

SIMULATING IMPACTS OF INVASIVE PLANTS IN SOUTHERN APPALACHIAN LANDSCAPES USING LANDIS

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ABSTRACT

Landscape simulation models are a useful tool for exploring the reciprocal interactions between forest structure and a variety of natural disturbance agents including wildland fires, windstorms, pests, and disease characteristic of a landscape or a geographical area. These models have also been used to simulate the effects of a variety of human-made disturbances such as harvesting, thinning, and planting. However, the utility of this approach for examining the impact of exotic species invasion is still unclear, particularly in the southern Appalachians, where species diversity is high and the forests are often under multiple environmental threats.

We provide a conceptual framework for using a landscape simulation model to evaluate impacts of invasive species, and we present an experimental study using this approach to explore the impacts of invasive trees on forest composition and structure in the southern Appalachians. Three invasive trees—tree-of-heaven (*Ailanthus altissima*), mimosa (*Albizia julibrissin*), and

princess tree (*Paulownia tomentosa*)—were simulated in hypothetical landscapes using LANDIS-II, a spatial explicit forest succession simulation model under no fires and with fires scenarios over a 500-year period. A gap model of forest growth and nutrient dynamics was used to parameterize tree establishment probabilities.

Our results indicate that establishment probabilities of the invasive trees differ among species across the landscape, controlled largely by a combination of temperature, precipitation, soil conditions, and tree life-history traits. At the landscape scale, fire regimes affect the number of invasive trees over time. The seed dispersal trait of the invasive trees is a significant biotic factor to influence invasion success. Our study suggests that using landscape models to investigate the interactions between long-term forest succession and invasion patterns may provide a promising opportunity for planning and evaluating management strategies in forest areas damaged by invasive species and other forest environmental threats.