the plants change, especially bunchgrasses (Pilliod et al., 2017)

For bunchgrasses to fully take advantage of water resources and soil nutrients, they need new shoots (called tillers) to grow from underground buds (Ott and Hartnett, 2015). Several studies have shown that fire can help these tillers grow in grasses like

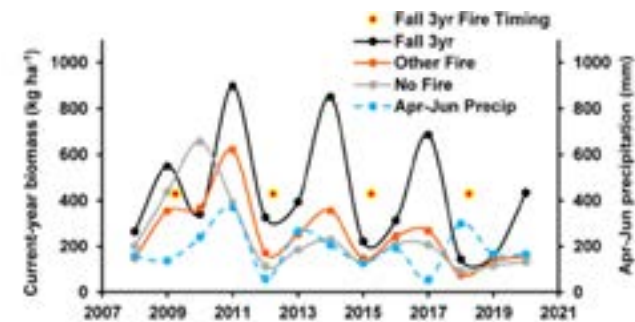
weeping lovegrass (*Eragrostis curvula*), blue grama (*Bouteloua gracilis*), and western wheatgrass (*Elymus smithii*). However, the number of tillers and when they grow largely depends on how often fires happen (McFarland and Mitchell, 2000; Russell et al., 2019).

Of course, while burning every three years in the fall has been shown to produce the greatest gains in bunchgrass growth—especially for needle-and-thread grass—timing alone cannot guarantee consistent results each year. Bunchgrasses rely on having enough soil moisture to regrow vigorously after fire, so periods of drought can slow recovery or reduce biomass even when burns are well-timed. On the other hand, burns followed by favorable rainfall support stronger regrowth and more robust pastures. Because precipitation is unpredictable, it's important for land managers to remain flexible and recognize that outcomes will vary from year to year, even when following the recommended three-year fire cycle.

Results

This study found that prescribed fire **significantly boosted the growth** of *H. comata*, especially **when burns were applied every three years in the fall**. This species grows in three-year life cycles, and the timing of fire appeared to align with those natural growth patterns. The heat from fire helped stimulate seedling emergence and tiller production, leading to much higher biomass in burned plots compared to areas that were left unburned.

The increase in grass growth from the 3-year fire cycle didn't show up right away—it only became clear after five years. If the study had ended earlier, like many short-term research projects do, this critical finding would have been missed. This shows that when it comes to fire and plant recovery, short timelines don't tell the whole story.



Vermeire et al., 2024. Current-year biomass of *H. comata* for fall fire with 3-year return intervals, the mean of all other fire treatment combinations, no fire and yearly April-June precipitation (mm).

SCIENCE AT A GLANCE

- Looked at how **fire timing** (spring, summer, or fall) and **frequency** (every 2, 3, or 6 years) affect grasslands
- Focused on a **native grass** called **needle-and-thread** (*H. comata*) in northern mixed prairies.
- Ran the study for **15 years** with **9 different fire treatments** and no-fire controls
- Found that **long-term fire patterns are important** for how this grass respond and recovers
- Discovered that burning **every 3 years in the fall** was most effective for regrowth
- Important to note that **drought conditions** and **precipitation** impact soil moisture, which in turn impacts bunchgrass regrowth

WHAT ARE THE IMPLICATIONS OF THIS RESEARCH?

1 Extension turns research into real-world tools that help landowners burn safely and effectively. This research reinforces the role of Extension as a trusted bridge between science and practice. By translating long-term ecological findings into clear, regionally relevant strategies, Extension professionals help landowners make informed decisions about when, where, and how to burn. This work would not be possible without the infrastructure, relationships, and expertise provided by the Texas A&M AgriLife Extension Service and similar institutions across the Great Plains. Extension-led workshops, field days, and certification programs are vital for building fire literacy, expanding safe fire use, and ensuring that landowners don't have to navigate the complexities of prescribed fire alone.

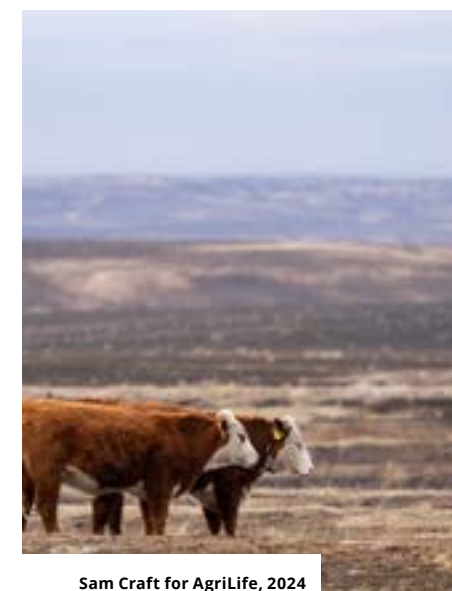
2 Fire boosts forage, protects property, and saves money. The ecological benefits of prescribed fire translate directly to economic outcomes. Improved forage production supports healthier herds and higher stocking rates, while reduced woody plant encroachment increases usable acreage. Just as importantly, fire reduces the risk of catastrophic wildfire—a growing threat not only to rangeland but also to homes, infrastructure, and livelihoods along the expanding urban-rural interface. Investments in prescribed fire now help avoid the massive public and private costs of unmanaged wildfire later.

3 This long-term study shows why we need more fire research that looks beyond short-term results. The 15-year study by Vermeire et al. (2024) sets a new standard for rangeland fire research. Its long-term design captured outcomes that shorter studies might have missed, showing how seasonality and frequency interact over time to shape plant community dynamics. This work supports future research that values longevity, ecological complexity, and the role of disturbance rhythms in semi-arid systems. It also provides a framework for how Extension and research institutions can partner to bring meaningful, long-horizon science to applied land management.

4 Prescribed burning keeps rangelands healthy, productive, and more resilient to future challenges. This study underscores that conservation isn't passive—it's an active process rooted in understanding disturbance, resilience, and renewal. Prescribed fire is not just a restoration tool, but a proactive strategy for keeping grasslands healthy, productive, and diverse. Long-term fire planning supports soil function, forage stability, and ecosystem balance—ensuring that rangelands can continue to provide food, wildlife habitat, and fire protection well into the future.



Laura McKenzie for AgriLife, 2021



Sam Craft for AgriLife, 2024

Now is the time to plan, partner, and burn with intention. Because when fire is used well, everybody benefits—your land, your livestock, your bottom line, and your legacy.

The science is clear: prescribed fire, when used with purpose and consistency, is a powerful tool for restoring and sustaining grassland health. But it's not something landowners have to do alone. With guidance from Extension, collaboration with Prescribed Burn Associations, and resources like the Great Plains Fire Science Exchange, landowners can build the skills and confidence to put fire to work—safely, strategically, and in service of long-term land stewardship.

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ADDITIONAL RESOURCES

Great Plains Fire Science Exchange <https://gpfirescience.org/>

Research, tools, and outreach to support safe, science-based fire use across the Plains.

How Grasses Grow <https://agrilife.org/howgrassesgrow/>

An interactive resource explaining how grasses respond to grazing and fire.

Planning a Prescribed Burn <https://agrilifeextension.tamu.edu/library/ranching/planning-a-prescribed-burn/>

Step-by-step guide to safely planning and implementing prescribed fire.

Prescribed Burn School – AgriLife Learn <https://agrilifeextension.tamu.edu/asset-external/prescribed-burn-school/>

Self-paced, online training course for landowners pursuing burn certification.

Texas A&M RWFM Department <https://rwfm.tamu.edu>

Programs, research, and Extension at the intersection of rangelands, wildlife, and fire.

Texas Prescribed Burn Handbook <https://agrilife.org/rxburn/>

Your one-stop hub for prescribed fire resources, workshops, and local contacts.



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