

Modeling the distributions of invasive tree-of-heaven (*Ailanthus altissima*) and ragweed (*Ambrosia artemisiifolia*) in native and exotic ranges

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ABSTRACT

Explaining and predicting the spatial distribution of an invasive alien species (IAS) is of great importance for IAS prevention and early warning efforts. Because of the high potential for biological invasion between the US and China, we are investigating the distribution of Sino-American invasive plants, the environmental factors that influence these distributions, and the ability to predict them using statistical and machine-learning tools. We generated a variety of distribution models at a 10-minute grain for *Ambrosia artemisiifolia* (ragweed, a North American herb invasive in China) and *Ailanthus altissima* (tree-of-heaven, a Chinese tree invasive in the US) in both their US and Chinese ranges. Models were developed using logistic regression and the genetic algorithm for ruleset production (GARP) based on herbarium specimen locations and a suite of climatic, topographic, and land cover variables. Logistic regression model selection was based on Akaike's Information Criterion (AIC), while variables were selected for inclusion in GARP models using a jackknife-based approach. We used models developed in native ranges to "project" a potential distribution onto the exotic ranges. Results suggest that both species have not yet colonized large portions of their potential exotic range, especially *A. artemisiifolia* in China. Such "immature invasions" were also reflected in substantive differences between models developed independently for native and exotic ranges. Model disparities may also be the result of differing ecological niches due genetic factors, biotic interactions, spurious associations between distributions and climate variables. Projections of species distributions between ranges were much more reasonable when based on a conservative subset of available climate variables most directly related to ecophysiological factors. Predicted distributions based on logistic regression were comparable to those derived from GARP but the logistic regression models were more readily interpretable. Major challenges identified by this approach include accounting for spatial autocorrelation, working with presence-only distribution data, the volatile nature of invasive species genetics, and working with distributions that may not be approaching equilibrium. Predictions of potential exotic distributions of taxa based on native ranges should thus be made and interpreted with caution.

keywords: invasive species, logistic regression, genetic algorithms, distribution, China