TITLE: Assessment of Decline and Contributing Diseases in White Ash Stands in Michigan

LOCATION: Michigan (Statewide)

DURATION: Year 1 of a 3-Year Project

FUNDING SOURCE: Base

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PROJECT OBJECTIVES:

- Determine the distribution and severity of ash yellows, root and butt rots in urban, rural and forest ash trees across Michigan.
- Determine the frequency of occurrence of these diseases in forest stands with ash decline.
- Identify risk factors associated with these diseases in forested stands, including stand dynamics, climatic, physiographic and edaphic site factors and stand management history.
- Evaluate impact of these diseases on radial growth of ash.
- Quantify relationship between ash decline, ash yellows and various field symptoms, including deliquescent branching, witches'-brooms, basal bark cracks and epicormic sprouts.
- Assess role of insect vectors in establishment of ash yellows in forested stands.

JUSTIFICATION AND BACKGROUND:

- Ash yellows has been implicated as part of ash decline that is occurring across Michigan. This decline is being documented by the Rural Ash Monitoring Plot System (RAMPS), an FHM off-plot monitoring network established in 2004. This system consists of 250 plots distributed across Michigan and uses FHM crown and damage indicators to quantify ash health.
- FIA estimates place the total number of ash trees in Michigan at nearly 800.000,000. RAMPS has confirmed ash decline throughout the species range in Michigan, affecting white, green and black ash growing under a wide variety of moisture and soil regimes.

- Ash trees under stress from ash yellows and ash decline are highly susceptible to attack by emerald ash borer, *Agrilus planipennis*. Rapid early detection of high-risk stands beyond the generally-infested area of Michigan is considered a critical part of efforts to control this pest.
- This project will incorporate plots from the RAMPS network and use baseline tree- and stand-level information from this system as part of the data collection and analysis protocol. The project will also take advantage of ash distribution information from the ASHMAP system, a USDA Forest Service-funded project begun in 2004 to quantify ash distribution and density in Michigan as part of ongoing emerald ash borer control efforts.
- The National Risk Mapping Project, a multi-agency effort spearheaded by the USFS, predicts the risk of mortality to the forest resource using tree species-level forest health data and FIA-based cover type distribution information. Data from this study will be immediately useful in refining the ash decline component of the model.

DESCRIPTION:

Methods:

At each forest site, ten trees will be classified as healthy or declining based on visual symptoms, including dieback class (FHM crown indicator), main branch mortality (FHM damage indicator), loss of apical dominance, epicormic sprouts on trunk, basal bark cracks, and presence of witches'-brooms. Many of these symptoms of decline are also key characteristics of ash yellows infection. For each sample an increment core representing the most recent 20 years of radial tree growth will be taken. The width of the growth increment during the previous 1 to 5 years, 6 to 10 years and 11 to 20 years will be measured. Additional trees will be sampled until a minimum of five trees from the healthy class and five from the declining class are selected to compare incidence of ash yellows in healthy and declining trees on each site.

Bark plugs containing phloem, and root samples will be collected. If witches'-brooms are present, shoots with leaves will be collected along with the roots and plugs.

Phytoplasma-infection and detection of ash yellows phytoplasma ('*Candidatus* Phytoplasma fraxini') in DNA extracted from root, stem, and insect samples will be determined by nested PCR using phytoplasma-specific primers. Phytoplasma-infection will also be determined using DAPI fluorescence microscopy for all root samples.

Insect traps will be used to capture leafhoppers in open fields nearest to each ash site. Leafhoppers will be tested by PCR for presence of the ash yellows phytoplasma.

Data will be summarized overall and by site. The detection of ash yellows by PCR and DAPI will be compared with the site and stand history, tree health, crown dieback class, growth ring width and tree diameter.

Products:
This project will provide a current and detailed estimation of the role of various diseases in white ash decline in Michigan forests. It will examine the relationship between presence of ash yellows phytoplasma and poor crown conditions, and presence of ash yellows phytoplasma and other visual symptoms of decline. The study will examine and identify the presence of root and butt rots, including specific *Armillaria* species, and estimate their role in white ash mortality. The study will measure the amount of ash yellows in Michigan forests with white ash, and will attempt to identify the vectors in nearby openings responsible for the transmission of the disease.

The results of the study will improve decision-making in the management of white ash and emerald ash borer in Michigan. Data from this study will be used to refine decline and mortality models used in the National Forest Risk Map Project.

Schedule of Activities/Progress & Accomplishments:
Year 1- Identify graduate student, visit half of forest sites, locate trees to sample, record decline features, collect root and stem samples summer through November, process tree samples, process insect samples, identify and sort insects, detect phytoplasma in trees with DAPI, detect phytoplasma in trees and vectors with nested PCR, and identify *Armillaria* and other root and butt rot to species from sites and trees in which they were located. Write report of progress.

Year 2- Visit remaining forest sites, locate trees to sample, record decline features, collect root and stem samples summer through November, identify and sort insects, process tree & insect samples, detect phytoplasma in trees with DAPI, detect phytoplasma in trees and vectors with nested PCR, and identify *Armillaria* and other root and butt rot to species from sites and trees in which they were located. Complete statistical comparisons. Write final report.

Costs:

	Item	Requested FHM EM Funding	Other Source Funding	Source
Year One				
Administration	Salary & Benefits	$20,000		
	Travel	$1,500		
	Overhead	$0	$12,750	MSU
Procurement	Supplies	$3,500		
Total		$25,000	$12,750	

	Item	Requested FHM EM Funding	Other Source Funding	Source
Year Two				
Administration	Salary & Benefits	$25,000		
	Travel	$1,000		
	Overhead	$0	$14,790	MSU
Procurement	Supplies	$3,000		
Total		$29,000	$14,790	

Two Year Totals: $54,000 $27,540

The Michigan Department of Natural Resources Forest Health Program will assist with site selection, field data collection and aerial photography during this project.

USFS S&PF, St. Paul will assist with field data collection and analysis.