



Post-fire *Quercus* mycorrhizal associations are dominated by *Russulaceae*, *Thelephoraceae*, and *Laccaria* in the southern Appalachian Mountains

Karen W. Hughes¹ · Jennifer A. Franklin² · Jennifer Schweitzer¹ · Stephanie N. Kivlin¹ · Alexis Case¹ · Matthew Aldrovandi⁴ · P. Brandon Matheny¹ · Andrew N. Miller³

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Abstract

Following disturbances such as wildfires, oak seedlings must form a symbiotic association with mycorrhizal fungi to survive. Wildfires, however, reduce available mycorrhizal fungal propagules in the soil. Ectomycorrhizal (ECM) fungi on oak seedlings sampled in severely burned (7 sites), moderately burned (7 sites), and unburned areas (8 sites) in the Great Smoky Mountains National Park were evaluated 21 months after the 2016 Chimney Tops 2 Wildfire by Sanger sequencing of the nuclear ribosomal DNA internal transcribed spacer region (nrITS; fungal barcode). Sequences were aligned and grouped into Operational Taxonomic Units (OTUs) based on well-supported phylogenetic clades and 98–100% nrITS sequence homology with sequences in GenBank. One hundred seventy-nine root-associated fungi comprising 124 OTUs were recovered after removing duplicates (the same fungus on two or more roots of the same plant). The ECM genus *Russula* was the most diverse genus (25 OTUs), followed by the *Thelephora/Tomentella* clade (18 OTUs), *Lactifluus* (8 OTUs), *Lactarius* (4 OTUs), and *Laccaria* aff. *laccata* (2 OTUs). *Russula* OTUs were identified more frequently on oak roots from burned areas and in burned soils, suggesting that some *Russula* taxa may have a selective advantage in burned areas. High alpha diversity occurred within each of the burn categories, but little overlap of taxa occurred between burn categories (high beta diversity). Approximately half of the recovered OTUs (100/179 total root-associated fungi = 55.9%) were found on a single plant. Oak seedlings growing in moderately and severely burned areas 21 months after a fire were capable of forming root associations with available fungi. In contrast to the expectation that root-associated fungal diversity would be reduced after a wildfire, diversity 1 year after the Chimney Tops 2 Fire was high with ectomycorrhizal *Laccaria*, *Russulaceae*, and *Thelephoraceae* dominating. This study suggests that the availability of ECM fungi post-fire is not a barrier to oak re-establishment.

Keywords Community ecology · Fungal diversity · Ectomycorrhiza · Species richness · Wildfire recovery

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✉ Karen W. Hughes
khughes@utk.edu

¹ Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN 37920, USA

² Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37920, USA

³ Illinois Natural History Survey, University of Illinois Urbana-Champaign, Champaign, IL 61820, USA

⁴ Division of Forestry, Organization Tennessee Department of Agriculture, LaFollette, 211 N Indiana Ave, 37766, TN, USA

Background

Wildfires are an essential component of ecosystems worldwide (Marlon 2020). Many ecosystems are dependent on wildfires, but the frequency and intensity of wildfires have varied over time (Calder et al. 2015; Hély et al. 2020; Hoecker et al. 2020). In the Southern Appalachian Mountains (Tennessee and North Carolina), and in forests of the eastern USA, fire prevention strategies have successfully suppressed forest fires for approximately 100 years (Nowacki and Abrams 2008; Aldrich et al. 2010; Flatley et al. 2011, 2013; Lafon et al. 2017). In the Great Smoky Mountains National Park (GSMNP), fires have been largely suppressed since the Park was established in 1934 (Flatley et al. 2011,