# Effects of Longleaf Pine Restoration on Key Soil Chemical Processes

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## Objectives

We propose to examine the effects of longleaf pine (*Pinus palustris* Mill.) (LLP) ecosystem restoration on key soil chemical processes by using stable isotope ratios of carbon (C) and nitrogen (N).

## Background

This work is part of a broad long-term ecological restoration project consisting of silviculture, plant ecology, herpetology, wildlife, and soil components. Interest in restoration, management, and conservation of the LLP ecosystem continues to expand within federal and state resource management agencies, the Department of Defense, and non-governmental conservation organizations, as well as forestry professionals and private landowners, throughout the southeast. ~255,000 new ha of LLP has been established in the last decade with many more areas designated as significant landscapes for LLP restoration (see map below).

## Introduction

Research will focus on C and N cycling and variations in their pools related to LLP plantation thinning and old-field LLP planting, along with native legume and native warm-season grass groundcover restoration. These former agricultural soils, in old-field and young plantation management, have shown depleted values of C and N for several years following establishment. Previous work has shown clear relationships between soil C concentration and land use history on similar sites, with increasing values of C concentration from abandoned ag<young plantation<reference LLP. Due to differences in C isotope values between $C_3$ and $C_4$ plants, and differences in N isotope values between $N_2$ fixing versus non-$N_2$ fixing plants, we believe we will be able to track and quantify changes in soil C and N.

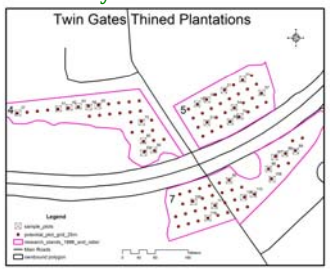
## Pre-Harvest Plantation

## Post-Harvest Plantation

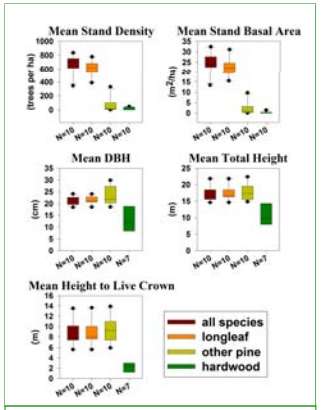
## Pre-Planted Old-Field

## Post-Planted Old-Field

## Grid Layout & Plot Selection



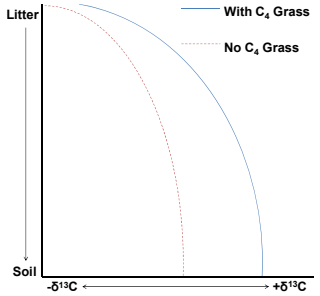

## Pre-Thin Stand/Tree Attributes

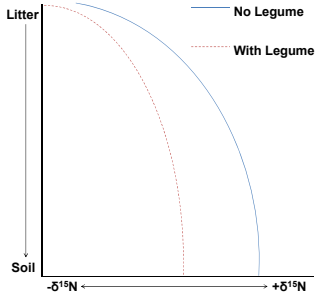



Note: These data were averaged within each plot, then within each stand, and finally across stands.

## Hypothesis

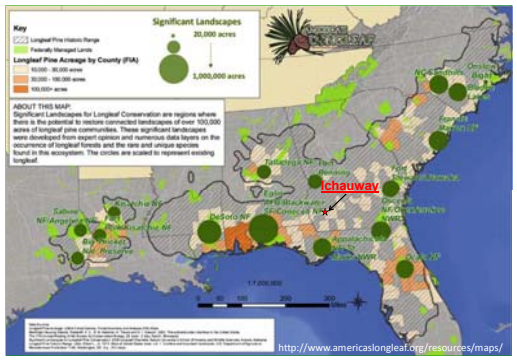
We hypothesize that C and N changes will be influenced by grass, legume, and organic matter inputs associated with groundcover restoration, pine root turnover, and prescribed fire. Stands will be driven initially by residual nutrients, shifting to groundcover influences with introduction of $C_4$ grasses and legumes, and these changes will be identifiable through differences in C and N isotope values with time as land use shifts (see graphs below).




## Materials and Methods

• Work is being conducted at Ichauway (see map below), the outdoor laboratory of the Joseph W. Jones Ecological Research Center in southwest Georgia, USA (31° 13.2'N, 84° 28.7'W), which encompasses 12,000 ha with ~1,200 ha in planted pine plantations of various ages.
• 10 LLP plantations at least 2 ha in size and ready for a first thinning were identified (see graphs at right).
• 5 stands will be planted in a native seed mix containing, *Aristida stricta* Michx. (wiregrass), *Sporobolus junceus* (P. Beauv.) Kunth (pineywoods dropseed), *Schizachyrium scoparium* Michx. (little bluestem), *Sorghastrum secundum* (Elliott) Nash (lopsided indiangrass), *Sorghastrum nutans* (L.) Nash (yellow indiangrass), *Lespedeza hirta* (L.) Hornem. (hairy lespedeza), *Desmodium strictum* (Pursh) DC (pine barren ticktrefoil), and *Crotalaria rotundifolia* Walter ex J.F. Gmel. (rabbitbells).




• 6 old-field sites were identified, prepped, and planted with LLP and 3 were seeded with the same native seed mix.
• Soils are classified as Typic (Orangeburg series), Arenic (Lucy series), or Grossarenic (Troup series) Kandiudults.
• Baseline soil characterization took place in early 2014 before thinning or planting and consisted of soils being sampled at randomly selected points from 0.10 ac (0.04 ha) grids (see map above).
• 5 soil samples from 3 depths (0-10, 10-20 and 20-50 cm) were taken at each sample point with a 5 cm soil auger and composited by depth to represent one sample per depth for each selected point.
• The 5 samples consist of 1 sample taken at the center point and 1 sample taken at each of the cardinal directions 10 m from the center.
• The number of sample points depends on the size of the stand (145 total plots).
• At each soil sample point standing intact litter (grass, legume and pine), as well as mixed forest floor material is collected in 0.25 $m^2$ rings and composited by plot.
• C and N analysis for soil and plant material is being conducted using mass spectrometry for total C and N as well as their stable isotopes at the UC Davis Stable Isotope Facility, Davis, CA.
• Proportion of coarse woody debris at each sample point is noted by line intersecting transects.
• Follow up sampling will occur in 2015 for thinned stands after herbiciding, burning, and planting, and continue every 2 years following burning for 2 burn cycles, at that time an extension of the sample period to every 4 years will be evaluated. Old-field sites will be resampled in 2017 and then follow a similar schedule as thinned stands.

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