Climate Change-Induced Invasion Risk of Ecosystem Disturbing Alien Plant Species: Comparative Analyses of Five Species Distribution Models

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Species distribution modeling is widely used for evaluating invasion risk, and for prioritizing areas for the control and management of invasive species. However, selecting a modeling tool that accurately predicts species invasion risk is a challenging task. In this study, this challenge was addressed by evaluating the performance of five species distribution models (SDMs) in predicting plant species invasiveness. The SDMs evaluated included artificial neural network (ANN), generalized linear model (GLM), multivariate adaptive regression splines (MARS), maximum entropy (MaxEnt), and random forest (RF). SDMs were assessed using the area under the curve (AUC), true skill statistics (TSS), and Kappa scores of 12 ecosystem disturbing alien plant species (EDAPS). The mean evaluation metric scores were highest in RF and lowest in ANN, which suggested that RF is the best predictor of species invasiveness among the five SDMs. The potential distribution area and invasion risk for each EDAPS were quantified using all SDMs. Under the current climate conditions of South Korea, the average potential distribution area of EDAPS ranged from 13,062-19,324 km^2, and 5.96-9.23% of the area of the country was estimated under the high risk of invasion. Invasion risk under current climate conditions was highest in highly populated cities and provinces of the Northwestern, Southern, and Southeastern regions of South Korea. However, in future climate change scenarios, RF highest proportion of the country (60.43%) under the very high-risk category for species invasiveness. Taken together, our results strongly suggest that RF is a powerful tool for predicting the distribution and invasion risk of 12 EDAPS. The modeling approaches, and the invasion risk assessment described in this study, could serve as an early planning to prevent the introduction and establishment of EDAPS and protection of agriculture lands and wildlife sanctuaries.

Keywords: Climate change, Comparative analyses, ecosystem disturbing alien plant species, invasion risk, species distribution models, South Korea