SIMULATING THE IMPACTS OF ALTERED FIRE REGIMES AND LANDSCAPE STRUCTURE ON THE INVASION OF *PAULOWNIA TOMENTOSA* IN THE SOUTHERN APPALACHIANS

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ABSTRACT

The southern Appalachian forests have long been under multiple environmental threats, including periodic fires, insect outbreaks, and more recently, increased invasion by exotic invasive plants. Past studies suggested these multiple disturbances interact to shape the species-rich forest landscape, and hypothesized that the changed fire regimes, interacting with increasing landscape fragmentation, may insert complex influences on patterns and processes of the invasion. The long-term impacts of fires, landscape-scale interactions among the multiple influencing factors, and the sound forest management practices to reduce the damage, however, are still unclear. We developed a modeling approach to explore the synergistic effects of fires and fragmentation on spread of an exotic invasive plant, princess-tree (*Paulownia tomentosa* [Thunb.] Siebold & Zucc. ex Steud.). LANDIS-II, a spatial explicit forest succession model, was used to simulate vegetation dynamics and plant invasion in a hypothetical xeric landscape, which captures the predominant vegetation distribution in the southern Appalachian Mountains. We parameterized a pool of the 30 most dominant trees species using the double-exponential seed dispersal algorithm. Changes of abundance of the invasive species were simulated over a 300-year period along a combined fire frequency and forest fragmentation (measured as edge density) gradient. We found that intermediate level of fire frequency (~10 years <fire spread age <300 years) promoted spread of the princess-tree, while both low and high extremes of the fire frequency spectrum limited its invasion. Under the same level of fragmentation, higher proportion of initial forested patches resulted in an increase in abundance of the species in the landscape, in part due to greater seed availability. We also found that edge densities and abundance of princess-tree retained a positive log-linear relationship over time. Our study indicates that on more fragmented landscapes, intermediate level of fire frequency increased abundance of the invasive plant that resulted from a strong edge diffusion effect, and suggests that effective fire management combined with the harvest practices of creating less forest edges can help to reduce the frequency of the invasive plant in the landscape. This information may help forest managers in the region to develop effective strategies to manage the ongoing invasive plant problem.