# CARBON STORAGE OF RESTORED OAK SAVANNAS TREATED WITH VARYING FIRE FREQUENCY AND SEASONALITY COMPARED TO A CLOSED-CANOPY FOREST AND AN OLD FIELD IN TENNESSEE, USA

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## PURPOSE AND SCOPE

Oak savannas comprise a bilayer structure of low-density, pyrophytic overstory oaks and a diverse herbaceous understory maintained by frequent, low-intensity surface fire. However, oak savannas represent <1 percent of their original range because of fire exclusion over the last century and consequent transition to closed-canopy forests (Barrioz et al. 2013). Generally, savannas store less overstory carbon (C) than closed-canopy forests because of fewer trees, but savannas and other fire-dependent open forests may store more resilient C in understory vegetation, fine roots, and mineral soil (Bennett et al. 2017). The specifics of fire implementation required to effectively restore and maintain oak savannas, such as frequency and seasonality, also may influence C storage.

## METHODS AND APPROACH

We conducted a study at the Bridgestone/Firestone Centennial Wilderness Wildlife Management Area in central Tennessee, to investigate the effects of fire frequency and seasonality on C sequestration in restored oak savannas. Stands sampled represented 1-, 2-, and 3-year fire return intervals, with both early and late growing-season fire in separate burn units. In addition, we sampled an adjacent closed-canopy forest and old field for comparison. We estimated C pools within three 15-m fixed-radius plots per stand by estimating biomass of live trees, snags, downed fine and coarse woody debris, understory vegetation, leaf litter, and organic soils by using current or modified U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis protocols, in combination with published or laboratory-determined bulk density and C content values for litter, organic soils, and understory vegetation. We additionally harvested soil monoliths for coarse root estimates and cored soils to 30-cm depth for fine root and mineral soil C estimates.

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## FINDINGS AND IMPLICATIONS

Based on preliminary analyses, aboveground C pools were greatest in the closed-canopy forest, intermediate in restored savannas, and lowest in the old field, apart from understory vegetation, which was significantly lower in the closed-canopy forest than everywhere else. Fire frequency and seasonality treatments within the restored savanna had no impact on aboveground C pools. Fire seasonality but not frequency appears to influence fine root C, with early growing-season burn units exhibiting higher fine root C than late-season units. No differences in percentage of C in mineral soil were detected, however trends and tradeoffs in C pool quantity and location may change as the study continues. Our project contributes to a holistic understanding of the benefits of oak savannas, which include herbaceous species diversity and resilient C storage as aboveground C pools become increasingly vulnerable.

## LITERATURE CITED

**Barrioz, S.; Keyser, P.; Buckley, D. [et al.]. 2013.** Vegetation and avian response to oak savanna restoration in the mid-south USA. The American Midland Naturalist. 169(1): 194–213. https://doi.org/10.1674/0003-0031-169.1.194.

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## ACKNOWLEDGMENTS

The authors thank members of the Auburn Forest and Fire Ecology Lab for field and lab assistance. This research was supported in part by the U.S. Department of Agriculture, Forest Service FS-22-JV-11330180-064, and the U.S. Department of Agriculture, Forest Service with funding from the Inflation Reduction Act of 2022 (FS-23-JV-11221632-156).