USDA FOREST SERVICE- FHM- EVALUATION MONITORING PROPOSAL 2011

TITLE: Evaluating the Extent and Nature of Pine Decline and Health using FIA Plots in the Southeastern U.S.
LOCATION: Georgia and Alabama
DATE OF SUBMISSION: 9/30/2011
DURATION: 9/1/2012-8/31/2015
FUNDING SOURCE: Base Plan
PROJECT LEADER: Dr. Kamal J.K. Gandhi, University of Georgia, Athens, GA, 706-542-4614, kgandhi@warnell.uga.edu
COOPERATORS: USDA Forest Service: Dr. Kier Klepzig, Dr. Bill Otrosina, Dr. John Coulston, Dr. Bill Smith, and Dr. Frank Koch. UGA: Dr. Larry Morris
FHP SPONSOR/CONTACT: Dr. John Nowak, USFS Southern Region, 828-257-4326, jnowak@fs.fed.us
PROJECT OBJECTIVES: Our project goal is to evaluate the relative health of loblolly and longleaf pine trees in FIA-associated stands in Georgia and Alabama. Further, we will elucidate the relative contributions of predisposing (e.g., stand characteristics, disturbance and management history, and soil types), inciting (e.g., short-term insect activity and weather conditions), and contributing (e.g., subcortical insects and root pathogens) factors associated with pine health issues. Our overarching goal is to provide a better understanding of pine health issues to guide future management decisions for sustainable forest practices in the southeastern stands.
JUSTIFICATION: **a. Linkage to FHM Detection Monitoring**- Our project is directly linked to the FIA-FHM plots, as historical tree growth data collected from these plots will be analyzed first. Based on these data, we will undertake field sampling in stands that are showing slower rates of decline, and determine the associated abiotic and biotic factors. **b. Significance in terms of Geographic Scale**- Sampling will be conducted primarily in Piedmont Georgia and Alabama, regions that contain major tracts of pine stands. **c. Biological Impact and/or Political Importance of the Issue**- Problems with pine health, especially pine decline and mortality, have been reported in the southern region. This project will further push the field into refining where pine health issues are present in these states, and documenting the full-complement of associated insects and diseases. **d. Scientific Basis/ Feasibility** - Our project is interdisciplinary and interagency, with diverse personnel including spatial and soil scientists, as well as forest entomologists and pathologists. **e. Priority Issues** - The priority areas of our project are those exhibiting deviations from expected and normal levels for tree mortality and poor crown conditions.
BACKGROUND: During the last 20-30 years, decline and mortality of pine stands have been reported in the Piedmont Province, Atlantic and Gulf Coastal Plains, and Sandhills Fall-line region of the southeastern U.S. *(1)*. Loblolly and longleaf pines have been the primary species showing signs of decline *(2, 3)*. Literature indicates that the decline includes symptoms such as loss of crown, reduction in annual growth, presence of root pathogens such as *Phytophthora cinnamomi* Rands and *Heterobasidion annosum* (Fr.) Bref., and species in the genus *Leptographium*. In addition, rhizophagous (root-attacking) weevils and beetles in the genera *Hylastes* and *Pachylobius (1-4)* have been reported. In contrast, there has been little work conducted on the relative contributions of abiotic factors such as weather conditions, stand history, and soil types, and other important biotic factors such as bark beetles (*Ips* and *Dendroctonus* spp.) and woodboring beetles (*Monochamus*) that may be interacting with pine trees under varying conditions. The need to better study pine decline and mortality has become more prominent as a growing number of land-owners and forest managers are contacting the PI and collaborators about this problem. As a part of a related project, Drs. Koch and Smith (USDA Forest Service, Southern Research Station) conducted analyses of the FIA data from the Southeast to assess the extent of pine decline at a regional-level. Preliminary results indicate that there are no clear patterns of pine decline in the region; although there are a large number of stands that are slower-growing than others, these stands are mostly older in age, and dominated by loblolly pines. A lack of clear patterns of pine decline or slower growth may indicate that there may be multiple agents involved in this syndrome. As a multi-disciplinary and multi-agency team, we propose to conduct a regional-level study to better understand pine health issues in stands associated with FIA plots, and to assess the complex of subcortical beetles and root pathogens present in these forest stands.
METHODS: A. FIA-FHM Data: We will analyze the existing FIA plot data in Georgia and Alabama during the last 10 years to find a suite of stands that are showing decline (symptomatic) and no decline (asymptomatic) *(5)*. The advantages of existing FIA plots are that they provide reliable measures of stand growth and

changes in structure over time. Both Drs. Koch and Smith have considerable experience working with the FIA data and related personnel. B. Field Sampling: Using these FIA plots as approximate guides, we will select >50 each of both symptomatic and asymptomatic stands nearby for sampling, and non-FIA plots (primarily on public lands) will be established to allow stand-level analyses. For symptomatic stands, another adjacent stand <200 m away will also be established to allow pair-wise comparisons of pine health. Sampling of forest structure and composition, and insects and diseases will be performed on the new non-FIA plots similarly to how it is conducted on the FIA plots *(5, 6)*. Minimal or no sampling will be done in the FIA plots to retain their plot integrity. The following data will be collected at stand-level: stand age and area, silvicultural and disturbance history, and local weather conditions. Within each stand, we will collect the following data on each plot: 1) tree attributes including dead/alive, species, DBH, height, and crown condition, symptoms, and class; 2) % cover of each understory plants including exotic species; 3) soil samples at 0-10 cm and >10.1-cm depth to impervious layer. Soils will be analyzed for physical (e.g., texture and compaction) and chemical (e.g., pH, N, P, and K content) characteristics *(6)*; 4) rhizophagous beetles will be sampled in each plot with 2-3 pitfall traps baited with host-attractants. We will use 2-3 window and funnel traps with baits to sample other bark and woodboring insects. Traps will be emptied every 3 weeks during the summer, and all insects will be identified to species. External evidence of insect attacks (exit/entrance holes, oviposition scars) will be noted on each tree. If insect activity is found, then bark will be peeled to further assess insect damage; 5) root pathogens will be sampled by digging up >2 lateral roots on a subset of trees. These roots will be plated on selective media for fungal pathogens such as *Heterobasidion*, *Leptographium*, etc. C. Statistical Analyses- GIS maps will be created to show relative pine health in these stands. The percentage of stands and plots showing symptoms of decline will be assessed. Multiple regression analyses will be used to determine whether pine health issues are related to soil type, stand age or area, tree density, basal area, and disturbance history *(7)*. Insect and fungal species will be correlated with pine health issues using multivariate ordination.

PRODUCTS: Our target audience will include managers and scientists working on pine health issues both locally and regionally. Results will be transferred through outreach and scientific presentations at national and international meetings, a web-site at University of Georgia, and various publications. We expect to publish 2-3 peer-reviewed papers, as well as several conference proceedings and extension papers. Results from this study can be used regionally to guide forest management practices related to pine health issues as based on soil types, stand history, and insects and pathogens likely to be present in these landscapes.

SCHEDULE OF ACTIVITIES: Sept 2012- Jan 2013- conduct historical analyses on FIA plots, select and find stands, finalize project design; Feb 2013- May 2015- collect plot and stand-level data in GA and AL, analyze collected data, make presentations at meetings; June- August 2015- submit final report and manuscripts for publication, present to forest managers.

LITERATURE CITED: *(1)* Eckhardt, L.G. et al. 2007. For. Sci. 35: 84-92. *(2)* Eckhardt, L.G. and Menard, R.D. 2009**.** AL Treasured Forest Magazine Volume XXV111: 10-12. *(3)* Eckhardt, L.G. et al. 2010. South. J. Appl. For. 34: 138-141. *(4)* Otrosina, W. et al. 2008. Ecological Society of America, Forest Health White Paper. *(5)* USDA Forest Service. 2010. The Forest Inventory and Analysis Database: Database description and User's Manual Version 4.0 of Phase 2. *(6)* USDA Forest Service. 2005. 3.0 Phase 3 Field Guide-soil measurements and sampling. *(7)* Zar, J.H. 1996. Biostatistical Analysis. Third Edition, Prentice-Hall Inc., New Jersey.

COSTS:

Year 9/1/2012-8/31/2013	Item	Requested FHP EM Funding	Other-Source Funding	Source
Administration	Salary- Research Coordinator	4,000	5,513	UGA
	Fringe benefits	1,680	2,315	UGA
	Salary- Student Worker	15,000		
	Fringe benefits	225		
	Salary - PI - Kamal Gandhi		33,640	UGA
	Fringe benefits		11,438	UGA
	Overhead- 26%	13,756	13,756	UGA
	Travel	13,200		

Procurements	Supplies	12,000		
	Vehicle Expense	6,800		
Year Totals		**66,661**	**66,662**	
Year 9/1/2013-8/31/2014	**Item**	**Requested FHP EM Funding**	**Other-Source Funding**	**Source**
Administration	Salary- Research Coordinator	4,080	5,513	UGA
	Fringe benefits	1,714	2,315	UGA
	Salary- Student Worker	6,000		
	Fringe benefits	90		
	Salary - PI - Kamal Gandhi		19,447	UGA
	Fringe benefits		6,612	UGA
	Overhead- 26%	8,810	8,811	UGA
	Travel	6,600		
Procurements	Supplies	12000		
	Vehicle Expense	3400		
Year Totals		**42,694**	**42,698**	
Year 9/1/2014-8/31/2015	Item	**Requested FHP EM Funding**	**Other-Source Funding**	**Source**
Administration	Salary- Research Coordinator	**4,162**	**5,513**	**UGA**
	Fringe benefits	**1,748**	**2,315**	
	Salary- Student Worker	**6,000**		
	Fringe benefits	**90**		
	Salary - PI - Kamal Gandhi		**10,576**	
	Fringe benefits		**3,596**	
	Overhead- 26%	**5,720**	**5,720**	
	Travel	**6,600**		
Procurements	Supplies	**0**		
	Vehicle Expense	**3,400**		
Year Totals		**27,719**	**27,720**	

JUSTIFICATION: SALARIES & FRINGE BENEFITS: A Project Coordinator will assist with all the laboratory and field aspects of this project ($4,000 for each year with an estimated 2% increase starting January 2013; ~11.4% of their time or ~1.4 months). Fringe benefits are estimated at 42% for the Project Coordinator. About 2-3 undergraduate students will assist in data collection in the field ($15,000 the first year, and then $6,000 for the next two years; at $12/hour for 1,250 hours in first year and 500 hours in years two and year three). Fringe benefits are estimated at 1.5% for the students. TRAVEL: Travel funds are requested to visit field sites to collect forest health data in Georgia and Alabama. Travel will be for at least 50 days at ~$40/day per diem each for the field personnel ($6,000) and hotel expenses at ~$60/night for two rooms ($6,000). There will also be travel to present papers at conferences each year. Conference travel is estimated at $1,200 for 2-3 conferences. Total for travel is: $6,000 + $6,000 + $1,200 = $13,200 for the first year. Half of the year one total for travel will be needed in years two and three. SUPPLIES/OPERATING EXPENSE: Supplies for the project include (but are not limited to) GPS unit, flagging, DBH tape, loggers' tape, tree tags, rite-in-rain paper, field-vests, pitfall, window, and funnel traps for insect collection, antifreeze, ethanol, vials, slides and chemicals for fungal isolations, chemical analyses of soil macro-nutrients, etc. Vehicle expenses in a Warnell vehicle to travel to field sites for at least 50 days at a daily rate of $20 ($1,000), and ~ 10,000 miles at 0.58/mile ($5,800). Vehicle expenses total $6,800 in the first year and $3,400 in the second and third year. INDIRECT COSTS: 26% for off-campus research. COST-SHARE: 1:1 match.