Seasonal variation in root-feeding insect capture in longleaf pine

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Land managers at Fort Benning, GA, have been intensively managing to restore forested lands to longleaf pine, primarily for habitat for the red-cockaded woodpecker (RCW). However, these efforts have been hampered by a decline of longleaf and other pine species in the southeast. While many abiotic factors are likely to be contributing to the decline, symptomatology including wilting and chlorotic needles, and reductions in height and radial growth, suggests a disruption of root function which may be mediated by biotic agents such as insects and fungi. We have engaged in pitfall trapping of root-feeding bark beetles and weevils in longleaf pine stands at Fort Benning since March 2006, and we report on seasonal trends observed in their abundance and distribution. In addition, we report on the incidence of Ophiostomatoid (blue-stain) fungi vectored by these insects and frequently isolated from roots of declining and dying trees. While the ratio of insect species change between seasons and the total number of insects is variable with peaks in mid-Spring and mid-Fall, potential insect vectors of Ophiostomatoid fungi are present throughout most of the year.

Introduction:

Longleaf pine (*Pinus palustris*) forests once dominated the southeastern United States, with a historic range of 37 million hectares. This range has been reduced to approximately 1 million ha (Frost 2006), to the detriment of many species dependent on longleaf ecosystems such as the red-cockaded woodpecker (RCW, *Picoides borealis*) and the gopher tortoise (*Gopherus polyphemus*). Managers of Federally-owned lands are obligated to enhance habitat for these species under the provisions of the Endangered Species Act, as RCW is a listed Endangered Species. At Fort Benning, GA, efforts are being made to reforest in longleaf pine for future RCW habitat.

However, some plantations of longleaf and other southern pine species exhibit symptoms of decline, which affects the growth of trees and may lead to premature death. The decline manifests as a reduction in height and radial growth, chlorosis and wilting of needles, and affected trees typically begin to exhibit symptoms at an age of approximately 35 years (Otrosina et al 1999). As these symptoms are consistent with a disruption in root function, and Ophiostomatoid fungi were frequently found in association with declining trees (Otrosina et al 1999, Eckhardt et al 2007), we investigated the populations of insects known to vector these fungi at Fort Benning.

Figure 1: Insect feeding on roots of longleaf pine

Methods and Materials

Plot Locations

Thirty-two plots were established in plantations containing longleaf pine at Fort Benning, GA, with two decline categories (Healthy and Decline) as predicted in a model derived from data for loblolly pine (Eckhardt 2003) in four stand age classes (<10 years, 10-20 years, 20-40 years, and >40 years), with four replicates of each decline/age class. Each plot consists of four circular subplots 25 feet in radius, a central subplot and three satellite plots, whose centers were 120 feet from the focus of the central plot and where the three pitfall traps were installed at each plot.

Pitfall trapping

Pitfall traps were constructed of PVC tubing (4" diam by 8" long) with a fixed cap at one end and a loose cap at the other and eight entrance holes drilled in the sides (adapted from Klepzig et al 1991). A PVC cup was installed at the bottom of the trap to collect crawling insects, and two vials (0.25 oz) suspended from the lid for baits.

The traps were buried up to the entrance holes, and baited with steam-distilled turpentine (Hercules) and 95% ethanol. Three longleaf pine twigs, approximately 2" long by ½" diameter were also left in the trap cup as substrate for insects attracted to the baits. Insects were collected weekly in clean specimen cups, along with the twigs, and the baits and twigs replaced. Collected insects were stored at 40 °F until sorted, identified to species and tallied. Insect collection periods were from March – May 2006, and from August 2006-August 2007, in order to compare 2 Springs, and one continuous year.

Incidence of infestation by blue stain fungi

Regeneration weevils and bark and ambrosia beetles were then rolled on selective media (malt extract agar amended with cycloheximide and streptomycin, and unamended malt extract agar) to assess the presence of Ophiostomatoid (blue-stain) fungi such as *Leptographium* spp. and *Ophiostoma* spp (Figure 3). Petri plates were monitored weekly for 4 weeks and fungi of interest transferred for later identification to species.

Figure 2: Pitfall traps in the field (L), closed (ctr) and opened (R)

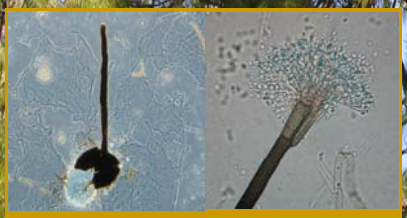
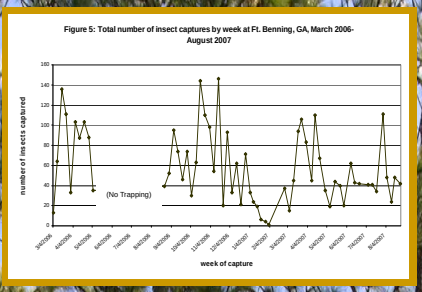
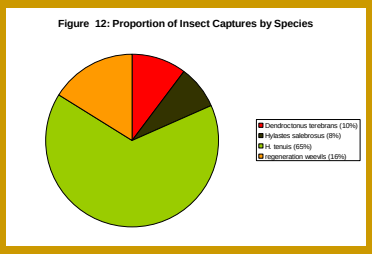
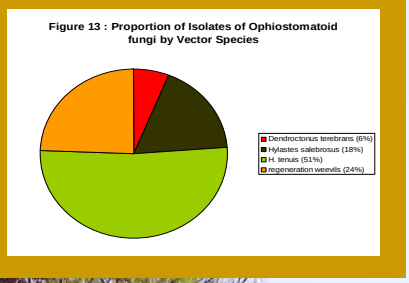
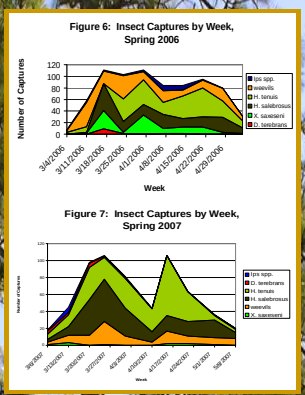


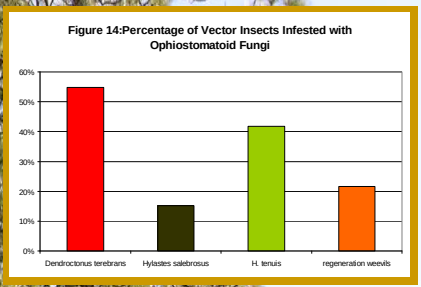
Figure 3: Fruiting Structures of *Ophiostoma* (L) and *Leptographium* (R)

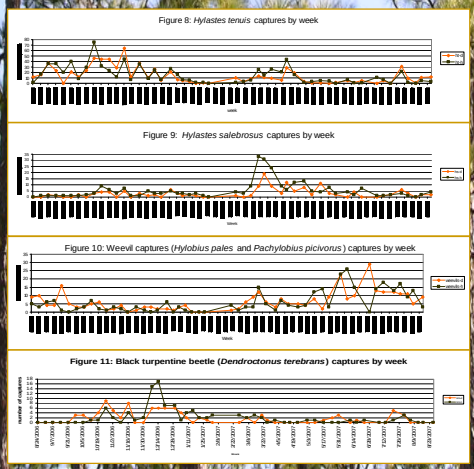


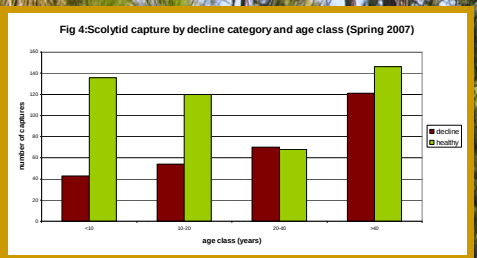












Results and Discussion

Our expectations for the distribution of insect captures by age class and decline category (based on microsite conditions) were not born out. Insect numbers were typically similar or greater in stands predicted to be healthy, and a greater number of insects were recovered in the youngest stands, predicted to be healthy (Figure 4).

In the two Springs during which traps were in place (Figures 7 and 8), insect numbers were similar overall, with some variation in the distribution of species. The anticipated peak in mid Spring was observed in both years.

Previous pitfall trapping experiments have focused on the Spring as the peak of scolytid activity, based on surveys for southern pine beetle (*Dendroctonus frontalis*) (Eckhardt 2003, Menard 2007). We show here that a second peak in populations of root-feeding scolytids may be observed in the Autumn near the Fall Line in Georgia, where Fort Benning is situated (Fig 5,Figs 8-11). Weekly numbers of insects were highly variable, with the highest peak occurring only a week earlier than one of the lowest observation, likely due to fine scale (daily to weekly) weather conditions.

Hylastes tenuis, the smaller of the two species we encountered, was the most abundant insect captured (Figure 8 and Figure 13). Regeneration weevils (*Hylobius pales* and *Pachylobius picivorus*) were the second most abundant (Figure 5 and Figure 13). Similarly, the greatest proportion of Ophiostomatoid fungal cultures was isolated from *H. tenuis*, (Figure 14) with more than 40% of individuals carrying these fungi (Table 1), and with *Leptographium* spp. being predominant (data not shown).

Besides *Hylastes* spp., black turpentine beetle, and regeneration weevils, we also recovered *Ips* spp. and ambrosia beetles (*Xyleborinus saxeseni* being the most abundant of these), although these have not been recorded as being root feeders. Future work will include identification of these fungi to species to determine whether certain fungi are more commonly associated with certain beetle species. Also, we will be investigating the degree to which these fungi are found on roots of trees exhibiting symptoms of decline.

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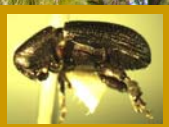
Hylastes tenuis



Hylastes salebrosus

Dendroctonus terebrans

Ips avulsus

Ips grandicollis

Xyleborinus saxeseni

Hylobius pales

Pachylobius picivorus