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Planned burns in the Great Plains

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The varied regions of the Great Plains share a history of fire, for example, the mixed-grass prairies of the Dakotas, tall-grass prairie of Kansas, and cross timbers of Texas all evolved with periodic burning. The first European settlers found grasslands shaped by Native American burns and lightning-caused fires. When settlers began suppressing fires, one of the most important processes that maintain native species and nutrient cycles was lost.

No other management tool can replace periodic fire in Great Plains ecosystems. However, one planned burn cannot make up for a century or more of fire suppression. Restoring historic fire regimes requires burning regularly over time (Figure 1).

Periodic fire can improve the health of grasslands, but cannot by itself return the Great Plains to its pre-settlement condition. Invasive species, both exotic and native, have changed fundamental processes across the region. Landscape fragmentation constrains natural cycles and increases edge effects. As the remaining prairie patches border more non-prairie areas, invasive plants become more likely and it becomes more difficult to carry out planned burned. Finally, even as we learn more about how Great Plains ecosystems work, climate change is altering ecological relationships.

This fact sheet provides an overview of planned burns in the Great Plains: why they are used, how to burn safely, what steps are involved in conducting a burn, and where to find more information.

REASONS FOR USING PLANNED BURNS

Land managers in the Great Plains use fire to achieve many goals. These include reducing undesirable plants and increasing desirable ones, increasing the amount and quality of livestock forage, improving wildlife habitat, and reducing hazardous fuels or plant debris.

Fire is used to manage eastern redcedar across large swaths of the southern and central Great Plains where this native tree is encroaching. Wildlife managers in the Dakotas burn mixed-grass prairie to reduce exotic smooth brome and Kentucky bluegrass. Landowners across the region burn Conservation Reserve Program (CRP) fields to maintain a vigorous mix of seeded species.

Planned burns are less expensive than most chemical or mechanical treatments, especially on large areas, but fire alone cannot achieve every management goal. Other treatments are often needed in addition to planned burns. Before burning, consider the likely results of fire and compare them to the likely results other treatments. Also consider the consequences of not burning.

Figure 1. No other management tool can replace periodic fire in Great Plains grasslands. Photo, Chris Helzer /The Nature Conservancy.

SAFETY, PERSONNEL, AND EQUIPMENT

Safety is the most important goal of every planned burn. Workshops, webinars, and fact sheets can provide background, but there is no substitute for on-the-ground learning with experienced practitioners.

Before planning a burn, learn about state and local requirements for planned burns, review your liability for escaped fire and smoke on roads, and make sure you have adequate insurance. Even burns on private land may require burning permits and usually require notifying local authorities prior to burning. All burns must abide by local regulations including burn bans and red flag warnings. Neighbors should also be notified before a burn.

A written burn plan is an irreplaceable planning tool and is often required for a burn permit. A burn plan includes details such as:

- Location of the burn and maps showing access roads, firebreaks, and hazards.
- Purpose of fire and expected results.
- Types of fuels and burn prescription.
- Equipment and personnel.
- Types and locations of firebreaks.
- Smoke management plan.
- Contingency plan: what if something goes wrong?

Safe and effective planned burns need an experienced fire boss to direct a team to ignite the fire and to extinguish any spot fires--fires that ignite outside the burn area--and insure that flames remain within firebreaks. Equipment used on planned burns typically includes:

- Safety: clothing with natural fibers or fire retardant, first aid kit, radios/phones, emergency contact information.
- Ignition: ignition source such as drip torches, field weather kit (to verify conditions).
- Suppression: water source such as pickup truck with slip in pumper unit, hand tools for small spot fires and complete suppression.

BURNING PRESCRIPTIONS

Prescriptions include weather guidelines for safe and effective planned burns for different fuels and topography. These guidelines specify safe ranges for temperature, relative humidity (RH), and wind (speed, direction, and consistency).

Weather interacts with fuel and topography to shape fire behavior. Low RH dries fuel, high temperature can increase fire intensity, and strong wind pushes flames rapidly across a burn area (Table).

Table. General guidelines for safe planned burns (Anderson and Stubbendieck 2006, Volesky et al. 2007, Weir et al. 2009).

Team experience / fuel conditions	Temp. (°F)	RH (%)	Wind (mph)
Experienced team / moderate fuels	< 80	> 25	< 15
Inexperienced team / heavy fuels	< 60	> 40	5-10

Spot fires are much less common above 40% RH, but increase quickly at lower humidity. Ideal winds are steady and from a consistent direction, in order to move the planned burn across a site safely.

As a rule of thumb, when the temperature increases by 20°F, the RH drops by half. For example, if the temperature increases from 50 to 70°F, the RH will drop from its original 80% to 40%.

Prescriptions usually specify the fuel types and amounts on a site. Sites with patchy fuel or varied topography pose special challenges. Fire moves uphill quickly as it preheats the vegetation ahead and slows when moving downhill.

Safe burns require conditions that are within prescription during the entire time the fire is burning. Wait for a forecast with at least 12 hours of suitable weather before starting a burn. Check the weather hourly during the burn and ask, “Could we stop this fire if it escapes?” Extinguish any potentially unsafe fire.

Figure 2. Gravel roads can be effective firebreaks, but may need to be widened with an additional, created firebreak. Photo, Mary Means/The Nobel Foundation.

Figure 3. Make sure vegetation is well-incorporated when rototilling or disking firebreaks. Photo, Steven Smith/The Nobel Foundation.

FIREBREAKS

Firebreaks, also called fireguards, are areas with little or no fuel that enclose and contain a planned burn. Firebreaks should be drivable, so that people and equipment can access all parts of the fire.

When wide enough, existing breaks such as roads, agricultural fields, waterways, and snow banks can be used as firebreaks (Figure 2). Some of these areas may contain vegetation that must be removed or incorporated, such as in borrow ditches and within two track roads.

Existing firebreaks can also be widened and connected with firelines that are bladed, disked, or mowed (Figure 3); blacklines burned before the main part of the fire; wetlines sprayed with water or fire retardant; or handlines dug with hand tools. Bare soil lines are the safest and most effective, but may need to be rehabilitated after a fire, especially on slopes. Mowed or grazed firebreaks slow, but rarely stop a fire and are safest when inside a firebreak of bare soil.

Firebreak widths vary with fuel conditions; when fuels vary across a fire, firebreak widths should also vary. Remove trees that could fall on, or throw firebrands across, a firebreak. Downwind firebreaks must be wide enough to contain a fire pushed by wind.

IGNITION AND BURNING

Planned burns during the dormant season are fueled by dry grass from the previous growing season. From 750 to 1,500 pounds per acre of this fuel carry fire to produce a complete burn (Volesky et al. 2007). Plants with less than 15% moisture burn well. Estimate this by tearing off a bunch of grass at the base and bending it; if it breaks easily in the middle, it is dry enough (Hanselka 2009). However, the moisture content of grass can change in an hour as the fine stalks respond quickly to changes in humidity.

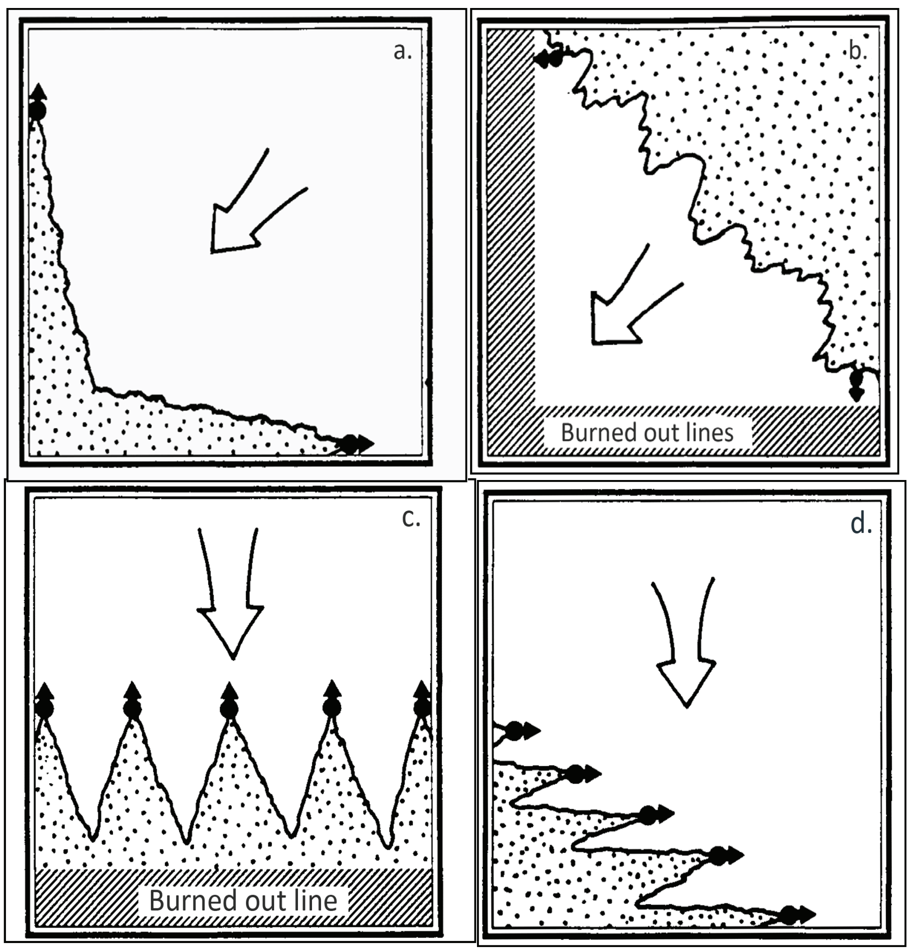

Figure 4. Types of fire used in planned burns. a. Backfires burn into the wind and are used to create firebreaks, b. Headfires are pushed by the wind into wide firebreaks, c. Flankfires burn perpendicular to the wind, d. Strip-headfires burn across an area in strips. Stippled areas indicate fire, wide white arrows indicate wind direction, small black arrows indicate direction of fire movement. All diagrams, Oklahoma Cooperative Extension Service.

Planned burns during the growing season require enough dead plant material left from the previous year to carry fire to green, growing plants and dry them enough to burn. Growing season burns move more slowly and are less likely to produce spot fires than dormant season burns. The high moisture content in growing plants produces patchier burns and more smoke than does burning dormant plants.

Burning during both the dormant and growing season helps managers meet their burning goals by increasing the number of days available for planned burns. Growing season planned burns can produce a flush of high quality forage for livestock late in the growing season, when the quality of most forage declines.

Planned burns typically use backfires, headfires, and flank fires (Figure 4). Backfires are easier to manage than headfires, as they move slowly into the wind and produce relatively short flames. These are used to create firebreaks and to burn volatile vegetation safely. Because they move more slowly, backfires consume more vegetation and produce less smoke.

Flank fires burn perpendicular to the wind, on the sides of a fire. These are riskier to carry out than other fires, as a change in wind direction can easily turn them into headfires. Headfires move faster than backfires, as they are pushed by wind. They produce taller flames and are harder to control. Because these fires move more quickly, they do not burn as completely, and produce more smoke than backfires.

Strip-head fires combine aspects of head and backfires to burn across an area in strips. Starting from the downwind side, each strip is ignited perpendicular to the wind and burns as a narrow headfire into the previous strips.

SMOKE MANAGEMENT

Smoke is unpleasant to breathe and can imperil drivers by reducing visibility on roads. Avoid problems with smoke by burning when smoke lifts and winds carry it away from towns, roads, and homes. Fire continues to smolder for hours after flames reach firebreaks, so burn when effective winds are forecast through the night following the fire.

Calm days with stable air trap smoke close to the ground where it can be a hazard. Windy days with unstable air disperse smoke quickly, but can make it more difficult to burn safely. Planned burns must balance conditions for safe burns with those for effective smoke management. Even on ideal burn days, cold air drainage in the evening can trap smoke in low-lying areas.

POST-FIRE FOLLOW UP

Each planned burn is an opportunity to fine tune your management skills with fire. Immediately after the fire, evaluate the effectiveness of firebreaks and ignition and suppression teams. Written burn records are essential, because memories fade and details blur. Photos and video of the team and fire can be even more valuable than written records.

Evaluating the fire's effect on vegetation needs to start before burn day. Before and after photos from several places within the fire are useful, and quantitative data is even better for making management decisions. Measuring the density, height, and cover of target species across the burn area will reveal changes not visible in photos. Note and manage any invasive plants and watch for erosion on bare soil firebreaks. The effects of fire are not all seen immediately, so it is important to continue to measure and photograph the burned area for several to many years. This information will help determine when to burn again.

A single planned burn cannot recreate the historic fire regime or pre-settlement vegetation on Great Plains grasslands. But reintroducing this vital process to these imperiled ecosystems starts with the first fire.

GETTING HELP

The Great Plains Fire Science Exchange is a clearinghouse of science-based information on fire in the grasslands of the Great Plains. The GPFSE has resources on fire, fire effects, monitoring, and more at http://GPFireScience.org. links to online, in person, and in the field resources and events. We can also locate experts to address your fuels questions.

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