UNDERSTANDING MACROSCALE INVASION PATTERNS AND PROCESSES WITH FIA DATA

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Abstract—Using empirical data from FIA, we modeled invasion richness and invasion prevalence as functions of 22 factors reflective of propagule pressure and/or habitat invasibility across the continental US. Our statistical models suggest that both propagule pressure and habitat invasibility contribute to macroscale patterns of forest plant invasions. Our investigation provides insight into sub-continental invasion patterns and processes, confirming the utility of accounting for multiple invasion measures and sub-regional heterogeneity.

Biological invasions are a major component of global change, resulting in significant impacts. Despite the vast number of smaller-scale investigations, these studies cannot provide comprehensive insight into the complexities of invasions at macroscales. Stronger inferences about biological invasions may be obtained when accounting for multiple invasion measures and the spatial heterogeneity occurring across large geographic areas. We pursued this inquiry by utilizing a multi-measure, multi-regional framework to investigate forest plant invasions at a sub-continental scale.

METHODS

We mapped invasion richness and invasion prevalence across the contiguous 48 states of the USA based on FIA invasive plants dataset. To determine the extent to which different invasion measures and spatial heterogeneity affect factors most associated with invasion patterns, we modeled each invasion measure separately for eastern and western forests as a function of 22 variables reflecting propagule pressure and habitat invasibility using simultaneous autoregressive error models (SARerr).

INVASION SPATIAL PATTERNS AND DRIVERS

Eastern forests were more invaded than western forests. The invasion richness per county was twice more in the East than the West (6.1 ± 0.1 and 3.2 ± 0.2, respectively). Invasive prevalence was 48 ± 1% in the East and 10 ± 1% in the West. Invasion patterns were spatially heterogeneous both for the East and West.

Both propagule pressure and habitat invasibility contribute to macroscale patterns of forest plant invasions.

Population density, distance to the nearest port, and years since annexation by the USA were positively related to invasion richness and prevalence. We also found that human-caused forest fragmentation, along with native tree live biomass, species richness, and phylogenetic richness, was associated with the observed invasion patterns.

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DISCUSSIONS

Our investigation provides insight into sub-continental invasion patterns and processes. By accounting for spatial heterogeneity, we detected a declining effect of propagule pressure on macroscale invasion patterns. Our analyses suggest that eastern and western forests as a whole are at different stages of invasion and are influenced by different drivers, indicating a need for considering spatial heterogeneity when prescribing invasive plant management and policy.

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