A New Approach To Ecology: Using Machine Learning to Predict the Spread of Invasive Species

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This study focuses on creating a machine learning model that will predict the spread of any invasive species. This study used hemlock woolly adelgid (HWA), an invasive forest pest that poses an economic and ecological threat to the Eastern United States as a base case. A statistical analysis of winter temperature and HWA spread indicated that bioclimatic variables can be used as factors to predict the spread of invasive species. This result motivates the primary study—a machine learning model that predicts current and future invasive species threats. This model uses the Random Forests algorithm and it incorporates nine global climate variables, presence points, and generated pseudo-absence points. We match each presence and pseudo-absence point to its corresponding nine climate variables to serve as the training data for the model. Then, we generate one thousand decision trees in Python with “threat level” being the proportion of trees that output a “presence” class prediction. The model was run for current, 2040, 2060, 2080, and 2100 climate projections. We utilize the Gini impurity equation to optimize our algorithm, a class prediction algorithm to calculate the majority tree prediction and a feature importance equation that indicates what factors affected the model the most. Lastly, we created an invasive species reporting and tracking website called “Find Your Invasive.” As the first user-interactive invasive species tracker, “Find Your Invasive” allows ecologists to know when and where an invasive will be in the future, thus enabling them to utilize effective management strategies to prevent invasive species damage.

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