Using Prescribed Fire on Illinois Grasslands

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Illinois Ecological Sciences Technical Note No. 2 is intended to be used as a tool to assist in the use of prescribed fire on Illinois grasslands. The two primary reasons for burning grasslands are wildlife habitat improvement and native prairie establishment or restoration. Additional reasons for burning include:

- to improve forage quality or quantity
- to improve or manipulate grazing or browsing distribution
- to remove excess plant litter and wildfire hazard, and
- to suppress woody plant invasion of grasslands.

See Illinois Field Office Technical Guide (FOTG) Standard 338, Prescribed Burning, for a complete list of purposes for conducting a prescribed burn. These guidelines present a set of reasons, criteria, techniques, and examples of simple prescriptions which aid in the planning and execution of a safe and effective prescribed burning program for a variety of purposes in grassland areas of Illinois. NRCS employees must have the appropriate Job Approval Authority (JAA) in order to provide technical assistance or participate in any way in prescribed burning. NRCS policies and JAA documents may be obtained from the sources listed at the end of the Technical Note.

IS FIRE A CHOICE?

Illinois grasslands can be managed in different ways; fire is but one possible choice. Other grassland management options include grazing, mowing, haying, fertilization, herbicides, soil scarification (strip disking), interseeding, and total renovation and reseeding.

A land manager's first decision is to determine whether fire is a viable option. Fire should not be a grassland management choice for a specific area if:

1. Federal or state regulations prohibit burning.
2. Local ordinances or zoning prohibit burning.
3. Containment and safety factors are extremely risky.
4. Endangered species or natural communities are subject to harm or their status is in doubt (peak or muck soils).
5. Fire behavior or fire effects will not meet the objectives for the area.
6. Local residences or other improvements could be jeopardized.
7. Smoke presents too many public health or visibility risks.

If fire cannot be used for any of the reasons listed above, accept the decision as final. Establish a file record of the specific area that may not be burned and list the reasons that limit or prohibit the use of prescribed fire. List the most probable alternative grassland management methods for the specific area and the reasons for these choices.

The following guidelines were developed with the assumption that fire can be used as a grassland management tool for a specific area.

REASONS FOR GRASSLAND BURNING

Grasslands are burned primarily to manipulate vegetation and enhance the biological productivity and diversity of specific organisms or to accomplish specific objectives. Specific objectives may be broad (prairie restoration and maintenance) or narrow (management for endangered or rare species or reduction of woody plants). Whatever the reason for grassland burning sound planning must be initiated and carried out well in advance, usually 3 to 6 months prior to the scheduled burn.

PREPARING THE BURN PLAN

Use Job Sheet 338-JS, Prescribed Burn Plan, to guide preparation for a prescribed burn. Important pre-burn activities called for in burn plan preparation will include:

1. Estimating the amount and kind of fuels present.
2. Surveying the conditions of natural and artificial fire containment barriers and the proposed fire unit boundaries.
3. Recording obvious sensitive areas or physical constraints.
4. Noting recent precipitation amounts and dates.
5. Noting any features or conditions, e.g., topography or windbreaks, that might affect fire behavior.
6. Developing a clear, detailed map of the proposed burn area showing sensitive areas, planned wind direction, firing sequences, firebreaks, and specific burn crew escape paths.
7. Noting any high risk environmental areas that might need to be excluded from the burn area.
8. Estimating the time, equipment and personnel that will be required to complete the burn and provide for timely post-burn monitoring, mop-up, and clean up.
9. Notifying appropriate local authorities, agencies and property owners.

As an option, taking pre-burn photographs and marking locations could be beneficial.

PERMIT TO BURN

Use of prescribed fire in Illinois is regulated by the Illinois Environmental Protection Agency, Division of Air Pollution Control, P.O. Box 19506, Springfield, Illinois, 62794-9506, 217/782-7187 or -2113, fax: 217/524-5023. A four page Open Burning Permit Application can be obtained from the address above and must be completed for each prescribed burn, including any fires used for "…instruction in methods of fire fighting or …research or management in prairie or forest ecology." Regulations governing Open Burning may found in Title 35, Subtitle B, Chapter I, Subchapter i, Part 237, Open Burning. Regulations can be obtained on the internet at: www.epa.state.il.us/air/permits/openburn/open-burning-permit-app.pdf. One of the standard conditions that apply to an Illinois Open Burning Permit is that the permittee (landowner) shall notify the local fire department or fire protection district at least 24 hours prior to the burn. Contacting local fire authorities also provides an opportunity to inquire about local burn regulations or restrictions.

Burn site constraints

Each burn site has individual constraints and sensitive issues. Final inventory and evaluation of the total set of constraints for each proposed burn site will help determine whether a prescribed burn is practical or feasible. Another treatment may need to be considered or refer the landowner to an environmental consultant.

If several sites need to be burned, arrange all potential burn sites sequentially, starting with those sites with the least constraints. Constraints can be economical (high cost per unit of burn area); operational (poor access or a high-risk fire problem area); environmental (highly erodible soil or high risk of air pollution); administrative (site includes a special management or natural area or endangered species);

regulatory (a moratorium on open burning); and/or conflictive (adverse publicity, multiple use area for both domestic livestock and wildlife production or research versus management objectives).

Examples of sensitive issues or constraints include smoke problems in relation to residential areas, airports, highways, and roads; the presence of electrical poles and wires; adjacent farm crops or livestock; coal or oil deposits; presence of endangered biota, nesting or fawning areas; sensitive neighbors; peat or muck soils; or poor access for backup fire fighting or emergency medical equipment.

Address many of the constraints and sensitive issues well in advance of the actual time to burn. Leave time to re-check such things as the presence of livestock within a few hours or days of the burn. Refer to Job Sheet 338-JS, Prescribed Burn Plan for a pre-burn checklist.

SAFETY

The safety of the people conducting or present during a prescribed burn is the highest priority. Safety is promoted through training, a carefully completed burn plan, removal of hazards, and through provisions for personal protective equipment and devices. Every person on the burn will be aware of the details in the burn plan and know of escape routes and safety zones in case of unexpected changes in weather conditions. An escape route is a fireproof path leading away from the burn and from areas of heavy fuels. A safety zone is a fireproof area large enough to provide a refuge from both fire and radiant heat.

Safety clothing

All people actively involved in conducting a prescribed burn must wear safety clothing that, at minimum, includes:

1. Hightop, 8-inch or higher leather boots or work shoes with non-slip soles and leather laces. Steel-toed shoes should not be worn for fire duty.
2. Cotton or wool socks
3. Nomex slacks or cotton pants, loose fitting, with the hems lower than the shoe tops
4. Nomex or cotton long-sleeved loose fitting shirts
5. Leather gloves
6. Leather belt and/or natural fiber suspenders
7. Cotton undergarments

Additional safety clothing or equipment may be required on specific jobs or situations. These might include:

hard hat	face shield	knife	wire cutters
goggles	neck shield	lip balm	canteen
ear plugs	Flares	map	food
first aid kit	Compass	matches	
2-way radio	Handkerchief	weather radio	

Specific instructions will be given to not wear synthetic clothing fabrics that will melt or flame easily. These include nylon, polyesters, and plastics. Contact lenses will not be worn.

Life-threatening situations

Serious fire encounters should be avoided at all costs; materials can be replaced whereas life is lost forever.

Some obvious indicators of potentially hazardous conditions are (1) flame lengths exceeding 4 feet, (2) fire brands or spot fires occurring ahead of the main fire front, (3) smoldering fires over a large area, (4) a sudden increase in wind speed or a large change in wind direction, and (5) thick, massive smoke held close to the ground for lengthy periods. Unless you are trying to help another person, these are times to use previously identified escape routes and safety zones. When in doubt, get out!

Notification and publicity

Notification is necessary for every prescribed burn. The local fire department chief and any neighbors within 1 mile of the burn unit will be notified in advance of a burn as well as on the burn day. Some localities may also have township or state pollution officers who should be contacted.

Provide everyone who has been notified with your name, office and cellular telephone number, agency affiliation, and when and how long the burn will probably take. If at the last moment the burn is cancelled, notify these same people.

The general public should be informed of burn plans and the results of using fire as a grassland management tool. This is often done locally with articles in newspapers or magazines, or with an illustrated presentation or field tours before and after a fire.

Provide the press with a fact sheet of pertinent burn details for accurate reporting. Journalists are not required to show you advances of their stories, but ask anyway, so you can have input into the screening or editing of the final products. If publicity is to be aired on national media, obtain the necessary clearance with the NRCS Public Affairs Specialist.

Equipment check and testing

Burn crew members will check all equipment necessary for their job. All vehicles and motorized equipment will be operated until the engine is warmed up, turned off, and restarted again under warm-motor temperatures. Keys will be left in the ignition of all vehicles at all times.

All pumper units should be tested for spray pressure and spray patterns at all manual nozzle settings. All equipment and auxiliary containers will be checked for proper levels of fuel, oil, water, or other chemicals. Two-way radios and other communication equipment will be tested for working conditions and signal distance.

As an additional precaution, the fire boss may want to poll crew members about their own personal attitude and health status prior to setting the fire. It may be necessary to adjust crew assignments or dismiss crew members.

Pre-Burn Meeting

The fire boss, and only the fire boss, will give the last-minute instructions during the pre-burn meeting to the crew, but not until all of the preburn plans, publicity, preparations, weather checks, and equipment testing have been completed and meet fire boss approval. At final instructions, the fire boss will go over the prescription plan for setting fire, containment actions, escape routes and safety zone plans for possible wild or escaped fire situations, and final reconnaissance and mop-up after the fire. These instructions should be clear and understood by all crew members and they should include the chain of command and the location and job obligations of each crew member before, during, and after the fire.

SMOKE MANAGEMENT

Smoke can sometimes be an undesirable element of a prescription burn. Every grassland fire emits smoke, and the landowner is responsible and liable for any damages, human health effects, or air pollution violations due to smoke.

Smoke can be highly visible and attract unnecessary attention. Smoke can also reduce visibility on highways and roads, in some cases, increasing the risk of traffic accidents.

Smoke management is designed before ignition. During pre-burn planning, use your knowledge of fuel moisture conditions, amounts of dead plant materials present (litter), wind direction and wind speed.

General considerations for smoke management on any fire are:

1. Moist fuels produce more smoke than dry fuels.
2. Head fires produce more smoke than slower backing fires which give more complete consumption of fuel.
3. Smoke problems at night are more hazardous than during daylight. (NRCS conservation practice standard 338 – Prescribed Burning, does not allow night burning).
4. Stable air mass conditions can cause air inversions which restrict smoke convection and dispersion. Unstable atmospheric conditions are usually better for smoke management.

Critical considerations for smoke management include the following:

1. Mixing Height (the distance between the ground and the base of an inversion layer) must be between 1600 feet and 6500 feet. (Both Mixing Height and Transport Wind Speed, below, are available as part of a Fire Weather Forecast from the National Weather Service at: http://www.weather.gov/
2. Transport Wind Speed (the average wind speed throughout the mixing layer) must be between 9 and 20 miles per hour.
3. A 360-degree check for sensitive areas such as residences, highways, golf courses, airports, and public institutions within 1 mile of the burn area.
4. A check of sensitive areas up to 5 miles downwind and 30 degrees on either side of initial wind direction of firebreak locations. This will allow compensation for a wind shift which can cause a change in smoke flow.
5. Notification of nearby residents, local fire departments, and if necessary, publicity about the burn through news media before burning.

Proper pre-burn planning and surveillance of restrictive and sensitive areas will minimize smoke management problems and adverse public reaction.

CONFINING FIRE - FIREBREAKS

Confining fire to only the targeted grassland fuels requires a combination of adequate firelines or firebreaks, good weather forecasts, and onsite weather information. Several types of firebreaks have been used on grassland fires in Illinois. In approximate order of effectiveness, these are (1) streams, lakes, and wetlands; (2) bare or mineral soil; (3) burned or blacklined strips or areas; (4) tilled farmlands, roads, or trails; (5) permanent firebreaks; (6) chemical or foam retardants; (7) wetline; or (8) mowed or hayed strips.

Usually two or more types of firebreaks will be used on any one fire. Do not forfeit prescription objectives to get by with an easier or cheaper firebreak method. Remember, fires are more difficult and dangerous to confine than to set. See conservation practice standard 394 – Firebreak for more information.

Existing natural or artificial firebreaks

Costs of fire confinement can be reduced if natural and artificial firebreaks such as highways, roads, trails, tilled farmland, streams, lakes, drainage ditches, and wetlands are utilized in fire plans. These firebreaks are only usable if they conform to firebreak, smoke management and other prescription planning. Many small grassland areas can be burned using only the available natural or artificial firebreaks. These firebreaks have few inherent problems except for potential smoke problems along roads or trails.

Bare ground or mineral soil firebreaks

Cultivated or bladed bare soil firebreaks at least 2 times as wide as the height of the projected flame height are very effective, but they are also the most expensive to establish and maintain in grasslands. If cultivated firebreaks are used during two or more successive years, problems with landscape scarring, soil erosion, and weeds can occur.

Bare ground firebreaks can be established by tilling with farm plows or disks, roto-tillers, with bulldozers, road graders, or with soil sterilants. When implements or machinery are used to make bare soil, the vegetation and litter residue should be worked away from the prescription burn area along the firebreaks or fully incorporated into the soil.

Erosion and landscape scar problems can be minimized on bare soil firebreaks by moving and spreading the former vegetation and debris back onto the firebreak after the completion of a burn. Annual weeds will establish in one year and secondary succession of more permanent cover will evenly restore vegetation on the sites in the following few years.

Cultivated firebreaks can be established several days in advance of the prescription fire. Cultivated or bare soil firebreaks are also useful for fire research where experimental plots need annual protection as well as control during treatment. Flame lengths and chances of fire escaping along firebreaks can be reduced by mowing vegetation for 5 to 10 feet on each side of the firebreak (intensity reduction mowing).

Burned firebreaks or blacklines

A common type of firebreak is a blackline strip that is burned to remove fuels prior to burning the whole area. This requires setting and containing fires two different times on the same land area and usually requires the use of special water or retardant applicators. The advantage of using a blackline firebreak is the confidence of knowing that all combustible fuel has been burned and fire cannot creep across the area. Perform blacklining within one week of scheduled burns when wind speeds are under 10 mph and relative humidity over 40%. Use wetlines (parallel strips saturated with water) to contain the blackline fire.

Chemical retardants

Chemical retardants are usually applied on the fireline just prior to fire ignition. Retardants are excellent for fire confinement, and their use can eliminate tillage scars in native prairie.

The biggest drawbacks are the needs for a second crew on each fire and for special application equipment. In addition, the retardant material can be expensive. Requirements for special clothing and training for the people who mix and apply the chemicals must be met. Some chemical retardants contain phosphorus which can affect native prairie through unnatural fertilization, which in turn might affect species composition or biomass production.

Permanent Firebreaks

Firebreaks that are comprised of plant species such as Kentucky bluegrass, clover, Kentucky bluegrass/clover mix, or wheat planted in the fall for an early spring prescribed burn. Kentucky bluegrass is not advised as a permanent firebreak for prairie restorations.

Foam retardants

Foam retardants can be applied on a fireline just prior to fire ignition. Foam retardants are excellent fire confinement tools, but they have the same drawbacks as chemical retardants described above.

Some advantages of using foam over water and chemical retardants are that (1) foam expands the amount of water available and extends a given water supply 3 to 10 times, (2) it incorporates the characteristics of a wetting agent, (3) it has smothering and insulation effects, and (4) foam is more persistent and visible than water.

Wetlines

Confining fires with wetline techniques is similar to applying chemical and foam retardants, except that the water can be applied with simpler equipment and larger tankers will be necessary to carry large volumes of water.

Unlike retardant chemicals, water or wetness can evaporate rapidly in fine grassland fuels, requiring that you be more cautious during fire ignition. The advantages of wetline techniques are that water is cheap and that simple equipment, even farm-type sprayers, can be used during application. Wetting agents can be added to improve absorption by fuels. Wetlines will only be used in conjunction with other kinds of firebreaks to enhance their effectiveness or reduce fire intensity.

Mowing and haying

Mowed or hayed firebreaks should be used in combination with other firebreaks such as blacklines, wetlines, or foam or chemical retardants. The cut vegetation should be removed prior to setting the fire. All firebreaks can be made more effective by “fire intensity reduction mowing”. Strips of vegetation 8 to 15 feet wide in the burn area, adjacent to the firebreak, are mowed to a height of 10 to 15 inches. Flame length and heat intensity are greatly reduced, especially in tall stands and high fuel loads. Be sure mowed material does not become windrowed or concentrated. Consider using this technique adjacent to areas where burn crewmembers may be located, such as backfire and flank lines.

WEATHER CONDITIONS

There is probably no element of a prescribed burn more important than weather. Wright and Bailey (1980) contend that the secret to all prescribed burning is to let the weather work for you. Weather is the main controlling agent of fire behavior, smoke behavior, fuel condition, flammability, and fire containment; all of these affect the success and safety of the burn.

Important weather variables

The weather variables most applicable to prescription burns are relative humidity, wind direction, wind speed, air temperature, precipitation, and air mass stability (Sando 1969). A combination of wind speed, relative humidity, temperature, and solar insulation largely determines fuel condition which, in turn, affects fire behavior. Relative humidity, wind speed and direction and air temperature will be recorded immediately before igniting the fire and at 30-minute intervals during the burn and post-burn mop up.

Seasonal wind direction is important when burning near areas having restrictions or smoke regulations. Daily and seasonal precipitation patterns often determine when burns can be conducted, whereas days since measurable precipitation (greater than 0.01 in) determine the severity of the fire or completeness of a burn in terms of fuel consumption.

Relative humidity

Preferred relative humidity for prescribed burning varies from 25 to 50%. When relative humidity is as low as 20%, prescribed burning is dangerous because fires are more intense and spotting is more likely. When the relative humidity is higher than 50%, fires may not burn an area completely or may not burn hot enough to accomplish the desired result. Relative humidity changes can quickly affect the moisture content and flammability of grassland fuels. Increases in air temperature and solar radiation cause relative humidity to drop. Falling temperatures and cloudiness, or darkness, will cause relative humidity to rise.

A temperature rise of 20 degrees F from sunrise to mid-afternoon reduces the relative humidity by about one half. A similar temperature drop in late afternoon or early evening can cause relative humidity to rise by twofold.

However, when a cold front passes over an area, the temperature drop is usually accompanied by a drop in humidity. The lower humidity is a result of a change in air mass from warm and moist to cold and dry.

Wind

Prescribed fires behave in a more predictable manner if some wind movement is present. The most desirable wind speeds for burning are fairly steady winds between 4 and 15 mph.

Persistent winds from a constant direction before, during, and after a burn provide the safest conditions for burning. Gusty or variable winds are indicators of unstable atmospheric conditions. Immediate changes in wind direction can cause instant fire control and smoke management problems.

Probable wind directions for any particular burn should be obtained just prior to burn time and from your best weather forecast source. Placement of firebreaks and other fire containment measures and smoke management are largely dependent on wind direction.

Calm or low wind speed (less than 2 mph) days are not good burning days. Fire spread will be slow; the fire will take longer to complete and result in higher containment and labor costs; the fire will create its own wind and may change direction; and heat will dissipate more slowly, sometimes resulting in damage to non-target plant species.

Temperature

Air temperatures higher than 60^{o} F are recommended when prescriptions call for total fuel consumption. These include initial reclamation burns or burning to reduce undesirable plant species and medium to heavy coarse fuels like brush or trees. Hot (high intensity) fires also produce higher risks than cool (low intensity) fires, thus requiring more emphasis on control measures. Fire behavior and fuel conditions are most unpredictable when temperatures are rising during morning hours. This should be considered in any burn plan.

Cloud cover

Overcast conditions produce higher relative humidity and lower temperatures. Suddenly clearing skies can produce rapidly lowering humidity and rising temperatures, sometimes accompanied by increasing winds sending conditions out of prescription. Variable cloudiness can result in rapidly fluctuating conditions and gusty, unpredictable winds.

Precipitation

Grasslands have been burned successfully just 9 hr after 0.5 in of rain. Cool burns are achievable when 0.5 in. or more of rain has fallen 24 to 36 hours prior to the burn. Hotter fires usually require 5 or more dry days prior to burning, but the drying time is dependent on solar radiation, air temperature, and wind speed.

Atmospheric stability

Atmospheric stability is the resistance of the atmosphere to vertical motion. A prescribed fire generates vertical motion by heating the air, but the strength of convective activity over a fire is affected by the stability of the air mass.

Strong convective activity will increase the drafts into the fire and can result in erratic fire behavior.

When the atmosphere is stable, a small decrease in temperature occurs with an increase in altitude. Under stable conditions, inversions can develop in which temperature actually increases with height.

Stable air tends to restrict convection-column development and produces more uniform burning conditions. However, combustion products are held in the lower layers of the atmosphere, especially under temperature inversions, and visibility may be reduced because of smoke accumulation. Temperature inversions can be a serious problem at night, producing dense smoke accumulations.

When the atmosphere is unstable, there is a large decrease in temperature with height. Once air starts to rise, it will continue to rise, and strong convective activity may develop over the fire, drawing in surrounding air. Strong indrafts will help confine a fire to its prescribed area.

In extreme cases, the effect of air mass instability on fire behavior results in erratic spread rates and spotting. The burn no longer meets the prescription and might have to be extinguished.

Forecasts of low-level stability, inversion layers, or unstable conditions can be obtained from local weather forecasters and the National Weather Service. Local indicators at the fire site should also be observed. Indicators of stability are steady winds, clouds in layers, and poor visibility due to haze and smoke hanging near the ground. Unstable conditions are indicated by dust devils, gusty winds, good visibility, and clouds with vertical growth.

Passage of Weather Fronts

The passage of frontal boundaries is a frequent event in the middle section of North America. Temperature and humidity differences on either side of a frontal boundary can be very significant. Severe weather often accompanies the frontal boundary. In planning a prescribed burn the most important characteristic of passing weather fronts is instability in wind direction. The direction of winds can change 180 degrees in less time than most prescribed burns are completed. Therefore, conservation practice standard 338 – Prescribed Burning does not allow prescribed burning within 24 hours of the passage of a weather front.

Weather information sources

A fire weather kit is an essential part of any prescribed burn. Field observations of weather will be made at the prescribed burn area before and every 30 minutes during burning. Such observations serve as a check on the weather forecast and keep the burning crew up-to-date on any changes or effects of local influences.

Compact belt weather kits containing a sling psychrometer and windspeed measuring instrument are available. With this kit, and by observing cloud conditions and other weather indicators, a competent observer can obtain a fairly complete picture of current weather. Always plan to have a burn crew member assigned to observe weather conditions.

Successful grassland burning and smoke management is based largely on adequate weather knowledge. Before a fire is set, the weather forecast should be known for at least the next 24 to 48 hours.

The National Weather Service (NOAA) is usually the best source of local weather forecasts and information, particularly for forecasts of several days in advance. The best source of up-to-date forecasts is a continuous broadcast weather radio. Secondary sources of weather forecasts and outlooks are the meteorologists at local television, radio stations, or universities who should be able to provide reliable 48-hour advance forecasts.

Some suggested internet resources include the following:
http://www.weatherunderground.com,
http://www.weather.gov, http://www.intellicast.com, and
http://www.weather.com.

Site Specific Burn Prescriptions

Job Sheet 338 - JS, Prescribed Burn Plan, includes a table on page 2 entitled "Acceptable Conditions for Prescribed Burns". The same table appears in the example burn plan in Appendix A of the National Range and Pasture Handbook. This prescription table was developed for the more humid portions of the upper Midwest using a fire behavior model entitled BEHAVE. A combination of relative humidity (RH) and wind speed is used to determine whether or not fire behavior will fall into an acceptable range of conditions. The table begins at 25% RH and goes up to 89% RH. At these relatively high RH values air temperature ceases to be a significant factor in fire behavior. Conditions that do modify the RH/wind speed combination include percent cloud cover and time of day. Consideration of these two modifying conditions is included within the body of the table. In general, hotter, faster and more complete burns will occur in the upper right portions of the table and cooler, slower, less complete burns in the lower left portions of the table. The prescription table found in Job Sheet 338 – JS has been applied successfully in this region for more than a decade and is perhaps the most useful tool available for conducting prescribed burns in Illinois.

General ecological prescriptions

For a detailed description of fire effects on a particular plant or wildlife species, see the Fire Effects Information System at: http://www.fs.fed.us/database/feis/welcome.htm. For more information on effects of burning at different times of year see McCarty, et al. 1997. The following is summarized from Schlichtemeier (1967), Kantrud (1986) and Wright and Bailey (1980).

1. Warm-season grass species, e.g. big bluestem (Andropogon gerardi), and little bluestem (A. scoparius), Indiangrass (Sorghastrum avenaceum), switchgrass (Panicum virgatum), gentians (Gentiana spp), and Maximilian's sunflower (Helianthus maximiliana):

Best increases in seed production, vigor, and canopy cover are obtained with late spring burns when warm season grasses have attained 1 to 1½ inches of initial growth. Consider applying a prescribed burn to only 1/3 of the area annually due to nesting species.

2. Cool-season species, e.g. green needlegrass (Stipa viridula), Kentucky bluegrass (Poa pratensis), needle-and-thread (Stipa comata), western wheatgrass (Agropyron smithii), quackgrass (A. repens), pasque flower (Anemone patens), and white onion (Allium textile):

Best responses in seed production, vigor, and canopy cover are obtained with very early spring (March-April) or late summer (August-September) burns.

3. Mixtures of exotic cool-season grasses and legumes, e.g. smooth brome (Bromus inermis), tall (Agropyron elongatum) and intermediate (A. intermedium) wheatgrass, alfalfa (Medicago sativa), and sweet clovers (Melilotus spp):

Best responses in seed production, vigor, and canopy cover are obtained with burns during March and April; least response by legumes in late summer-early fall burns. Consider applying a prescribed burn to only 1/3 of the area annually due to nesting species.

4. Shrubs, e.g. western snowberry (Symphoricarpos occidentalis), silverberry (Elaeagnus commutata), chokecherry (Prunus virginiana), and raspberry (Rubus spp):

Spring burns (April - May) generally induce shrubs and brush to sprout, but frequent fires may reduce the frequency of woody plant cover. Backing fires when shrubs and small trees show first signs of full leaf size will top kill some shrubs and trees, resulting in root sprouting.

5. Burns should be planned so that no more the 1/3 of the available nest cover is burned annually. Many species use residual cover for nesting and if all cover is burned within the nesting range of individuals; the individuals may not reproduce during the year of prescribed burning.

For details see Schlichtemeier (1967), Kantrud (1986), and McCarty, et al, 1997.

METHODS OF SPREADING FIRE IN GRASSLANDS

There are three basic kinds of prescribed fires: backing, flank, and head fires.

Backing fires burn into the wind. Fire is started along a prepared baseline firebreak such as a road, plowed line, stream, wetland, or black line, and allowed to burn into the wind.

Backing fires are generally the easiest way to burn. Flame lengths are shorter, rate of fire spread is slow, and smoke density is generally less than in head or flank fires. Backing fires burn hotter at the ground surface and do a better job of total fuel consumption than head or flank fires. Top kill of undesirable vegetation can be achieved if fuel load is great enough and undesirable vegetation is small in size.

Backing fires work best with wind velocities of 4 to 12 mph from a constant direction. Some disadvantages are the time required and the need for interior firelines at frequent intervals (usually every 500 to 1000 feet) to allow for more than one ignition point to speed up the burning of a large or long area. Burning downward on slopes has an effect similar to backfires in flat country.

Flank fires burn at oblique angles to the wind direction. Flank fires are somewhat similar to backing fires in that lines of fire are set to burn into the wind but at angles to the wind direction. Flank fires are often used to secure the flanks of a ring fire before setting the head fire, as described below. This method of firing can stand little variation in wind direction and needs expert crew coordination and timing.

Head fires burn with the wind. They have greater flame lengths, faster rates of spread, greater smoke volumes, and burn cooler at the ground surface than backing fires or flank fires. Containment becomes more critical as wind speed and fuel quantity increase. Great care must be exercised to ensure that the fire will not escape. Burn out a strip downwind with a backfire wide enough to contain the head fire. Often the best top kill of undesirable woody vegetation is achieved with a high-intensity head fire.

BASIC WAY TO CONDUCT A BURN

Assuming a completed burn plan with all equipment, and personnel on site and ready, an effective way of conducting a grassland prescribed burn is described below:

Determine the onsite wind direction by holding up a light cloth, tossing dry soil or residue into the air, or by watching the smoke and fire behavior from a small (less than 20 square feet) test fire.

Put out the test fire, then plot the wind direction as an arrow on your burn unit map. The point where the arrow strikes your farthest downwind firebreak is referred to as the baseline identifying where the fire will be ignited. Thus, the initial fire will be a backing fire.

1. Before igniting the fire at the baseline, again go over the basic burning plan and procedures with your crew, explain alternate courses of action on the map should the wind shift or should the fire breach a fire control line. (An example of a completed Burn Plan, IL JS-338, can be found in Appendix A). Inform the crew where the fire boss will be during the sequence of the burn and how to keep in constant communication with the fire boss. Also provide contingency fire control plans for wind shifts.

2. If the burn has only one person setting fire and the wind is blowing perpendicularly toward the firebreak, then start the backing fire at one end of the baseline firebreak. If the wind is blowing diagonally across the burn unit, start the backing fire at a corner or bend in the baseline firebreak.

3. If only one person is setting fire and starting at a corner, the fire should be set in a series. First set 300 feet or less of fireline on one side of the corner and then about the same length on the other until a backing fire has been established along about a fourth of the perimeter length.

If the burn crew has two people setting fire and the wind is blowing perpendicularly to the baseline firebreak, start the fire at the midpoint of the baseline with fire setters moving in opposite directions from the midpoint. When the wind is blowing diagonally across your burn unit, start at the downwind corner with the people setting fire moving away from each other.

Starting a fire at a corner with two fire setters rather than with one is much easier. Corners and points are higher risk areas to burn than gradual curves, so when possible bend fire containment lines around corners and obstacles rather than using sharp angles.

4. After setting the fireline along the full length of the baseline and rechecking fire containment measures along the baseline, monitor the backing fire until a buffer strip 50 to 100 feet wide has been burned. Increase the buffer strip to more than 100 feet in width if winds are more than 8 mph. The baseline should not be considered secure until the buffer strip has been burned. Then and only then, can the fire boss prescribe action to complete the rest of the burn.

Steps 1 through 4 as presented above are recommended for any grassland fire. At the end of step 4, the rest of the burn can be completed with whatever burning pattern fits the objectives, equipment, and fire crew size and experience. For example, if the prescription requires a backing fire pattern, at the end of step 4 no new firelines are begun and the old fireline is monitored constantly by the fire crew until the backing fire reaches the fire containment line or consumes all of the fuel. If your prescription requires a surround pattern (ring fire), then at the end of step 4 the fire setter(s) continue setting flank fires and ultimately a head fire, taking care to skip no perimeter segments, until the total perimeter of the fire unit area is burning.

FIRE SETTING AND CONFINEMENT EQUIPMENT

The following list provides a check off of items needed to set, contain, or extinguish grassland fires. Asterisks have been placed beside the items necessary to all crews. The items without asterisks are optional or may be practical only on large burns.

Cell Phones with fire protection district or fire dept. phone numbers.*
Matches and/or sparkers*
Two-way radios *
Flappers*
Rakes or hoes
Shovels
Fuses
Drip torches (at least 1 backup torch)*
Backpack pumps*
Fire extinguisher (all vehicles)*
Extra torch fuel*
Extra engine fuel and oil*
Wire cutters (all vehicles)*
First aid kits and air splints*
Fire shelters
Maps of burn unit and locale*
Drinking water*

Flag/Signs for Roads
Weather RadioSmoke masks, respirators
Fire pumper units
Goggles (chemicals)
Water tanker unit or other water supply*
Foam unit
Tool kit
Bulldozers
Road graders
Tow chains, cables, or ropes
Handyman jacks
Chain saw
Chemical retardants (wet or dry)
Wetting agent
Belt weather kit*
Hard hats*
Tractor plus plow or disk
Safety clothing, e.g., Nomex*

As an additional precaution, extra sets of the necessary (*) items or an equivalent item should be kept on hand by each crew.

POST-BURN MONITORING, MOP-UP, AND CLEANUP

The fire is not over until all of the burn unit and its fuel are cold and not producing smoke. There are three basic steps to post-burn assessment:

1. perimeter monitoring
2. necessary mop-up of smoking or burning pieces or patches of fuel
3. site cleanup.

The last two steps do not begin until the fire has burned across the burn unit.

Perimeter monitoring

Perimeter monitoring of the burn unit is a continuous function from the onset of the fire until the fire boss determines the fire to be out and cold. After the main passage of the fire, monitoring intensity can be lessened. Usually, one person can periodically patrol the perimeter of the burn unit, watching for fires or smoke.

Mop-up

Mop-up includes any actions to put out smoke, hot coals, or flames from anything within the burn unit or within spot fire distances. Mop-up actions may include drenching with water or fire retardant chemicals, smothering with a covering of soil or sand, flapping and raking the fuels apart, or, if time permits, simply monitoring the area until everything gets cold and there is no more smoke production.

Site cleanup

Post-burn site cleanup may be as simple as removing all personnel and equipment from an area or as complex as renovation of firebreaks and the removal of undesirable rubbish. Site cleanup activities should not begin until the burn unit is declared cold and all monitoring and mop-up are complete.

EVALUATION OF FIRE EFFECTS ON THE ENVIRONMENT

Adequacy of plans and preparations

An evaluation of the preburn, burn, and post-burn operations should take place soon after the burn is complete and should answer:

1. Were there any accidents?
2. Were there any fire control problems (escapes or near escapes)?
3. Were there any smoke or air pollution problems?
4. Was the burning pattern correct?
5. Was the burn practical, considering the constraints and sensitive issues or areas?
6. Were there any unexpected detrimental fire effects on the soil, water, vegetation, or wildlife?
7. Was there any adverse post-burn publicity or reactions?
8. Were the primary objectives met?
9. Should this grassland unit receive consideration for future fire management, or should alternate land use practices be used?
10. What would you do differently the next time this area is burned?

Adequacy of the prescription on vegetation

Evaluations are usually made at least 30 days or more after a fire and periodically during several post-burn years. Example questions for evaluations are:

Did the burn increase the biological productivity of the area (e.g. increased nesting success, increased plant species diversity)?

1. Did the burn enhance target plant species numbers or coverage?
2. What percentages of nuisance or noxious plants were killed or reduced by the burn?
3. Was the composition of the plant and animal communities altered by the fire? If so, how much?
4. For how many years after the fire were livestock gains still noticeable?
5. How many post-burn years of vegetative regrowth were necessary to bring litter accumulations back to the preburn status or condition?

An evaluation can be time consuming and needs to be proportionate to the burn objectives, preburn planning, and prescription. It should be brief and yet descriptive.

EQUIPMENT PURCHASE AND REPAIR

Equipment purchase and repair

Soon after the last fire of the burning season, repair and purchase equipment and start preparing for the next year's burning season. Prescribed burning is hard on equipment. Every item should be checked in a standardized annual evaluation process. Make daily checks of all equipment after the completion of each burn. Do not store backpack pumps in areas subject to freezing temperatures to prevent damage to brass fittings.

ASSOCIATED TECHNICAL STANDARDS

This technical note will be used in association with conservation pracice standards 338 Prescribed Burning and 394 Firebreak.

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