Drought and Microclimate as Drivers of Montane Longleaf and Loblolly Pine Seedling Mortality and Density

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Abstract

Montane longleaf pine habitat in Alabama has greatly decreased over the past several hundred years, and intact montane longleaf forests are quite rare. Frequent, intense fire is needed to maintain or restore longleaf communities, but the response of longleaf pine performance to burning can be mediated by microclimate, especially at the scale of individual seedlings. This study measured the response of seedling mortality and density to small-scale variation in humidity, soil temperature, canopy cover, aspect, slope, and leaf litter depth at two burned plots, one burned most recently 6 years ago and another burned most recently 2 years ago, and an unburned site where no fires have been recorded in recent decades. We compared the performance of longleaf pine seedlings to that of loblolly pine, its primary coniferous competitor in the ridge and valley region of the southeast. We found that density of longleaf and loblolly seedlings is greater on the ridgetops than on slopes and at burned sites as compared to unburned sites. Leaf litter depth and average relative humidity was lower at burned sites, while average daily high temperatures were higher at the burned sites. Longleaf seedlings occurred at lower leaf litter depths than loblolly seedlings, and the depth of leaf litter at which seedlings occurred did not vary among sites. Longleaf and loblolly seedling mortality was highest at the unburned site and lowest at the recently burned site. A dense mid-story has formed at the most recently burned site since the last burn, changing light availability for seedlings, although canopy cover and leaf litter did not predict seedling mortality. Differences in seedling density and mortality among sites with different burn regimes suggest that some combination of biotic and abiotic variables is influencing pine establishment, and according to our results, it appears that leaf litter depth is the most important driver of longleaf seedling density.