ABSTRACT

Fundamental versus Realized Niches of Forest Trees: Spatially-explicit Analyses of the Effects of Climate on Growth and Mortality in Northeastern Tree Species

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Objectives. Our general objective is to use the extraordinary data resource offered by the nationwide network of forest plots maintained by the U.S. Forest Service Forest Inventory and Analysis (FIA) program to parameterize and statistically compare a suite of alternate regression models that encapsulate competing hypotheses on the nature of the empirical relationships between climate, competition, and tree growth and survival for the 24 most common tree species in northeastern forests.

Location. The proposed research will cover the 19-state region from Maine south to Virginia, and west to Illinois and Wisconsin. The region covers a broad range of existing climate and a wide range of dominant tree species.

Hypotheses. The analyses will allow us to test a suite of fundamental hypotheses about the controls over tree species distribution and abundance at local to continental scales. One of the most basic is to test whether the conclusion from our previous research that the fundamental vs. realized niches of shade tolerant species are congruent along edaphic gradients (while maximum abundance of early successional, shade intolerant species are displaced from their sites of maximum growth) also applies to the distribution of tree species along climatic gradients. If so, we should have much more success at predicting the distribution of late-successional species under changing climates than for early successional species.

Approach. We will compile a dataset from the more than 60,000 remeasured plots in recent FIA inventories for the 19-state region. We will use 1-km resolution interpolated climate data, with climate data summarized over the specific census interval in each state. Our analyses are based on likelihood methods and information theory, and allow a tight linkage between the models and the FIA data. Our analytical approach is to fit models to the data that are (1) based on knowledge of mechanisms and on underlying theory, (2) flexible enough to accurately fit the observed data, and (3) parsimonious.

Expected Accomplishments. These analyses will provide rigorous empirical estimates of the parameters of tree growth and survival functions that are essential in dynamic vegetation models that seek to predict the effects of climate change on tree species distribution and abundance. Our analyses will allow us to test for and take into account interactions between climate and competition, and will allow much more mechanistic representation of the effects of climate change on tree growth and survival in model-based assessments of the effects of climate change on northeastern forests.