

CFEOR Updates

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Conserved Forest Ecosystems: Outreach and Research

<http://sfrc.ufl.edu/cfeor>

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CFEOR Endorsed Project

Simulation of forest carbon dynamics in a north Florida landscape under contrasting silvicultural scenarios

Because of their great areal extent, southeastern U.S. pine forests serve an important ecological role, providing habitat, C sequestration, hydrology and erosion regulation, and recreation opportunities. High productivity southern forests are also a significant portion of the U.S. carbon budget. Overall, southern forests contain 12 billion metric tons of C, 36% of the sequestered forest C in the conterminous United States. The objective of this project was to quantify how different silvicultural scenarios affect the carbon balance in a 16,000 acre forested landscape in northern Florida. For the purposes of this project, tract-level carbon balance includes the effects of forest biomass increment (net primary production), soil respiration, the carbon cost associated with silvicultural activities, and carbon loss associated with decay of harvested carbon that becomes paper and solid wood products.

As a basis for our simulation scenarios, we used a privately-owned, 16,656 acre flatwoods forest tract located in Dixie County, Florida and managed by Natural Resource Planning Services, Inc. The tract is composed primarily of slash pine (*Pinus elliottii* var. *elliottii*) plantations (45% of the land area) and swamp (43% of the land area). The remaining 12% of the land base is divided among natural pine stands, food plots, pasture, natural range, borrow pits, and roads.

We simulated patterns of carbon sequestration using a model parameterized with data collected by our group using eddy covariance (a method which analyzes atmospheric data to measure net ecosystem flux of carbon) techniques over slash pine plantation forest, naturally-regenerated pine forest, and cypress swamp. Simulations were chosen to represent a range of silvicultural options likely to be considered by private and industrial pine forestland managers on the SE Coastal Plain, and included 20- and 30-year rotation regimes, and a 45-year rotation with a commercial thinning. "Evenflow" or sustained yield options were also simulated for each rotation length. In addition, we simulated two options where plantations were replaced by pasture to provide a contrast or baseline for comparison to the plantation-based options.

Left Photo: Flux tower containing eddy covariance measurement system over slash pine forest



At each 1-year time step of the simulation, the net carbon exchange rate for each vegetation type and age was multiplied by the area of that type, C losses due to silvicultural activities occurring in that simulation year were subtracted, and C transferred off site due to harvest were added to a "harvested products pool" that decayed annually at a rate that depended on the product class (paper or solid wood products). All types were then summed to obtain an annual tract-level carbon balance. Sequential years were added to obtain a cumulative tract-level NEE time series.

The average annual rate of C sequestration at the tract level depended on the rotation length and the pattern of harvest and plantation establishment. Overall, the evenflow regimes for the 30-year and 45 year rotation with a thinning were quite favorable in terms of carbon, fixing almost twice as much C per year as the next highest scenario. The primary effect of the evenflow treatments was to spread out harvest periods throughout the simulation period, resulting in more years with a positive cumulative carbon balance than the options where stand establishment was concentrated in a few years early in the simulation. The evenflow options may bear some opportunity costs associated with deferring the establishment of new plantations and harvesting of older plantations, but in terms of the temporal patterns of carbon balance for the tract, the "evenflow" options are definitely desirable.

This project is funded by the Florida Forestry Association. The main researchers are Tim Martin, Wendell Cropper, and Janaki Alavalapati at the School of Forest Resources and Conservation, University of Florida. Please contact Tim Martin, at tamartin@ufl.edu for more information on the carbon scoping project.

Upcoming Conferences

- **Public Land Acquisition & Management Partnership Conference**
Hosted by the Southwest Florida Water Management District
December 5-7 Hyatt Hotel in Sarasota, FL
For more information visit <http://www.ces.fau.edu/plam2007/index.php>

Recent Research Finding

***Melaleuca quinquenervia* dominated forests in Florida: analyses of natural-enemy impacts on stand dynamics**

Rayamajhi, Min B., Van, Thai K., Pratt, Paul D., Center, Ted D., Tipping, Phillip W. Sept 2007. *Plant Ecology*. 192 (1): 119-132.

Melaleuca quinquenervia (melaleuca) is a native of Australia but has become an invasive plant in Florida, USA. We conducted a long-term demographic study of melaleuca in three sections (central, transitional, and peripheral) of monoculture stands located in Florida, and quantified absolute density, diameter at breast height and basal area of trees by section at three sites. Additionally, we monitored the impacts of natural enemy (insects and fungi) on melaleuca populations which became apparent after 2001. Both absolute density and basal area, from before (1997-2001) and after noticeable natural-enemy impact (2002-2005), were compared.

Prior to the natural-enemy impact, absolute density of melaleuca trees declined primarily due to self-thinning and associated losses of small trees, but diameter at breast height increased, as did the basal area. Later during the period when natural enemies prevailed, absolute density declined at a significantly greater rate across all sections but was highest at the periphery. The decrease in mean absolute density and basal area/ha of melaleuca during the natural-enemy impacted period coincided with the increased incidence of the populations of plant-feeding insects and fungi. The mean diameter at breast height continued to increase in all sections of the stands throughout the study period. An increasing trend in basal area prior to natural-enemy impact was reversed after increase in natural-enemy abundance and noticeable impact in all three sections of the stands.

These findings lend support to a growing body of literature that implicates natural enemies as increasingly important density-independent regulators of *M. quinquenervia* populations.