

The Species Composition of Hardwood Litter Drives Fuelbed Moisture and Flammability

In 2008, Greg Nowacki and Marc Abrams coined the term “mesophication” to describe the process of maples and other “mesophytes” (species of moist habitats) becoming more abundant in oak-dominated forests. They provided evidence that fire suppression was a primary cause of this widespread change. They also noted that prescribed fire to favor oak would likely become more difficult because fuel beds with litter from the ever-increasing mesophytes, would be less flammable. However, at that time, rigorous research on the flammability of litter from most eastern tree species was lacking. Several recent studies have aimed to address this knowledge gap, by comparing the characteristics of litter fuel beds, such as wetting, drying and flammability. A new paper authored by Jesse Kreye, an Assistant Professor of Fire and Natural Resources Management at Penn State University, compares the moisture dynamics and flammability of litter fuel beds with different amounts of litter from “pyrophytes” (fire-adapted oaks and hickories) and mesophytes.

Methods:

- Recently fallen leaf litter from 6 pyrophytes (oak and hickory species) and 3 mesophytes (sweetgum, winged elm, flowering dogwood) was collected from an oak-hickory forest in northern Mississippi.
- In the laboratory, fuel beds were created with 0%, 33%, 66% and 100% mesophyte litter. Fuelbeds were fully wetted and moisture content and drying rates were measured over time. The fuel beds were also burned at several different stages to determine flammability, measured as flame height, flame time, smoldering time, and consumption.



Surface fire behavior in oak dominated litter during a prescribed burn in north Mississippi. Photo by Morgan Varner.

Key Findings:

- Fuel beds with more than half of the litter from mesophytes (66% and 100%), gained more moisture during the wetting process and also dried more slowly.
- As the percentage of mesophyte litter increased, the controlled burning experiments in the lab showed that flammability decreased.
- Even when fuel beds were allowed to dry to similar moisture contents (about 14%, at equilibrium with the lab atmosphere) the fuel beds with >50% mesophyte litter were less flammable than those with 0% and 33% mesophyte litter.
- Some good news for prescribed fire: Fuel beds with a modest amount (33%) of mesophyte litter, dried and burned much like fuel beds with 100% oak-hickory. This finding indicates that in forests where oak and hickory are still dominant but mesophication is taking place (stands with an oak-hickory overstory and a mesophyte-dominated understory), litter fuels are still quite flammable under the right conditions.

Links to paper:

[Kreye, J. K., Varner, J. M., Hamby, G. W., & Kane, J. M. \(2018\). Mesophytic litter dampens flammability in fire-excluded pyrophytic oak–hickory woodlands. *Ecosphere*, 9\(1\).
<https://doi.org/10.1002/ecs2.2078>](https://doi.org/10.1002/ecs2.2078)

[Nowacki, G. J., & Abrams, M. D. \(2008\). The demise of fire and “mesophication” of forests in the eastern United States. *Bioscience*, 58\(2\), 123-138.
<https://doi.org/10.1641/b580207>](https://doi.org/10.1641/b580207)

Related research:

<https://www.appalachianfire.org/oak>