Evaluating the Extent and Nature of Pine Health Issues in the Southeastern U.S.

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Introduction

During the last 20-30 years, dieback and mortality of loblolly pine (*Pinus taeda*) stands have been reported in the Piedmont Province, Atlantic and Gulf Coastal Plains, and Sandhills Fall-line region of the southeastern U.S. (Fig. 1) *(1)*.

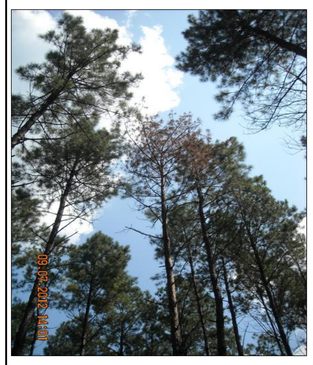

Fig. 1. Typical dieback and mortality in a pine stand.

Literature indicates that dieback symptoms include loss of crown, reduction in annual growth, presence of root pathogens such as *Phytophthora cinnamomi*, *Heterobasidion irregulare*, and *Leptographium* spp. *(2)*. In addition, root-attacking weevils, *Hylastes* and *Pachylobius* spp., have been reported *(2,3)* .

Little work has been conducted on the relative contributions of abiotic factors (e.g., drought, soils, stand history) and other biotic factors (e.g., *Ips, Dendroctonus*, and *Monochamus* spp.) that may be interacting with pine trees under varying conditions.

As a multi-disciplinary and multi-agency team, we are conducting a regional-level study to better understand pine health issues especially in stands associated with FIA plots, and to assess the complex of subcortical beetles and root pathogens present in these forest stands.

Research Objectives

1. Assess the relative contributions of a) predisposing (e.g., forest composition and structure, land-use history, and soil type); b) inciting (e.g., forest management activities such as prescribed fire, short-term subcortical insect and root fungal pathogen activity and weather conditions); and c) contributing (e.g., subcortical insect and root fungal pathogen activity) factors to pine health.

2. Build decision models based on site and weather conditions, management history, and presence of subcortical insects and root fungal species. These models will assist with effectively managing pine health issues for sustainable forests in the southeastern U.S.

Methods

FIA Analyses: We conducted preliminary analyses of pine growth and mortality in FIA plots in the Southeast. We performed two average nearest neighbor distance analyses, one for the set of negative net growth plots and the other for the set of all re-measured plots. This analysis yields an index which if <1, it's a clustered spatial pattern, and if >1, it's a dispersed spatial pattern. We determined whether the set of negative net growth plots had a similar pattern to those observed for all FIA plots.

Study Sites: We are currently selecting a suite of stands (>50) that are showing decline (symptomatic) and no decline (asymptomatic) in Alabama and Georgia. We have already established 120 plots in the Talladega National Forest, Alabama. In each stand, one transect with a cluster of four FIA-style 10 m radius plots is being established every 250 m along a line in similar soil series (Fig. 2).

Stand and Tree Sampling: Stand level data collection includes stand age and area, silvicultural and disturbance history, and local weather conditions during the last 10 years. Within each plot, we are collecting following data on each tree (>2.5 cm DBH): 1) species; 2) DBH; 3) height; 4) tree dead or alive; 5) % dieback or crown thinning; 6) crown condition on a 0-4 rating; 7) crown symptoms; 8) crown class; 9) crown to bole ration; and 10) any evidence of symptoms, damage and kind of damage (abiotic or biotic).

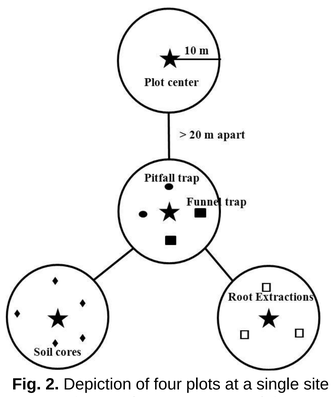

Fig. 2. Depiction of four plots at a single site with sampling scheme per plot.

Fig. 3. Sampling of roots and soils in the field.

Soil Sampling: Soil profiles are being classified and surface soils are being sampled from the 0-20 cm depth increment (Fig. 3). Each sample consists of a composite of 5 individual samples collected within the plot. Soils are being analyzed for physical (e.g., texture and compaction) and chemical (e.g., pH, N, P, and K content) characteristics.

Root Sampling: In each plot, we are sampling roots from up to three mature pine trees. Three sections each from a small (<1 cm diameter), medium (2-5 cm) and large (>7 cm) root are removed (Fig. 3). We are surface sterilizing and plating subsections of each root on selected agar media for *Heterobasidion* and *Leptographium* spp. that will be identified to species-level using DNA techniques.

Insect Sampling: Root-attacking beetles will be sampled in each plot.

Methods (continued)

Two pitfall traps baited with host-attractants will be used. We will use funnel traps with baits to sample other bark and woodboring insects. Traps will be emptied every 3 weeks, and all insects will be identified to species. External evidence of insect attacks will be noted on each tree. If insect activity is found, then bark will be peeled to further assess insect damage.

Preliminary Results & Conclusions

We found 181 FIA plots with negative net pine growth, representing ~3% of the total FIA plots (Fig. 4). The average nearest neighbor distance analyses produced similar index values for the set of negative net growth plots (ratio = 0.673, $p < 0.001$) and the set of all plots (ratio = 0.683, $p < 0.001$). This indicates that both sets of plots exhibit a clustered spatial pattern, which is expected for most tree species whose regional distributions are shaped by physiographic and climatic constraints. Similar index values suggest that there is no distinctive regional pattern of abnormally high pine mortality (Fig. 4).

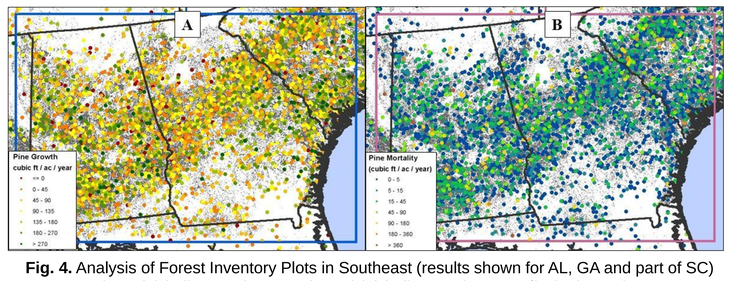

Fig. 4. Analysis of Forest Inventory Plots in Southeast (results shown for AL, GA and part of SC) where (A) indicates pine growth, and (B) indicates pine mortality in the region.

Field sampling in Alabama indicated a similar incidence of *Leptographium* spp. in symptomatic and asymptomatic stands. *Heterobasidion* spp. was also recovered in root samples. Our preliminary results, therefore suggest that there are no clear patterns of pine dieback in the Southeast, dieback is variable and at local scale, and that multi-level abiotic and biotic factors may affect pine health in this region.

Acknowledgements

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