FOREST HEALTH EVALUATION OF STAND HEALTH IN ASSOCIATION WITH BIOMASS REMOVAL AND STANDARD SILVICULURAL PRACTICES

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ABSTRACT

Forest Managers have long attempted to improve the health of their stands through management actions such as thinning, prescribed burns and biomass extraction. Few have studied impacts of these treatments on bark beetles inhabiting the roots and lower bole. Bark beetle species have the potential to weaken trees by vectoring fungal infestations in addition to causing direct mortality. Biomass removal is still a new process and its affects on the populations of these insect species at treated areas are not yet known.

Leptographium terebrantis (Barras and Perry), *L. procerum* (Kendrick) (Wingfield) and *L. serpens* (Goid.) Wingfield are known plant pathogenic fungi vectored through movement of *Hylastes* bark beetles. Southern pine regeneration efforts through the South would benefit from a more complete understanding of the impact of management practices on pathogen vectoring bark beetles.

The three treatments carried out at the experimental sites on the Oakmulgee Ranger District of Talladega National forest are biomass removal, pre-commercial thinning, and no treatment. These treatments will occur between November 2009 and February 2010. Tree vigor and management site characteristics will be related to changes in insect populations.

INTRODUCTION

Loblolly pine decline has been an issue affecting southeastern forests for decades. Trees in impacted areas begin to show signs of decline around age forty and rarely survive for a normal lifespan of 120 to 275 years. Visible symptoms of this condition are sparse, chlorotic needles, belowground deterioration of the root system, and reduced growth. Mortality occurs quickly after the first onset of visible aboveground symptoms. Afflicted trees are often located in upland, eroded areas and planted offsite. Widespread mortality of loblolly pine in many of these susceptible areas has been linked to the disease.

***Leptographium* spp. of fungi are consistently associated with loblolly pine decline. They weaken trees against other stresses and are particularly damaging to root systems. Root and lower-stem infesting insects are associated with *L. procerum*, *L. terebrantis*, *L. serpens* and *Grosmannia huntii* which transport these fungi into trees. Among the species known to transport *Leptographium* are bark beetles *Hylastes salebrosus*, *Hylastes tenuis*, and weevils *Hylobius pales*, *Pachylobius picivorus*. Bark beetles benefit from a symbiotic relationship with the fungi that they transport. They deliver fungi to new trees and in return the fungi weaken tree's defenses. Visible damage within the root and lower bole habitat of these insect species precedes the onset of easily observed symptoms in the canopy.**

MATERIALS AND METHODS

Plot layouts are in accordance with FHM (Fig. 1). There are 12 plot pairs. 5 pairs have a pre-commercial thinning, 4 pairs have a full biomass removal and 3 pairs are left as controls. Each pair of plots is composed of a symptomatic plot (slope >10%) and an asymptomatic plot (slope <10%).

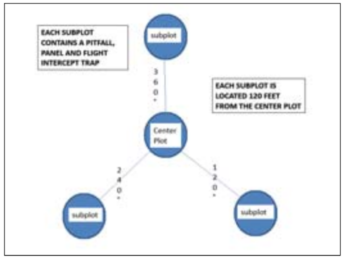

FIGURE 1. Basic FHP plot layout used at research sites

Insects are collected from traps at mixed loblolly pine stands in Talladega National Forest in west-central Alabama. Pitfall, panel and flight intercept traps are used at all subplots to collect a representative sample of insects (Fig. 2). Insects are collected biweekly, sorted, and identified (Fig. 3). Insect numbers will be used as an indication of forest health. Traps were installed March 2008.

FIGURE 2. Research plot at Oakmulgee Ranger District, Talladega National Forest, AL. All three trap types visable in photograph.

FIGURE 3. Insect identifications made at Forest Heath Dynamics Laboratory, Auburn University, Auburn AL

Crown ratings, resin volume, and five-and-ten-year growth rate measurements were collected in 2008 and will be sampled in 2009 and 2010. These measurements give a representation of tree vigor before and after the treatment. We predict that trees that have faster growth rates, fuller crowns, and greater resin production will be associated with lower insect totals.

Stands that undergo treatments show symptoms of decline and may be less healthy and have higher insect totals than control trees pre-treatment. We will be able to evaluate tree and insect parameters pre- and post- treatment.

The non-native plant surveys are conducted seasonally. Surveys began in summer 2008 and the next survey will occur in August 2009. This survey will be repeated post-treatment.

Plants are counted along continuous two-foot transect lines. Lines extend from the plot center to all subplots and additional lines extend 400 feet in the cardinal direction points from plot center. Plants are also counted on a circular walk between the subplots. This design attempts to account for invasive plants both within the plot and immediately outside the plot.

Pre-treatment data has been collected since March 2008. Treatments will occur between Nov. 2009 and Feb. 2010 and a minimum of one year of post-treatment data will be collected.

RESULTS: Invasive Species

Pre-treatment data revealed extremely low numbers of invaders. The most common species are Chinese lespedeza (*Lespedeza cuneata* (Dumont) G. Don) and Japanese honeysuckle (*Lonicera japonica* Thunb.). The majority of invasive plants have been observed by roads (Fig. 7).

- Proposed Treatment Thinning
- BM1-BM2-BM3-BM4-BM7-BM8-BM13-BM14-BM15-BM16
- Proposed Treatment Biomass Removal
- BM5-BM6-BM9-BM10-BM11-BM12-BM17-BM18
- Control
- BM19-BM20-BM21-BM22-BM23-BM24

FIGURE 7. Research plots with at least one invasive plant transect intercepting a road are in green. Research plots with no invasive plants recorded are in red.

Based on observations thus far, no sharp increase in invasive plant populations is predicted. Most areas surrounding the plots are relatively free of non-native plants.

If invasive populations do not increase over the course of this work this data will provide evidence for the ecological safety of biomass removal.

RESULTS – Insect Populations Study

-66,209 insects were identified from 3/4/08- /03/09 (Fig. 5)
-the largest number insects were caught in panel traps for most species (exceptions: weevils, *H. tenuis*)
-plots designated as controls generally appear to have slightly lower insect counts (Fig. 6)
-little difference exists between symptomatic and asymptomatic plots in any individual pair.
-some species (*H. tenuis*, *G. materiarius*) have population peaks during fall and winter (Fig. 6)

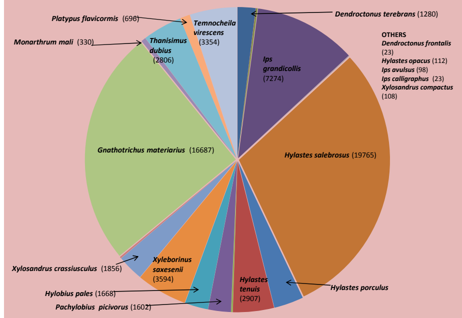

FIGURE 5. Total numbers of insects caught by species at research plots from March 4, 2008 to July 3, 2009. <u>Total collection numbers of each species are within parentheses.</u>

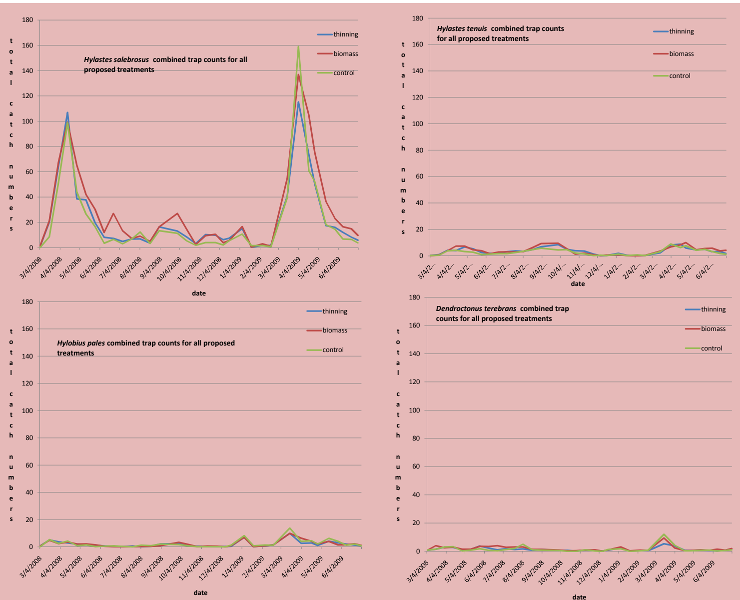

FIGURE 6. Comparison of total collection totals for *H. salebrosus* (upper left), *H. tenuis* (upper right), *H. pales* (lower left) and *D. terebrans* (lower right) at all traps from 03-04-08 to 7-03-09 in proposed conventional thinned stands, proposed biomass removal stands and control stands.

DISCUSSION

Previous experiments suggest that an increase in insect numbers should occur after pre-commercial thinning. The affects of biomass removal are less predictable.

The biomass removal could result in an increase in insects following release of chemical attractants into the air or a decrease through the removal of habitat from the plots. Current expectations are that the insect numbers will undergo a short-term increase and a longer-term decline following the removal of live trees and debris. This decline may not necessarily be apparent in the time frame of this experiment.

Surviving trees at both treatment categories are expected to become healthier with less competition for light. Loss of site-nutrient cycling inherent in the loss of debris during biomass removal may affect overall tree health and defensive capability. Under pre-treatment conditions resin production varies widely both within and between stands.

In addition to informing future biomass removal projects, the insect data collected by this project will be used in concert with data obtained in studies of associated fungi to produce a fuller understanding of loblolly pine decline.

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