Fire Nourishes Biological Diversity in the Northern Great Plains

by Carolyn Hull Sieg and Rick Fletcher,
Rocky Mountain Research Station

The Northern Great Plains region, stretching from Nebraska north through the Dakotas and into Manitoba, Saskatchewan and Alberta, Canada, is paved by seemingly endless expanses of grassland. The midsection of the region, dominated by mixed-grass prairie, is bordered by tallgrass prairie on the eastern edge. This sea of grass is broken by the forests of the Black Hills, and woody vegetation in draws, riparian areas, and on north-facing slopes. These are dynamic ecosystems, shaped by successional processes and abiotic disturbances such as fire, drought, and wind. The importance of disturbances in shaping these native plant communities is receiving increased attention by resource managers.

Mixed-grass prairie and Rocky Mountain juniper woodlands, Badlands National Park, SD.

Carolyn Hull Sieg, Research Wildlife Biologist at the Rocky Mountain Research Station's Laboratory in Rapid City, SD, is one of several Forest Service scientists and other natural resources specialists seeking a better understanding of the impacts of disturbances on the Northern Great Plains, specifically fire and its potential for maintaining and improving these ecosystems.

"An understanding of the frequency, timing, and intensities of past fires is necessary before fire can be incorporated into a strategy to conserve prairie systems," says Sieg. Historically, prairie fires were started by lightning and American Indians. Lightning was, and continues to be, an important ignition source in the Northern Great Plains. Historical accounts written between 1673 and 1920 reveal that fires accidentally or intentionally set by American Indians were common in the region. Fires were set to attract and herd wild animals, signal threats and warnings, improve pasture, mask and eliminate signs of campgrounds or trail use, and for pleasure, warfare, and ceremonies.

Using historical records and tree scar measurements, Sieg and other researchers estimate that fires occurred as often as every 1 to 5 years in the more mesic portions of the region, but less frequently in areas of rough topography and in lowlands. Lightning-caused fires occurred more often in July and August. American Indians set fires in nearly every month of the year; however, the greatest number were set in April, September, and October.

Developing a Fire Management Strategy

Researchers believe that the fire strategy most likely to manage diversity in the Northern Great Plains is based on two premises:

1) processes that mimic, as much as possible, the variability found in native ecosystems should be present and functioning; and

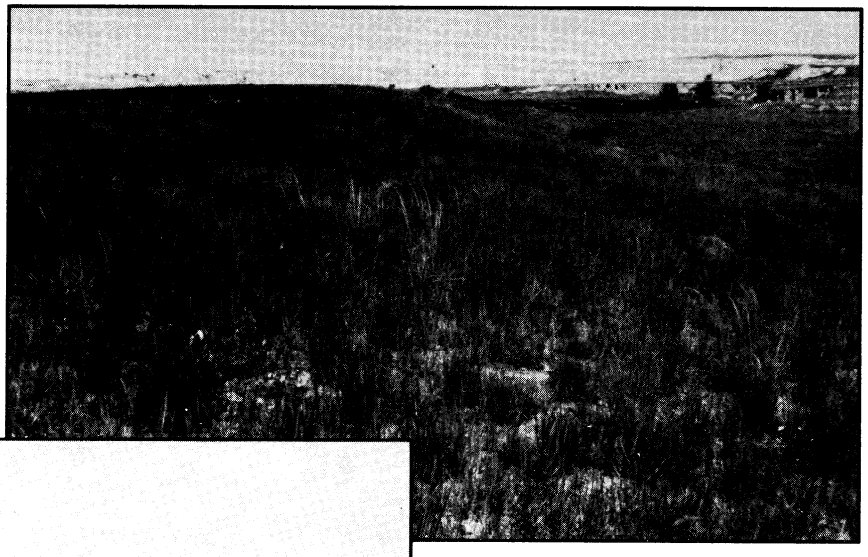
2) management activities should conserve or restore historical disturbance patterns.

"This strategy should reflect the differing roles that fire historically played in the various portions of the region," says Sieg. "However, this strategy must also address the fundamental changes that have occurred in the landscape, such as drastically different landscape patterns imposed by species changes and management unit boundaries."

One approach suggested for the Northern Great Plains is a scenario that mimics the presettlement fire history, including some high intensity summer fires on a return interval of 5 to 30 years. Shifting burning programs from all spring or fall bums to include some midsummer bums can favor some plant species not enhanced by spring or fall bums. For example, an April fire bums early foliage critical for root production of cool-season plants, leaving late-season plants unscathed; an August fire bums the largely inactive foliage of cool-season species, while consuming foliage and reproductive stems of warm-season species. Given the highly variable fire regime in the past, Sieg believes that bums of varying intensities at differing seasons are appropriate. Studies show that the interval between fires should be varied to best restore fire disturbance patterns of the Northern Great Plains. The strategy should avoid a uniformity in timing of bums or in intervals between bums that artificially simplifies what was probably a more complex system.

Biological Diversity

Reinstituting a fire regime based on historical processes that includes burning at varying intervals and in differing seasons is the first step in developing a strategy for using fire to manage biological diversity on native rangelands in this region. The second step involves assessing the direct and indirect impacts of fire on special habitats and sensitive plant species. "Special habitats are native biological communities or ecosystems that are rare, unique, or highly productive elements of regional landscapes," says Sieg.



This series of before, during and after photographs shows a controlled burn of crested wheatgrass (a planted, exotic species) conducted in the Badlands National Park, SD, to restore mixed-grass prairie.

"Sensitive species include those native species currently in danger of extinction or those whose population trends are negatively affected by human actions." The special habitats of the Northern Great Plains (wetlands, lowlands, and riparian areas) contain high numbers of listed vulnerable species. Sieg stresses that if sensitive communities such as these occur within a management unit, burning programs should be examined relative to the impacts on these habitats.

Wetlands, lowlands, and riparian woodlands in this region are examples of communities that, because of higher moisture, likely burned less frequently than uplands. However, the narrow configuration and close contact of these woodlands with flammable grassland fuels suggest that, historically, they were exposed to a high number of grassland fires. Earlier research found that, since the species composition in woody draws includes a number of deciduous species, and that several woody species establish best in mineral soils, fire probably functioned as a regeneration mechanism in these systems. Further, since these communities stay green longer than uplands, fires probably burned late in the growing season when there were adequate levels of cured, fine fuels. Repeated, annual fires, especially during droughts, tend to favor the growth of grasses over woody plants. Fires occurring infrequently when plants are dormant, followed by high precipitation, may enhance woody plant growth. "If the goal is to regenerate woody plants in woody draws, and/or to mimic historical fires, prescriptions should be set to achieve high intensities," says Sieg.

Threatened and Endangered Species

Threatened or endangered plant species are examples of sensitive species whose needs cannot be ignored. Because they are the first species to drop out of ecosystems, they are considered the weakest link in the conservation of native biological diversity. Vegetation management can be a useful tool for maintaining and restoring biodiversity, and for delisting or avoiding listing of certain species. Sieg says that adjusting fire management programs to meet the needs of threatened and endangered species requires an understanding of the role of fire in the long-term sustainability of the ecosystems supporting these species, and in the life history and habitat needs of individual species.

One study Sieg is leading involves the federally listed threatened western prairie fringed orchid (Plantanthera praeclara) which grows in tallgrass prairie. Although the tallgrass prairie is prone to bum every 1 to 5 years, it is unlikely that the low-lying wet land where the orchid grows bums as often, especially during wet years. "Lowlands supporting orchid populations likely burned throughout the growing season during prolonged droughts," says Sieg, "however, we found that fires that occur when orchids are actively growing are apt to injure or kill the plants. Since

fall burning allows orchids to complete their life cycle, and dry conditions and lightning are inclined to occur late in the growing season, we found that fall fires are a better choice than spring burning to sustain orchid populations and their associated habitat."

Introduced Species

The introduction of exotic species to new environments without their associated parasites and pests is a concern to resource specialists in the Northern Great Plains. Many introduced invasive species have characteristics that enable them to vigorously compete with native plants and to exploit disturbed areas. Although fire is not a panacea for discouraging introduced species, with careful planning, scientists believe it can be a useful tool. Past studies show that burning at a time when plants are most vulnerable is useful for suppressing undesirable species. Sieg points out a Nebraska study where burning in mid or late May, when smooth brome tillers are either elongating or

Western prairie fringed orchid (photo by Carolyn Hull Sieg).

heading, reduced tiller density of smooth brome by 50 percent when compared to unburned plots. However, scientists point out that burning is not a cure-all for reducing persistent species. In fact, it may even contribute to the expansion of some species such as Canada thistle. The outcome is also dependent on other factors such as climate and precipitation patterns.

One study by scientists at the Rapid City lab shows that, in addition to killing or injuring exotic plants, burning can be used to make the habitat less conducive to species expansion. Spring burning in western South Dakota killed Japanese brome seedlings for one growing season, and by reducing litter accumulations, decreased future germination rates. The key to success in managing invasive species is to begin treatment before expansive spread occurs and to focus as much as possible on the invaded ecosystem rather than on the invader.

Additional information about this research and related studies is available in the paper, The ***Role of Fire in Managing for Biological Diversity on Native Rangelands of the Northern Great Plains,*** by Carolyn Hull Sieg. The paper is contained in, ***Conserving Biodiversity on Native Rangelands: Symposium Proceedings,*** General Technical Report RM-298, available from the Rocky Mountain Research Station. You can contact Carolyn Hull Sieg by writing to her at:

Rocky Mountain Research Station, Forestry Sciences Laboratory, 501 East St. Joseph, Rapid City, SD 57701.

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