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# Predicting Species Richness in Forest Inventories: Implications for Assessing Ecosystem Service Trade-offs

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## Executive Summary

We developed a model to predict herbaceous richness using stand level and management data in Forest Inventory. Our model explained 57% of the variation in herbaceous richness in coastal plain flatwoods of the southeastern USA. Results were verified using field data and stand age, forest type, time since fire, and time since herbicide-fertilizer application were important predictors of herbaceous species richness.

## Background

When land managers assess and implement forest management for uses in addition to timber production, it is important to analyze potential trade-offs and/or synergies among different uses, including timber production, carbon sequestration, and biodiversity. It is also important to understand the role of land management in determining ecosystem structure and the resulting impacts on these functions and services.

Comprehensive biodiversity conservation is an important objective of multiple use forest management and requires an understanding of the makeup of the entire forest plant community, including understory shrubs and herbaceous vegetation. Most national forest inventory data are rich in tree-level data, but the quality and quantity of data on understory shrub and herbaceous components are limited. Therefore, we developed a model to predict herbaceous richness in Forest Inventory data.

## Methods

We selected data from the literature and developed a model that combines stand history, number and type of past disturbances, and applied forest management to predict herbaceous richness. We used regression trees, models that predict the value of a target variable based on several input variables, to develop our model with an emphasis on USDA Forest Inventory and Analysis (FIA) data for coastal plain pine flatwoods of the southeastern United States (Figure 1). This approach could be generalized for other inventory data as well.

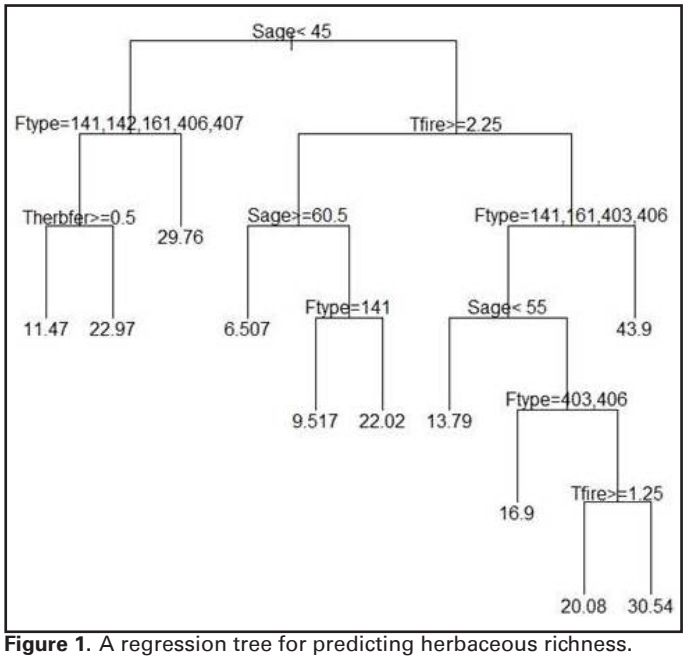


**Figure 1.** A regression tree for predicting herbaceous richness. Stand age (Sage), Forest type (Ftype), Time since last fire (Tfire), and Time since herbicide and fertilization (Therbfer) were important predictors of herbaceous richness. Values at the end of each terminal node are richness per 4 $m^2$.

## Results

Our model explained 57% of the variation in herbaceous richness. Validation of the model with an independent dataset showed that the stand-level model predicted 1 species more on average than what was observed. Results indicated that stand age, forest type, time since fire, and time since herbicide and fertilizer application—all important management activities—influenced herbaceous richness in coastal plain pine flatwoods. Results also showed that separate processes acted on older and younger stands to influence herbaceous richness. Specifically, in younger stands, forest type and time since herbicide and fertilizer application influenced richness to a degree, however, in older stands, forest type and time since fire played a more significant role in influencing herbaceous richness.

## Implications

This model provides a cost effective method for analyzing trade-offs/synergies between different ecosystem services by predicting herbaceous richness using USDA FIA data. This research will contribute to the PINEMAP goal of sustainable forest management under changing climate by providing information for the analyses of trade-offs/synergies between carbon sequestration and other ecosystems services due to change in forest management.

For more information on this research, contact Nilesh Timilsina (nilesht@ufl.edu).

Complete results will be presented in the following manuscript:

Timilsina, N., W.P. Cropper, Jr., F.J. Escobedo, and J.M. Tucker Lima. 2013. Predicting understory species richness from stand and management characteristics using regression trees. *Forests* 4(1): 122-136. doi: http://dx.doi.org/10.3390/f4010122

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