Tallgrass Prairie and Oak Savanna
Fire Science Consortium

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

Release: July 2014
Contact: Tracy L. Hmielowski
Phone: 608-890-4713
Email: thmielowski.tpos.firescience@gmail.com

Does long term use of prescribed fire influence soil properties?

Scharenbroch, B.C., B. Nix, K.A. Jacobs, M.L. Bowles. 2012. Two decades of low-severity prescribed fire increases soil nutrient availability in a Midwestern, USA oak (Quercus) forest. Geoderma 80-91.

There is little documentation of long term impacts of low-severity fires on soils in the Midwest. Instead, the effects of fire on soil properties (physical, chemical, and biological) are often considered to be short term or associated with high severity wildfires. The authors of **this study compared soil properties of oak-dominated forests managed with frequent prescribed fire for 23 years with soil from an unburned oak-dominated forest.** They had two objectives. First, to compare soils from sites managed with and without fire, and second, to determine if differences in aboveground vegetation between the two sites were influenced by soil properties.

This study was conducted at the Morton Arboretum in northern Illinois. Soil samples and vegetation data were collected from sites managed with either low-intensity prescribed fire every 1-4 years (referred to here as burned sites), or an unburned control site. Soils at Morton Arboretum were described by the authors as "deep and moderately-well to poorly drained" and sites were dominated by mesic soil types. Because soil samples were collected 12 and 24 months after the last prescribed fire the authors attributed any differences in soil properties to long-term effects and not to short term post-fire response.

Management Implications

- The oak-dominated forests in this study managed with history of prescribed fire had greater nutrient levels compared to unburned sites
- Management of these sites with long term low-severity fires did not result in negative impacts on soil which have been observed following high severity fires (e.g., loss of soil C, decreased invertebrate diversity)
- The benefits of prescribed fire for productivity of oak woodlands may be the result of increased soil nutrients in addition to increased light availability

The authors found significant differences in soil properties and vegetation structure between burned and unburned sites. The burned sites had greater pH, conductivity, cation levels (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}), $NO3^{-}$, total N, total organic carbon, and particulate organic carbon. Burned sites also had a more open canopy and greater herbaceous richness than unburned sites.

There were no differences in the invertebrate communities (found in litter) or soil biological properties (e.g., soil invertebrate community, earthworms, microbial biomass), and of the 8 soil physical properties measured (e.g. % sand), the only difference was a greater soil moisture in burned sites.

Although teasing apart the relationships between soil characteristics and vegetation is difficult, several of the patterns observed by the authors

may be of interest. The greater nitrogen levels may be an indirect effect of fire, where changes in other soil properties or microbial activity result in greater N mineralization. Woody and herbaceous species richness were positively influenced by light availability and soil nitrogen availability. These results suggest that soil nutrient dynamics may influence the observations of vegetation response to fire.

The authors conclude **frequent low-intensity fires are a good strategy for increasing diversity of herbaceous plants in oak-hickory forest** sites. The authors also point out the need for continued monitoring of both aboveground and belowground characteristics when evaluating fire effects.

It is also important to note that there may be negative consequences associated with prescribed fire. These sites are well managed for invasive species, but **the increase in nutrients associated with prescribed fire could provide an opportunity for invasive species to establish**. Because of this, using prescribed fire in areas where there is a high degree of disturbance or high presence of invasive species should be paired with other mechanical methods or herbicide for invasive species control.

Left photo: A fall burn conducted in oak dominated woodland. Right photo: Post-burn recovery at a site the spring after a fall burn. All photos provided by B. Scharenbroch.