

CHANGES IN GROUNDLAYER COMMUNITIES WITH VARIATION IN TREES, SAPLING LAYERS, AND FIRES DURING 34 YEARS OF OAK SAVANNA RESTORATION IN OHIO, USA

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PURPOSE AND SCOPE

Like many open habitats, sustainability of oak savannas in midwestern North America depends on periodic disturbances such as fires to curtail encroachment by tall woody plants. An uncertainty in restoring and sustaining oak savannas is how frequently fires must occur to maintain the groundlayer of herbaceous plant diversity savannas are known for and what levels of tree canopy and sapling layer encroachment trigger shifts in groundlayers. In an oak savanna undergoing restoration in northwestern Ohio, we examined how groundlayers changed with temporal variation in tree (≥ 10 cm in diameter) and sapling (< 10 cm in diameter) layers and prescribed fires. We also discuss the ongoing challenges and alternative management strategies of maintaining oak savannas.

METHODS AND APPROACH

The study site is a restored oak savanna (40 ha) on sandy soil at Oak Openings Preserve Metropark (1737 ha), OH. Six permanent vegetation plots (0.05 ha) were remeasured up to 17 times from 1988 to 2021. During this period, prescribed fires were implemented in spring or fall on a variable schedule, and a tornado in 2010 hit the site, greatly reducing oak tree canopy cover. For each vegetation sampling event, we visually categorized percentage of aerial cover of 42 vascular, savanna plant species, and measured basal area of all trees ≥ 1 cm in diameter. We used regression trees to model savanna plant cover and richness, and indicator species analysis to associate species cover with tree and fire estimators (Dufrêne and Legendre 1997).

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FINDINGS AND IMPLICATIONS

Groundlayer cover was maximized when tree basal area was $<13 \text{ m}^2/\text{ha}$ (35 percent of tree canopy cover), there were fewer than 100 trees/ha, and fire had occurred since the previous growing season (fig. 1). Illustrating attrition in groundlayers above these thresholds, two-thirds of savanna groundlayer cover disappeared when tree density exceeded 100 trees/ha and when over 2 years passed without fires. Through savanna species persisting at low cover, species richness endured longer between fires (>4 years), doubled during periods with at least one fire in 3 years, and increased by a third when saplings were sparse (<80 stems/ha). Savanna groundlayers during the 34-year study fluctuated with intermittent increases and decreases associated with dynamics in trees, saplings, and time since fire.

For oak savanna restoration, oaks are both a critical component of the habitat as well as one of the biggest threats, in the form of rapidly encroaching saplings. Although frequent prescribed fires are a critical management method for restoring or maintaining oak savannas, additional complementary disturbances on the sapling layer such as mastication or grazing may also be necessary.

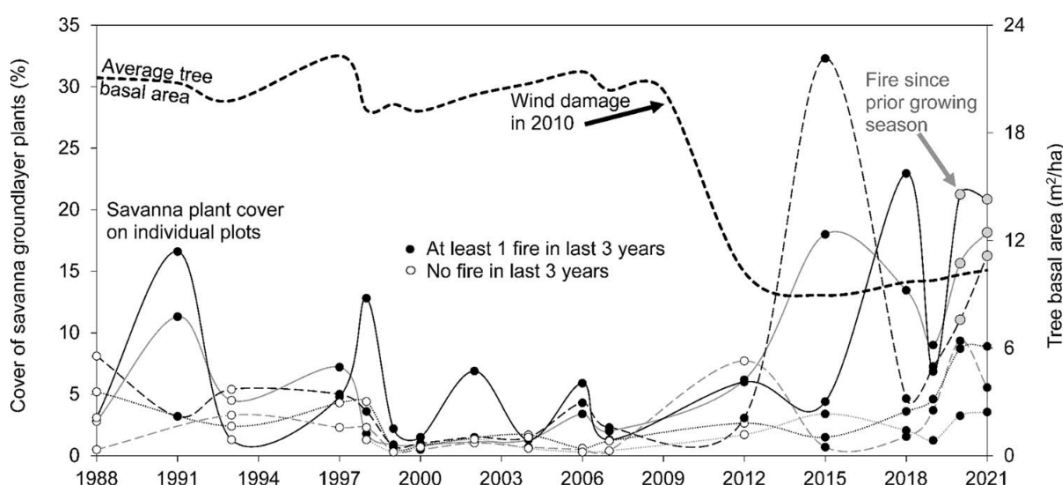


Figure 1—Prescribed fire history, change in basal area of trees, and cover of savanna plants during 34 years of oak savanna restoration, northwestern Ohio. Circles represent sample years on six plots. For the last 2 years of the study, fire history is subdivided into whether a plot received fire since the prior growing season (gray = yes; black = no, but still burned at least once in the last 3 years).

LITERATURE CITED

Dufrêne, M.; P. Legendre. 1997. Species assemblages and indicator species: The need for a flexible asymmetrical approach. *Ecological Monographs*. 67: 345–366. [https://doi.org/10.1890/0012-9615\(1997\)067\[0345:SAIST\]2.0.CO;2](https://doi.org/10.1890/0012-9615(1997)067[0345:SAIST]2.0.CO;2).

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