KONZA PRAIRIE
BIOLOGICAL STATION

Konza Prairie Fire Ecology and Management Fact Sheet

A tallgrass prairie is a dynamic system. Periodic fire, grazing, and a variable climate are all important natural components of tallgrass prairie ecosystems.

Historically, fire has had an important role in the development and maintenance of tallgrass prairie, preventing or suppressing woody plants. Simply, fire keeps trees from encroaching and taking over a prairie.

The goals of KPBS prescribed burning program are to 1) preserve the tallgrass prairie ecosystem, and 2) to study the effects of fire on the flora, fauna, and ecological processes.

Konza is divided into experimental units subjected to different prescribed fire treatments including:

1. annually burned (Spring)
2. burned every 2 years (Spring)
3. burned every 4 years (Spring)
4. burned approximately every 20 years (Spring)
5. burned in the summer (July)
6. burned in the autumn (November)
7. burned in the winter (February)

There are at least two replicates of each fire treatment. Mowed "fireguards" separate each. The boundaries of these units coincide with watershed boundaries (watershed= all the land area draining into a given stream).

The total area subjected to prescribed burns on Konza varies each year from approximately 3000 acres to 5000 acres.

A variety of prescribed burning techniques are used on Konza depending upon weather and fuel conditions and watershed topography. These include backfiring, headfiring, flank firing, strip firing, and most commonly, a ring fire technique.

Headfires = fires moving with the wind, they have a tendency to move quickly (large flame, lots of smoke)
Backfires = fires moving against the wind, they have a tendency to move more slowly (small flame, little smoke)
Flank fires = fires that move parallel to or at oblique angles to the wind. Lines of fires are set to burn into the wind but at angles to the wind direction.
Ring fires = fire surrounds and area and works in towards the center (most frequent type of fire on Konza)
Strip fires = multiple fire lines parallel to each other that work towards each other (widening the blackened area)

Prescribed burning on KPBS is more difficult than burning grazed pasture in a typical ranch setting because of the large amount of fuel in ungrazed watersheds, irregular watershed boundaries, and bordering highways. Thus, burning is conducted only under a restricted set of conditions (e.g. winds 5 to 15 mph steady from one direction). Prescribed burning on KPBS requires a crew of 12 to 16 persons for each section being burned.

Research conducted on Konza has identified several ecological effects of fire in the tallgrass prairie:

1. Spring burning stimulates the growth, tillering (development of new grass shoots from the base of the plant), and seed production of warm-season grasses (bluestems, Indiangrass, switchgrass). All of these developments are considered positive. Cool-season grasses (brome, bluegrass, fescue) and woody plants decrease in abundance with frequent spring fires. Forb (broadleaved herb) responses vary considerably among species.

2. Prairie plant species diversity is greater at intermediate fire frequencies (every 4 to 6 years). Annual burning results in a shift toward dominance by warm season grasses and very infrequent fire results in a reduction in prairie grass and forb species (loss of biodiversity) and increases in woody vegetation.

3. The percentage of exotic species (non-native) in the plant community decreases as fire frequency increases.

4. Varying the seasonal timing of burning (e.g. late spring, early spring, summer, winter) is an important tool for altering the plant species composition of the prairie. Plants respond differently to burning at different times, and different grasses are favored by burning in different seasons.

5. Fire is the major factor influencing the distribution and grazing patterns of bison. Bison graze preferentially on recently burned sites during late spring and summer, and unburned watersheds during cooler months. Higher grazing intensity on burned sites, in turn increases plant diversity, offsetting the effects of annual burning alone.

6. The most important effects of fire on the prairie ecosystem occur through the removal of dead plant material (litter), which may build-up to levels 2-3- times any single year's production. A thick litter layer reduces light availability to shoots, ties up nutrients, and keeps the soil cool in the spring, delaying plant growth. Removal of the liter layer increases spring soil temperature, which increases both microbe and root activity in the soil. These changes favor the dominant warm season grasses.

7. Fire releases the nitrogen bound in dead vegetation. Much of the nitrogen is lost to the atmosphere as it volatilizes in the heat of a fire. While some nutrients such as phosphorus and potassium remain in the ashes after a fire, most of the nitrogen goes up in smoke. This represents a major avenue for N loss from the prairie. Because nitrogen is an important nutrient for both plants and animals, this affects both plant communities and the animals that feed on them. Frequent burning in the absence of grazers results in reduced available nitrogen in the soil, and tighter recycling of N between soils and plants. Grazers can offset this effect, by the release of N-containing urine and feces, and available soil nitrogen will be greater in areas grazed by bison or cattle regardless of whether they are burned or not.

8. The frequency of fires on the tallgrass prairie can affect the amount and distribution of organic matter (or stored carbon) in the soil. The majority of carbon in the prairie is stored in the soil. Frequent fires reduce the amount of organic matter stored in surface litter and soil, but increase the growth of roots, which can help store carbon deeper in the soil. The net storage of carbon (also called "carbon sequestration") depends on the balance between losses and gains of carbon, and how those are affected by management practices and climate. Long-term monitoring of watersheds with different fire frequencies, and plot-level experiments manipulating fire and climate, are allowing KPBS scientists to test the effects of fire and other variables on soil carbon storage.

9. In years with adequate rainfall, fire increases productivity of tallgrass prairie by 20-40% compared to unburned sites, especially in areas with deep soil (i.e., lowland sites). The effects of fire on plant productivity also vary with fire frequency. Sites that had been previously unburned for several years typically have higher productivity following a spring fire, than sites that are burned annually. This is due to a build-up of available soil N between fires, which regrowing plants can utilize when a fire does occur.