Assessing trade-offs among different ecosystem services in pine flatwoods of southeastern coastal plain

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Introduction

BACKGROUND

Forest ecosystems provide a variety of ecosystems services. Interactions (trade-offs and synergies) occur between these different ecosystem services, and management and environment can influence the interactions. Understanding these interactions and influence of management and environment is crucial for managing forest ecosystems for multiple ecosystem services and perpetuating these services in a changing global climate.

OBJECTIVES

- Assess the trade-offs between carbon, timber, and biodiversity in southeastern coastal plain flatwoods
- Identify managements that can optimize these ecosystem services and asses subsequent trade-offs
- Understand how these interactions and management effects are altered by changing global climate

Methods

STUDY SITE AND DATA

- Study Site: State of Florida, USA (Fig. 1). Mostly Northern and Central Florida
- We will use USDA Forest Service Forest Inventory and Analysis (FIA) plot level data (Woundenberg et al. 2010; http://www.fia.fs.fed.us/tools-data/)
- Our focus is on pure and mixed Longleaf, slash, and loblolly pine ecosystems
- Plot level data on land tenure, forest management, and stand and disturbance characteristics are available
- We have already calculated plot level timber and carbon values for each plot using FIA tree level data

Methods

STUDY SITE AND DATA

- We are using overstory, midstory, and herbaceous richness as a measure of biodiversity
- We have also estimated midstory and overstory richness for each plot
- Unfortunately, herbaceous richness information are not available for FIA plots

Work in Progress

- We did extensive literature review of herbaceous richness literature on longleaf, loblolly and slash pine ecosystems to generate a database that can be used to develop a model to predict species richness
- Developed a database including variables available in FIA. Variables included are: Herbaceous richness, Forest types, Physiographic class, Stand Age, Fire, Time since last fire, Site preparation, Herbicide and Fertilization, Time since site preparation and herbicide, Thinning, and Grazing
- Developed a model to predict species richness using regression tree (Fig 2.)
- We selected and validated our model using independent validation data from Georgia and Florida

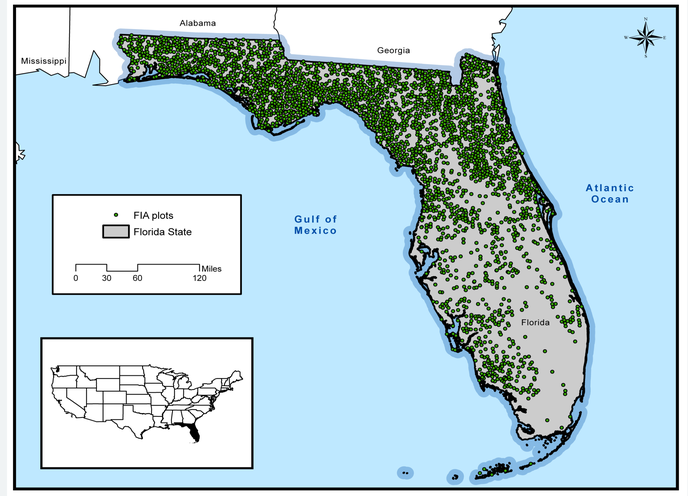

Figure 1:Map of Florida showing the distribution of FIA plots

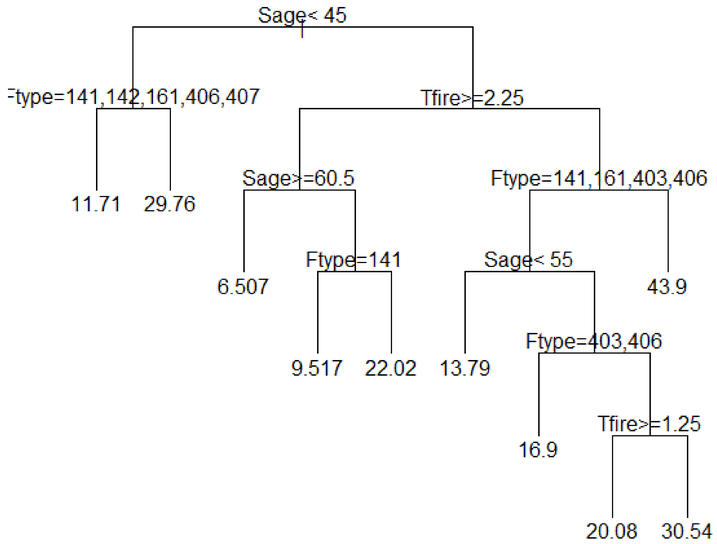

Figure 2: Preliminary regression tree model to predict herbaceous richness. Sage (Stand Age), Ftype(Forest type), and Tfire (Time since last fire) were the important predictors among all tested (see text)

- We selected models based on the minimum mean square error of prediction, mean prediction error ($\bar{e}$), and percentage error ($\bar{e}$%) on independent validation data.
- The selected model explained almost 60% of variation. The model over predicts the richness value ($\bar{e}$=-1.2, and $\bar{e}$%=12.01)

$$\bar{e} = \frac{\sum_{i=1}^{K} y_i - \hat{y}_i}{k}$$

$$\bar{e}\% = 100 \times \frac{\bar{e}}{\bar{y}}$$

$$\text{MSEP} = \frac{\sum_{i=1}^{K} (y_i - \hat{y}_i)^2}{k}$$

Future Works (Trade-offs assessment and Optimization)

- Spatial and temporal assessment of trade-offs among carbon, timber, and biodiversity
- We plan to use genetic algorithm to identify management choices that optimize these different ecosystem services
- Use different climate change scenarios and analyze the effect of climate change on these ecosystem services and interactions