

Article

Fine-Scale Environmental Heterogeneity Shapes Post-Fire Macrofungal Richness in a Mediterranean Relict Forest

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Abstract

Mediterranean relict forests, including Laurisilva and other humid forest refugia, are rare and ecologically distinctive habitats often embedded in fire-prone landscapes. Understanding how these ecosystems respond to disturbance is essential for biodiversity conservation and land management under increasing fire risk. However, the effects of fire on key components of these forests, such as macrofungi, remain poorly understood. Here, we examined how fine-scale spatial heterogeneity in fire severity, topography and vegetation shapes post-fire macrofungal communities in a Laurisilva relict forest in central Portugal. Fire severity reduced mycorrhizal richness while having negligible effects on saprotrophs, leading to shifts in the mycorrhizal-to-saprotrophic richness ratio along severity gradients. A similar shift toward saprotrophs also occurred from low to moderate–high elevations, consistent with more exposed, drier conditions at higher elevations. Aspect, topographic ruggedness, and wetness showed weaker, guild-specific associations with macrofungal richness, while vegetation cover and richness had more limited influence, possibly reflecting the complexity and vulnerability of post-fire plant–fungus interactions. Overall, these results highlight the importance of conserving humid and structurally complex environments to foster post-fire fungal diversity in relict forests. More broadly, our findings suggest that fine-scale environmental heterogeneity may help sustain relict forest resilience under intensifying wildfires and other disturbances associated with land-use and climate change.



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1. Introduction

Across the globe, relict forests represent remnant fragments of ancient vegetation that persist under restricted environmental conditions and are widely recognized for their ecological distinctiveness and conservation importance [1]. In the Mediterranean context, these include Laurisilva and other humid refugia, once widespread across southern Europe, but now confined to rare, small and isolated patches within predominantly dry and fire-prone landscapes [2]. Laurisilva remnant forests in this region are maintained by humid microclimates that favor dense evergreen canopies dominated by laurel (*Laurus nobilis* L.), holly (*Ilex aquifolium* L.), and other broadleaved species [3,4], in sharp contrast to the surrounding