We will model the succession of these stands, as well as other stands with data provided by collaborators, using the Forest Vegetation Simulator (FVS). FVS is a non-spatially-explicit model of tree growth and survival that is used by the US Forest Service and National Parks. We will use ordination and cluster analysis to identify different groups of stands that are predicted to behave similarly. We will parameterize the model to explore emerald ash borer effects on invasive shrub species, which are abundant in Ohio. The information generated by our studies will allow land managers to know what their forests will look like during and after emerald ash borer infestation and enable them to develop management strategies.

PATTERNS OF EMERALD ASH BORER-INDUCED ASH DECLINE AND MORTALITY IN THE FORESTS OF SOUTHEASTERN MICHIGAN

Kamal J.K. Gandhi[1], Annemarie Smith[1], Robert P. Long[2], and Daniel A. Herms[1]

[1]Department of Entomology, The Ohio State University
Ohio Agricultural Research and Development Center
1680 Madison Avenue
Wooster, OH 44691
gandhi.42@osu.edu, herms.2@osu.edu

[2] USDA Forest Service, Northeastern Research Station
359 Main Road
Delaware, OH 43015
rlong@fs.fed.us

ABSTRACT

The emerald ash borer (EAB), *Agrilus planipennis*, invasion of the forests of the Huron River Watershed in southeastern Michigan may result in drastic changes in forest structure and composition. The objectives of our study were to (1) quantify landscape-level spatial patterns of ash decline and mortality, (2) assess whether patterns of colonization and decline vary among black ash (*Fraxinus nigra*), green ash (*F. pennsylvanica*), and white ash (*F. americana*), and (3) determine whether observed spatial patterns of ash decline and mortality changes over time.

During 2004 and 2005, 31 permanent vegetation plots were established in forest stands within eight state and metro parks within the Upper Huron River Watershed. In 2004 and 2005, surveys were conducted in 11 and 20 stands, respectively. In 2006, all 31 stands were reassessed to quantify progression of ash dieback and mortality. Forest stands were selected to represent a moisture gradient with black, green, and white ash as the major ash component on hydric, mesic, and xeric sites, respectively. Forest stands were also chosen to represent an

ash mortality gradient that decreased with distance from the presumed epicenter of EAB infestation in the township of Canton, Michigan. Within each forest stand, three 0.1 ha circular plots were placed along a single transect. Within each plot, all understory and overstory plants were identified to species, and their diameter at breast height (DBH) and density (stems/ha) were recorded, and species diversity indices were calculated. On each ash tree, EAB colonization was quantified by documenting the density of adult emergence holes and woodpecker attacks on the main bole at 1-2 m from the ground. Each ash tree within a plot was assigned a dieback rating that ranged from 1 to 5, with '1' designated as a healthy tree with full crown and no sign or symptoms of EAB attack and '5' designated as a dead tree.

In 2004 and 2005, there was a significant curvilinear relationship between mean tree dieback rating and mean EAB attack density/m^2 of bark surface area on the main bole (P-value < 0.001; $R^2 = 0.72$), suggesting that EAB was the major source of ash decline and mortality.

There was no relationship between percent ash mortality and any stand-level variables including ash density, ash basal area, total basal area, total tree density, and species diversity. Thus, all ash stands are susceptible to colonization by EAB irrespective of stand diversity or density, suggesting that silvicultural practices may have little potential for preventing EAB colonization. The only significant relationship detected was a negative correlation between percent ash mortality and distance from the epicenter of infestation ($P = 0.001$; $R^2 = 0.35$).

Black ash experienced greater EAB-induced decline and mortality than white or green ash species (ANOVA, $P = 0.001$), although all three species were severely impacted. There were little differences among size classes, with ash trees ranging in DBH from 2.5 to 22.5 cm experiencing approximately equal degrees of decline and mortality. A comparison of ash mortality between plots that were sampled in 2004 and 2006, and in 2005 and 2006 indicated that ash mortality increased by 19-23% over 1-2 years. The slope of the line describing the negative relationship between ash mortality and distance from the epicenter remained unchanged between 2004-2005 and 2006 (2%/km). However the y-intercept in 2006 increased by 22 percent, suggesting that ash mortality is increasing rapidly and will reach 100 percent in all plots within the next few years.

Where ash was present in the overstory, it was the most common species in the understory and seedling layer. Common understory associates included maple (*Acer* spp.), basswood (*Tilia* spp.), and cherry (*Prunus* spp.). This suggests that as ash mortality progresses, community composition will shift in favor of these three genera. These results indicate that as EAB continues to spread it has the potential to substantially change the structure and composition of North America's central hardwood forests.