EFFECTS OF FIRE ON VEGETATION DYNAMICS IN TALLGRASS PRAIRIE: 30 YEARS OF RESEARCH AT THE KONZA PRAIRIE BIOLOGICAL STATION

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ABSTRACT

Fire is a key factor shaping the structure and dynamics of tallgrass prairie ecosystems. Since 1972, studies at the Konza Prairie Biological Station (KPBS) have been examining the effects of fire on plant and animal populations and communities, and on ecosystem-level processes. The 3,487-ha preserve is divided into 55 watershed units (average size = 60 ha), each subjected to a specific combination of prescribed fire frequency (burned in the spring at 1-, 2-, 4-, 10-, or 20-y intervals) or fire season (burned in February, April, July, or November), and grazing treatment (grazed by bison [*Bison bison*], cattle, or ungrazed). These experimental treatments, replicated at the watershed level, allow large-scale studies of the effects of varying fire regimes, and their interaction with grazing effects, on tallgrass prairie.

These long-term studies at KPBS have shown that frequent fire in tallgrass prairie (e.g., annual or biannual spring burning) increases the competitive dominance and relative abundance of warm-season perennial C_4 grasses and decreases the relative abundance of subdominant C_3 graminoids and forbs, resulting in a decrease in plant species richness and diversity. Frequent fire also significantly reduces the cover and frequency of woody plant species, and in the absence of fire, complete displacement of native prairie by woody vegetation can occur in <4 decades. Long-term study at KPBS has also shown that frequent fire reduces the frequency of exotic grass and forb species in tallgrass prairie plant communities. The reduction in floristic diversity due to frequent fire is offset by grazing, which increases plant species diversity. Plant species richness is not significantly affected by season of burn. Plant species respond differentially to season of fire, although there is a general increase in the relative abundance of perennial forbs under frequent dormant-season (autumn or winter) fire.

These vegetation responses are driven by fire effects on nutrient cycling processes and on shifts in the relative limitation of key plant resources (light, water, and nutrients). Many plant population and community responses to fire in tallgrass prairie are mediated by fire effects on mutualistic symbiotic associations between plants and arbuscular mycorrhizal fungi.

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