RESEARCH BRIEF

Landscape and site level responses of woody structure and ground flora to repeated prescribed fire in the Missouri Ozarks

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In this study, researchers assessed effects of landscape-scale, repeated prescribed fire for nearly two decades on forest overstory, midstory, and ground cover for nine ecological land type classifications (ELTs) in the Missouri Ozarks. They documented changes in species richness and abundance and patterns of turnover within plant communities between pre-burn and post-burn conditions.

The study occurred in the Current River Hills in southeastern Missouri within the Missouri Ozark Forest Ecosystem Project (MOFEP) and the Chilton Creek Management Area (CCMA). Forests are predominantly oak-hickory, and parent materials include dolostone, chert and sandstone, yielding cherty, clayey, nutrient-poor soils. ELT classifications were based on parent rock, soil depth, slope position (such as shoulders, ridges, backslopes, benches and waterways) and aspect class (protected: north and east slopes; and exposed: south and west slopes).

Three unburned control units, between 312-514 hectares each, were established at MOFEP and five burn units ranging from 160 to 240 hectares were located at CCMA. Here, one unit was burned annually, and the others were burned at randomly determined 1-4 year intervals, during March or early April using low to moderate intensity fire. Control units had no forest management since around 1950, either by fire or timber harvest. ELTs were similar for control units and burn units.

A total of 245 plots were established among the five burn units, and 124 plots across the three control units. Circular 0.2 ha plots were used to record overstory trees (greater than 11.4 cm diameter at breast height (dbh)). Within these, four circular subplots (.02 ha) were used to record midstory trees (3.8-11.4 cm dbh). Within each of those subplots were four 1 m² quadrats, totaling 16 per plot, used to sample ground flora. Plots were measured between 1995 and 2017, at intervals of 4-8 years at any given site.

Species within plant communities were compared pre-burn and post-burn, with separate analyses conducted for each ELT, which included identifying indicator species for each. Plant species were separated into seven functional groups: ferns, forbs, grasses, legumes, sedges, vines, and trees/shrubs. Calculations included total species richness (number of species), relative species abundance, and percent cover.

MANAGEMENT IMPLICATIONS

- On most ecological site types, repeated prescribed fire led to an increase in species richness, but this trend was stronger on drier, exposed sites, and was weaker on moist, protected sites. Species richness decreased on the wettest sites.
- Ground flora abundance more than doubled in prescribed fire units but did not increase in control areas.
- Plant communities responded gradually to prescribed fire. Ground-cover abundance took about ten years to double, and species richness did not respond significantly until about 15 years after burning began.

Left: *Periodic burn unit at Chilton Creek Management Area (CCMA) in October 2015.* ***Right:*** *Annual burn unit at CCMA, May 2015, after 17 years of prescribed fire. (Photos: Denise Henderson Vaughn, left, and Calvin Maginel, right)*

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Landscape and site level responses to repeated prescribed fire

Study results support previous findings that low-intensity prescribed fire reduces abundance of small-diameter trees but has less effect on larger size trees (see Knapp et. al 2015, and our associated Research Brief, RB-14). During the 20-year study, in all treatment areas, basal area in the overstory increased 16% even though trees per hectare decreased 14%. In the midstory, tree numbers decreased 336% in units burned periodically and 185% in annual burn units, but only by 38% in control units.

Also consistent with previous studies, this research demonstrated that repeated burning increased herbaceous ground cover. Total ground flora cover increased a modest 31% in control units but more so in burn units, increasing by 107% in the annual burn unit and 144% in periodic burn units. Cover of forbs, grasses, and legumes increased during the study period for both types of burn treatments. In the annual burn unit, forbs increased 154%, grasses increased 119%, and legumes increased 369%. In periodic burn units, forbs increased 187%, grasses 222%, and legumes 240%. Cover of shrubs, sedges, and woody vines also increased throughout the study period on both burn units and on control units. Species richness increased in six of nine ELTs that were burned periodically, with those increases ranging from 11% to 43%, but did not change in any control units.

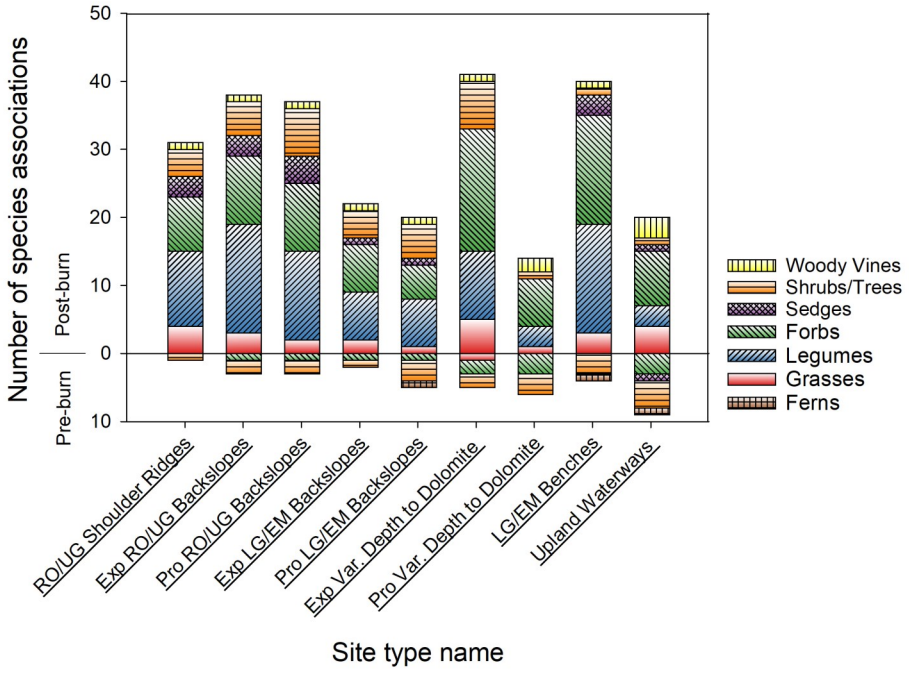
Significant differences were documented between ELTs. Midstory tree stem density was higher in protected site types than on exposed shoulders and backslopes. Similarly, total ground cover abundance was significantly greater in areas around waterways compared to shoulders, shoulder ridges, and high benches.

Post-burn species richness varied significantly depending on ELT. On most site types, richness increased, with this trend stronger on drier, exposed sites and weaker on moist, protected sites. Hence, richness increased on exposed shoulders, ridges, and higher elevation backslopes; it remained about the same in lower-elevation protected sites; but on upland waterways, the wettest site type, species richness was reduced on sites burned annually, decreasing 32% over the 20 year study. Authors suggest that fire-sensitive plants were reduced in upland waterways.

Researchers identified plant communities that grew in conjunction with each of the nine ELTs, both pre-burn and post-burn. Flowering dogwood (*Cornus florida*) and common blue violet (*Viola sororia*) were significant indicators of unburned communities. On burned units, indicator species included multiple varieties of sedges (*Carex* spp.), grasses (primarily *Dichanthelium* spp.), and legumes (primarily *Lespedeza* and *Desmodium* spp.). In addition, eastern milkpea (*Galactia regularis)* and hairy sunflower *(Helianthus hirsutus)* appeared to be indicators of burned sites.

In general, a larger number of species were indicators of communities in burned areas than in unburned. However, this trend was weaker on protected sites and upland waterway sites than other site types.

Of possible concern to land managers is that despite two decades of repeated burning, the overstory remained at a density typical of forests or closed woodlands, so a high percentage of sunlight was intercepted and did not reach ground flora. If increased sunlight is a management goal, then more time or cutting stems to reduce stand density may be necessary.



Count of species with significant Indicator Values by site type, separated by functional group, with the values above the horizontal line at 0 representing the number of species with significant associations to post-burn communities and the values below the line representing the number of species associated with pre-burn communities. Site type names include aspect, formation and lithology, and soil depth, which are exposed (exp) and protected (pro), Roubidoux sandstone (RO), Upper Gasconade dolomite (UG), Lower Gasconade dolomite (LG), and Eminence—Potosi dolomite (EM), and variable (Var.) depth to dolomite where it is present in the soil.

FOR FURTHER READING

Knapp, B.O., Stephan, K., and Hubbart, J.A. 2015. Structure and composition of an oak-hickory forest after over 60 years of repeated prescribed burning in Missouri, USA. Forest Ecology and Management 344: 95–109.

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