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Prescribed burning in the Great Plains: Timing and management considerations

David Brooke

Texas A&M AgriLife Extension

INTRODUCTION

Prescribed burning is a critical management tool for maintaining the health and biodiversity of Great Plains grasslands. These ecosystems evolved with fire as a natural process, which controls woody encroachment, promotes native plant growth, and supports wildlife habitats. The timing of a prescribed burn, whether conducted in winter, spring, summer, or fall, plays a vital role in determining ecological outcomes. This brief summarizes how burn timing affects native species and plant communities in the Great Plains and provides management recommendations based on recent research.

FIRE EFFECTS ON GREAT PLAINS ECOSYSTEMS

Prescribed fire benefits grasslands by improving vegetation structure and composition, which provides food, cover, and habitat diversity for wildlife.

Fire can stimulate both native warm-season (C4) and cool-season (C3) grasses, and this effect is particularly relevant in the northern Great Plains, where native C3 grasses dominate. Rather than focusing solely on C3 versus C4, it is often more impactful to consider the response of native versus exotic species to fire.

Fires suppress invasive species and woody plants such as mesquite and Eastern redcedar, while creating habitat mosaics that support a variety of wildlife species.

The effects of prescribed fire vary depending on its timing, frequency, intensity, and scale. Dormant-season burns (winter to early spring) are often used to prepare grazing lands and control young woody plants, while growing-season burns (late spring to summer) are more effective at reducing mature shrubs and promoting plant diversity.

Fall burns can enhance root energy storage for plants while minimizing disruption to wildlife.

PRESCRIBED BURNING BY SEASON

The timing of prescribed burns directly influences fire behavior, vegetation targets, and overall ecological outcomes. Each season offers unique opportunities and challenges for land managers.

Winter (Dormant Season)

In the southern and central Great Plains, winter burns are characterized by high-intensity fires fueled by dry grasses and leaf litter. These burns are particularly effective at controlling young woody saplings such as Eastern redcedar while preparing grasslands for spring green-up.

Figure 1. Winter burns are common in the southern Great Plains, where dry dormant fuels promote effective killing of adolescent woody species before they reach maturity.

However, in the northern and northwestern plains, winter burns are rarely possible due to snow cover, persistent moisture, and limited suitable weather windows. Winter burns have minimal direct impacts on wildlife since most bird species are not nesting during this time. However, they are less effective at killing mature woody plants and may increase soil erosion on slopes due to reduced ground cover.

Burn Day Availability: Winter burn days are often limited by high wind speeds, short daylight hours, and precipitation events such as snow or ice, especially in the northern and northwestern plains.

Figure 2. Spring burning is common the the tallgrass prairie of the central Great Plains.

Spring (Early Growing Season)

Spring burns occur during a period of variable weather conditions, with moderate-intensity fires driven by early-season moisture levels. These burns are ideal for stimulating native warm-season grasses like big bluestem while suppressing invasive cool-season species such as Kentucky bluegrass.

In the northern and northwestern plains, spring burns can be difficult to implement and are often least effective due to persistent wet or cold conditions. Spring burns also prepare forage for early grazing seasons but may disrupt ground-nesting birds like Western Meadowlarks if conducted too late in the season.

Burn Day Availability: Spring burn opportunities can be constrained by rapidly changing weather conditions, including fluctuating temperatures, unpredictable winds, and rainfall events that can dampen fuels.

Summer (Growing Season)

Summer burns produce high-intensity fires due to warm temperatures and dry conditions, especially in areas with sufficient dead fuel carryover. These fires are highly effective at controlling mature woody plants such as mesquite, as the heat penetrates their thin bark during active growth phases, achieving mortality rates of up to 80%. Summer burns also promote wildflower diversity by reducing competition from dominant grasses while increasing insect biomass critical for bird broods. However, in the northern plains, summer fires can reduce overall forb diversity, but this effect is generally positive because most reductions occur among undesirable non-native annual forbs. Summer is also the natural fire season in much of the Great Plains, but fire fighting resources may be stretched thin due to the prevalence of large wildfires during this time. Summer burns temporarily reduce cover for wildlife, increasing predation risks for species like deer fawns, and require careful planning to ensure safety during hot weather.

Burn Day Availability: Summer typically provides more consistent burn opportunities in the southern and central plains, but in the north, extreme heat, high winds, and competing wildfire activity may limit safe burning.

Figure 3. Growing season fires can be smoky due to the moisure in the vegetation turning to steam during the burn.

Fall (Late Growing Season)

Fall burns provide moderate-intensity fires under stable weather conditions. They target cool-season grasses and invasive species while enhancing nutrient cycling and preparing root systems of native grasses for spring regrowth. Fall burns minimize disruption to wildlife since most species are not nesting during this time but may reduce winter cover for small mammals.

Burn Day Availability: Fall often offers a higher number of suitable burn days compared to other seasons due to cooler temperatures, lower wind speeds, and more predictable weather patterns.

TARGETING WOODY PLANTS: SPROUTING VS. NON-SPROUTING SPECIES

Prescribed burns interact differently with sprouting and non-sprouting woody plants based on their physiological adaptations to fire.

Non-sprouting species like Ashe juniper (Juniperus ashei) and Eastern redcedar (Juniperus virginiana) lack the ability to regenerate from their root systems after being top-killed by fire. These species are highly susceptible to high-intensity fires during summer when low fuel moisture and high temperatures maximize fire severity. For example:

- Summer Burns: Achieve high mortality rates (>80%) in non-sprouting species by targeting their thin bark during active growth phases.
- Management Implications: Summer burns are ideal for controlling non-sprouting species but require sufficient fuel loads for effective heat penetration.

Figure 4. Mesquite readily resprouts after fire.

- In contrast, sprouting species like mesquite (Prosopis spp.) or oaks (Quercus spp.) regenerate vigorously after being top-killed by fire due to their extensive below-ground bud banks. These species are less affected by dormant-season burns but show reduced sprout vigor following early growing-season fires.

- Spring Burns: Reduce sprout height in resprouting hardwoods due to drier fuels and higher fire temperatures observed during early growing seasons.
- Management Implications: Frequent spring burns (every 1-3 years) can gradually reduce sprouting species' dominance while promoting grassland recovery.

Timing prescribed burns based on the physiological traits of woody plants allows land managers to selectively target problem species while preserving desirable vegetation.

WARM-SEASON GRASSES & FORBS

Native warm-season grasses are a cornerstone of southern and central Great Plains ecosystems, while native cool-season (C3) grasses dominate much of the northern plains.

Warm-season grasses, including species like big bluestem, little bluestem, switchgrass, and Indiangrass, utilize the efficient C4 photosynthetic pathway, allowing them to grow vigorously in warm conditions with minimal water loss. Their deep root systems enhance drought tolerance and contribute to soil health. Native cool-season grasses, such as western wheatgrass, are also important components of healthy prairies, particularly in the north.

Prescribed fire plays a vital role in maintaining native grass dominance by removing accumulated plant litter that shades new growth. This process stimulates vigorous regrowth while suppressing invasive exotic cool-season grasses such as Kentucky bluegrass and smooth brome. Native cool-season grasses often increase in abundance following prescribed burns, especially in the northern plains, and should be distinguished from exotic species in management decisions.

Figure 5. Kentucky bluegrass can form dense vegetative mats detrimental to desirable plant growth in the northern Great Plains.

Wildflowers, or forbs, benefit significantly from prescribed burns, particularly those conducted during the growing season. By reducing competition from dominant grasses, fire creates openings in which forbs can thrive. Increased forb diversity supports pollinators such as bees and butterflies while enhancing habitat for birds and other wildlife.

Figure 6. Forbs provide critical nutrition for wildlife and livestock, along with shade and cover habitat for wildlife, while adding beauty to the prairie.

MANAGEMENT IMPLICATIONS

Promoting Native Grasses: Prescribed burns conducted in late spring or early summer align with the active growth period of many native grasses, removing litter and suppressing non-native competitors.

Controlling Exotic Cool-Season Invasives: Early spring burns can target non-native cool-season grasses before they set seed, reducing their competitive advantage.

Enhancing Forb Diversity: Summer burns are particularly effective at increasing forb populations by reducing grass dominance and creating open spaces for wildflowers to establish. In the northern plains, managers should monitor forb response and focus on reducing non-native annuals.

TIMING PRESCRIBED FIRE AND THE IMPACTS ON WILDLIFE

The season in which a burn occurs can shape wildlife response as much as the fire itself. In the Great Plains, prescribed fire influences how animals move across the landscape, where they find cover, and how quickly the habitat recovers after a burn. Early-season burns often create short-term openings that benefit species using newly exposed ground for feeding or travel, while later-season burns tend to leave less residual cover and can temporarily reduce shelter for species that depend on dense vegetation.

For managers, the main question is not whether fire affects wildlife, but which habitat function is most important at a given time of year. Burns conducted when animals are least dependent on standing cover may reduce negative impacts, while burns timed to promote a mix of recently burned patches and unburned refuge areas can improve habitat diversity across a pasture or ranch. This patchwork approach is especially useful in working landscapes where wildlife, livestock, and vegetation objectives all need to be balanced.

Wildlife responses to prescribed fire vary with season, habitat needs, and available cover. The examples below show how burn timing can influence wildlife in the Great Plains.

Attribute	Native Grasses (C3 & C4)	Non-native Grasses (C3)
Growth Period	Spring through summer (varies)	Early spring and fall
Fire Response	Stimulated by fire; maintain diversity	Often suppressed by fire, especially when targeted before seed set
Wildlife Habitat Value	Excellent nesting/foraging cover; promotes forb growth	Can reduce plant diversity and alter habitat structure

Figure 7. Comparison of native and non-native grass responses to fire.

Grassland Birds: Grassland birds such as the Western Meadowlark, Greater Prairie-Chicken, and Mountain Plover rely on open landscapes created by fire for nesting, foraging, and breeding. Burns reduce woody encroachment that can obstruct predator detection or disrupt courtship displays.

- Spring Burns: Can disrupt ground-nesting birds if conducted during peak nesting seasons (May-July). However, rotational burning creates a mix of recently burned areas for foraging and older growth for nesting cover.

- Summer Burns: Increase insect biomass by stimulating herbaceous regrowth, providing critical food sources for fledglings. These burns also benefit species like Northern Bobwhite Quail by creating brood-rearing habitat.

Large Mammals: Bison, pronghorn, and deer utilize post-fire regrowth for high-quality forage.

- Winter Burns: Prepare grasslands for early green-up in spring, providing nutritious forage during calving or fawning seasons.

- Summer Burns: Promote protein-rich regrowth in warm-season grasses, benefiting grazers during the late summer when forage quality typically declines.

Keystone Species:

- Spring Burns: Encourage prairie dog expansion by maintaining open landscapes with reduced woody cover. Prairie dogs thrive in areas with reduced vegetation height following burns. Their colonies create habitat for other species like black-footed ferrets, burrowing owls, and swift foxes.

Figure 8. Great Plains pollinators depend on healthy grasslands managed with prescribed burning.

- Fall Burns: Provide long-term habitat stability by preventing shrub encroachment into colonies.

Pollinators: Bees, butterflies (e.g., monarchs), and other pollinators benefit from the increased forb diversity following burns.

- Summer Burns: Promote wildflower blooms by reducing competition from warm-season grasses during their active growth phase, supporting nectar-feeding insects critical to ecosystem health.

REGIONAL CONSIDERATIONS

Tallgrass Prairie

- Burn Frequency: Every 1-3 years
- Optimal Timing: Late dormant season (April) or late summer (August-September)
- Management Goals: Enhance livestock forage quality, control woody plants, support wildlife habitats.

Northern Great Plains

- Burn Frequency: Every 4-10 years
- Optimal Timing: Early spring (March-April), although burn windows are often limited by weather. Summer and fall burns are generally more effective, with fall being optimal in the northwestern plains due to safety and effectiveness.
- Management Goals: Suppress invasive cool-season grasses like Kentucky bluegrass and annual bromes; promote native perennials like western wheatgrass.

Southern Great Plains

- Burn Frequency: 2-5 years
- Optimal Timing: Summer (July-August)
- Management Goals: Control mesquite/juniper encroachment; improve forage protein content; enhance wildlife habitats.

EMERGING BEST PRACTICES

1. Variable Fire Regimes: Rotating burn seasons enhances biodiversity by favoring different plant and animal communities throughout the year.
2. Patch Burning: Burning smaller patches (e.g., <50 acres) on a rotational basis creates habitat mosaics that balance food availability with cover needs for wildlife.
3. Collaborative Models: Prescribed Burn Associations (PBAs) provide training, equipment sharing, and community support to expand prescribed fire use across private lands.
4. Training Exchanges (TREX): Events like Great Plains Fire Summit & Loup River TREX in Nebraska promote cross-boundary collaboration among landowners while improving prescribed burning safety and effectiveness.

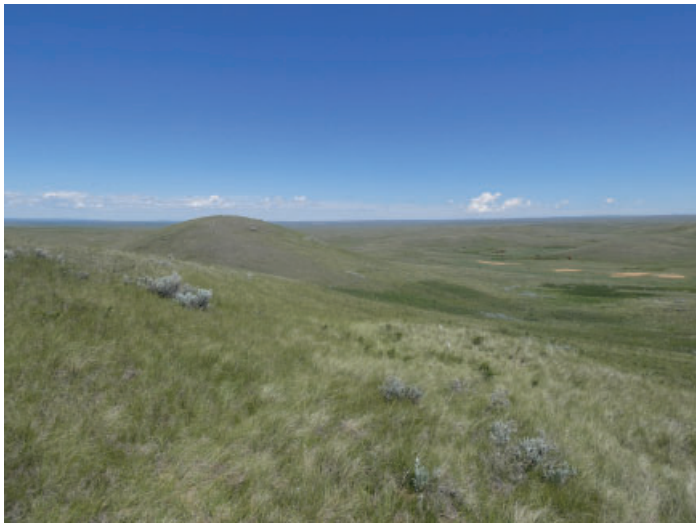

Figure 9. Northern Great Plains grasslands tend to burn less frequently than more southern grasslands.

SUMMARY

Prescribed burning is essential for maintaining the ecological health of Great Plains grasslands. By tailoring burn timing to regional ecosystems—whether focusing on summer burns for woody control or fall burns for nutrient cycling—land managers can optimize outcomes while balancing practical considerations. Carefully timed burns benefit native wildlife by creating dynamic habitats while supporting plant communities through enhanced growth of native grasses and wildflowers. Collaborative efforts such as PBAs and TREX events demonstrate scalable solutions to ecological challenges, ensuring long-term sustainability of these vital landscapes.

Figure 10. Shortgrass prairie grasses burn readily due to good fuel/air mixture.

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PHOTO CREDITS

Figures 1, 3: Cross Timbers Prescribed Burn Association.

Figures 2, 4, 5, 6, 8, 9: Carol Baldwin