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## On Long-unburned Sites, Oak-hickory Dominance Can Lead to Greater Delayed Canopy Dieback After Wildfire Due to Greater Duff Consumption and Fine Root Damage

*Dominance of ectomycorrhizal (ECM) oaks and hickories vs. arbuscular mycorrhizal (AM) maples and poplars is a contributing factor*

In Appalachian forests, overstory tree mortality after fire is usually associated with high intensity fires (flame lengths >4') that cause significant bark char and bole damage. However, in the southeast recent studies have shown that in long-unburned longleaf pine sites, the smoldering consumption of accumulated pine duff, and the fine roots located in the duff, can lead to significant mortality of large trees stressed by the loss of fine roots. A newly published paper in the journal *Ecosystems* [Benefit or Liability? The Ectomycorrhizal Association May Undermine Tree Adaptations to Fire After Long-term Fire Exclusion](#) examines duff and fine root consumption and delayed tree stress in long-unburned oak-hickory forests after a slow-moving wildfire in the southern Appalachians in 2016. The authors focus on how fire effects varied by overstory composition, from sites dominated by ECM-associated oaks and hickories- sites with slower decomposition and more duff, to sites dominated by AM-associated maples and poplars, with faster decomposition and less duff.



### Study location and methods

- Rock Mountain wildfire site in the Chattahoochee and Nantahala National Forests, GA, NC, which burned >22,000 acres in November and December 2016. The fire was mostly slow-moving and low-severity (little immediate post-burn tree mortality) but often burned deep into the duff layer. The forests were oak-hickory with maple and poplar more abundant on mesic sites.
- In 2017 the research team set up plots in adjacent burned and unburned areas, on four site types: ridge, mid-slope N-facing, mid-slope S-facing, and low-elevation.
- Trees >4" DBH were evaluated each year 2017-2019. Relative dominance (basal area) by ECM (oaks, hickories, others) and AM (maples, poplars, others) trees was determined.
- Depth and mass of the forest floor (litter, duff) was evaluated 1-year post-burn

### Study location and methods cont.

- Depth and mass of the forest floor (litter, duff) was evaluated 1-year post-burn
- In the laboratory, abundance of fine roots in the duff and upper mineral soil was determined from field samples.
- Decomposition rates of ECM (oaks, hickories) litter and AM (maples, poplars) litter were also measured in the field.

### Key findings

- Unburned plots showed that duff loadings increase with oak-hickory dominance. With greater abundance of the ECM oaks and hickories, litter decomposition rates slow and duff accumulates without periodic fire.
- Duff consumption was significant- loadings were 75% lower on burned plots vs. unburned plots – and, because oak-hickory sites had greater amounts of duff, more was consumed on those sites.
- Fine roots were abundant in the duff layer, so on sites dominated by oak-hickory, which had greater duff accumulation, more fine roots were consumed. Of all the fine roots located in upper soil (8”) and duff, the authors estimate that 40% were consumed on the strongly oak-hickory dominated sites.
- The greater duff and fine root consumption on oak-hickory dominated sites was related to greater canopy dieback by year 3, as only about 30% of trees had a full crown, though topkill or mortality was relatively low (16% of trees), at least up to year 3.

### Take home points for management

- Although oaks and hickories are fire-adapted, the duff accumulation that occurs with long-term fire exclusion makes oak-hickory dominated sites susceptible to post-fire tree stress and mortality as duff and fine roots are consumed when wildfires occur in drought conditions.
- Prescribed fires conducted in non-drought conditions will have much less duff consumption and fine root damage.
- Repeated fires can limit duff accumulation and thus the probability of fine root damage and tree mortality if a wildfire were to burn under drought conditions.

The authors of the study are from the [Odum School of Ecology](#), University of Georgia (Dana Carpenter, Nina Wurzbarger), the [Center for Forest Disturbance Science](#), USDA Forest Service, Southern Research Station (Mac Callahan, Louise Loudermilk, Joseph O’Brien, Melanie Taylor), and [Tall Timbers Research Station](#) (Kevin Hiers).

Melanie Taylor, a co-author and Ecologist with the Southern Research Station, commented on this research "*What we have learned from this work is that the novel fuels caused by long-term fire exclusion lead to negative effects, upon the reintroduction of fire, on tree species that we generally consider to be fire-adapted. Those novel fuels are deep organic horizons, or duff, on the forest floor that are driven by the slow decay of oak/hickory leaf litter, coordinated by ECM fungal associations, and are allowed to accumulate due to absence of fire.*"

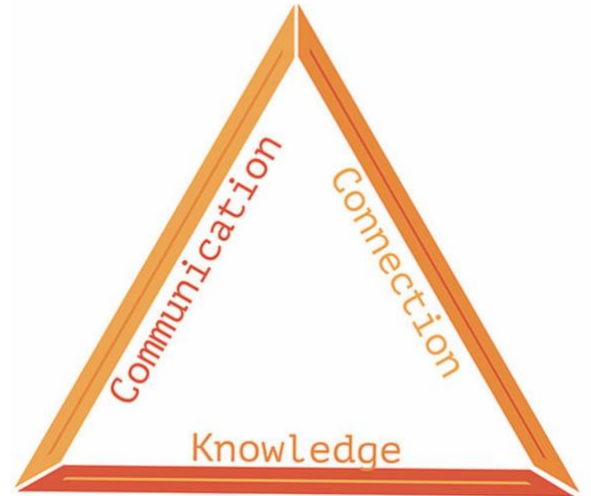
# Fueling Collaboration....

## Season 2

If you missed the first series of Fueling Collaboration that occurred this past winter, then you are in luck. There is another series planned for this coming winter.

These are interactive panel discussions designed to encourage collaboration between fire managers and scientists. The series is built on questions from the registered attendees.

To register for season 2 or view recordings from season 1:  
<https://www.fuelingcollab.com>



### Fire and the Carbon Cycle

Nov. 18, 2021 - Exploring the dynamic role that fire plays in soil nutrient cycling, carbon dynamics, and other ecosystem processes.



### Fire and Timber Management in Mixed Woods

Dec. 16, 2021 - Challenges and opportunities for using prescribed fire in oak-pine forests that have both timber and natural community management values.



### Smoke is NOT Just Smoke

Jan. 20, 2022 - What are the messages we should be communicating? What are the tools that can help us assess impacts?



### Fire and the Wildland Urban Interface in the eastern U.S.

Feb. 17, 2022 - How wildfire, prescribed fire, and climate change intersect in the WUI of the East.



### Thinking Beyond Fuel Reduction

Mar. 17, 2022 - Prescribed fire is more than an alternative to wildfire. We'll discuss some of the benefits of controlled burns besides fuel reduction.



## NC PRESCRIBED FIRE WORKSHOP

Did you miss the NC Prescribed Fire Council 2020 Workshop? Click below to view the recordings:

<https://www.appalachianfire.org/past-workshops-and-webinars/2020/10/5/presentations-from-the-2020-nc-prescribed-fire-council>

### Request for Research Needs

Do you have ideas for research needs in the Appalachian region?

If so, we would like to hear from you! We are compiling a list of research needs to submit to the Joint Fire Science research needs database. Please send your ideas to [helen@cafms.org](mailto:helen@cafms.org).



#### Communicate with Us!



Find us on twitter @APfirescience or find us on Facebook by searching Consortium of Appalachian Fire Managers and Scientists.

#### Join CAFMS:

The consortium is for all land managers and researchers in the region who deal with any aspect of fire. To join, simply provide us with some contact information at the web site listed below.

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