

EFFECTS OF LONG-TERM PRESCRIBED BURNING ON STRUCTURE, COMPOSITION, AND TIMBER QUALITY OF OAK-HICKORY FORESTS IN THE MISSOURI OZARKS

Benjamin O. Knapp and John M. Kabrick¹

ABSTRACT

Introduction

Prescribed fire is commonly being used as a management tool for restoring or maintaining woodlands in the Central Hardwood Forest region. Woodlands are characterized as having canopies that are more open than those of forests, with lower abundance of woody stems in the midstory and understory layers, and a dense, diverse ground flora that is dominated by herbaceous species. Frequent fire may promote the structure and composition associated with woodlands by reducing the encroachment of woody stems in the subcanopy layers and encouraging the development of herbaceous vegetation (Hutchinson et al. 2012, Kinkead et al. 2013, Peterson and Reich 2001). However, many questions remain regarding the application of prescribed fire, especially over long timeframes. This paper reports on the effects of over 60 years of prescribed burning at regular intervals in oak-hickory forests of the Missouri Ozarks.

Methods

This study was established in 1949–1950 in University Forest Conservation Area (previously University State Forest) in Butler County, Missouri (36°55' N, 90°15' W). A randomized complete block design with two blocks that were located about 1.6 km apart was used. Within each block, six 40 m x 40 m plots were established, and two plots in each block were randomly assigned one of the three following treatments: Control (no prescribed fire); Annual (prescribed fire applied every year); and Periodic (prescribed fire applied every 4 years). Prescribed burns were conducted from March to May during scheduled burn years. Prior to the installation of this study, the stands consisted of all-aged oak-hickory forests that had not been burned for at least 20 years (Paulsell 1957).

In summer 2013, we recorded fire scar presence and diameter at breast height (d.b.h.) for all trees ≥ 10 cm d.b.h. In each plot we established five circular subplots (0.01 ha) and tallied all woody stems ≥ 1.5 m tall but < 10 cm d.b.h. by species. All woody stems < 1.5 m tall were tallied by species in four 1-m² quadrats in each subplot, and all standing vegetation < 1 m tall was clipped from four additional 1-m² quadrats in each plot to determine biomass. Analysis of variance was used to determine treatment effects on stand structure, composition, and the presence of fire scars.

Results

Total basal area of overstory trees ≥ 10 cm d.b.h. was significantly greater on the Control plots (23.2 m²/ha) than on the Periodic plots (17.0 m²/ha) in 2013. The basal area on Annual plots (19.3 m²/

¹ Assistant Professor (BOK), University of Missouri, School of Natural Resources, 203S Anheuser-Busch Natural Resources Building, Columbia, MO 65211; and Forest Researcher (JMK), U.S. Forest Service, Northern Research Station. BOK is corresponding author: to contact, call 573-882-0867 or email at knappb@missouri.edu.

ha) did not differ from that on the other two treatments. There was no significant treatment effect on the number of overstory trees per hectare despite there being 335 trees on Control plots, 250 trees on Annual plots, and 186 trees on Periodic plots. Species in the white oak group contributed >70 percent of the basal area and trees per hectare on the Annual and Periodic plots but only around 50 percent on the Control plots. On the Control plots, hickories (*Carya* spp.) made up 10 percent of the basal area and 20 percent of the trees per hectare but represented <5 percent for either variable on Annual and Periodic plots. In total, 60 percent of the canopy trees on Periodic plots had at least one fire scar and 7 percent of trees on Annual plots were scarred.

Large midstory (3.00–9.99 cm d.b.h.) stems were the most common on Control plots (510 stems per hectare), with 30 stems per hectare on Periodic plots and zero stems per hectare on Annual plots. Small midstory (1.50–2.99 cm d.b.h.) stem density did not differ among treatments despite zero small midstory stems on Annual plots, 1,586 stems per hectare on Control plots, and 1,288 stems per hectare on Periodic plots. There was very little herbaceous vegetation biomass on Control plots (1.6 kg/ha), and the biomass of herbaceous vegetation did not differ between burned plots (Annual = 382 kg/ha; Periodic = 481 kg/ha).

Conclusions

Our results demonstrated that long-term prescribed burning at intervals of 4 years or less created the structure and composition associated with woodlands by reducing stand basal area and increasing production of herbaceous vegetation. Burning annually eliminated woody stems from the subcanopy layers, but periodic burning resulted in continual resprouting that retained small saplings in the midstory layer. However, there has been no apparent recruitment of new canopy trees in burned plots since this study was initiated in 1950. Given the prevalence of fire scars on the periodically burned plots, this fire regime is likely to reduce timber quality and may affect the longevity of canopy trees.

Acknowledgments

This research was partially funded by a Research Council grant sponsored by the Office of Research at the University of Missouri. The study plots are maintained and managed by the Missouri Department of Conservation with special thanks to Mark Pelton. We also thank Michael Hullinger and Dave Bourscheidt for their help with data collection and organization.

Literature Cited

- Hutchinson, T.F.; Yaussy, D.A.; Long, R.P.; Rebbeck, J.; Sutherland, E.K. 2012. **Long-term (13-year) effects of repeated prescribed fires on stand structure and tree regeneration in mixed-oak forests.** *Forest Ecology and Management*. 286: 87-100.
- Kinkead, C.O.; Kabrick, J.M.; Stambaugh, M.C.; Grabner, K.W. 2013. **Changes to oak woodland stand structure and ground flora composition caused by thinning and burning.** In: Miller, G.W.; Schuler, T.M.; Gottschalk, K.W.; Brooks, J.R.; Grushecky, S.T.; Spong, B.D.; Rentch, J.S., eds. *Proceedings of the 18th Central Hardwood Forest conference*. Gen. Tech. Rep. NRS-P-117. Newton Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 373-383.

Paulsell, L.K. 1957. **Effects of burning on Ozark hardwood timberlands.** Agric. Expt. Stat. Res. Bull. 640. Columbia, MO: University of Missouri. 24 p.

Peterson, D.W.; Reich, P.B. 2001. **Prescribed fire in an oak savanna: fire frequency effects on stand structure and dynamics.** Ecological Applications. 11: 914-927.

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