TITLE: Assessing and Projecting Southern Pine Beetle Impacts in the New Jersey Pinelands

LOCATION: The New Jersey Pinelands

DATE: September 30, 2012

DURATION: Year 2 of a 2-year project  

FUNDING SOURCE: EM Base

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PROJECT OBJECTIVES: The objectives of this project are 1) to characterize the extent and severity of the southern pine beetle (SPB, Dendroctonus frontalis Zimmerman) outbreak in New Jersey; 2) to determine the relationship between stand characteristics and mortality; 3) to characterize the defenses of pitch pine (Pinus rigida) against SPB; 4) to assess the strength and character of controls on SPB populations in New Jersey from predators and competitors; 5) to use data from 2-4 above to develop a risk assessment model for the New Jersey Pinelands.

JUSTIFICATION:

a. Linkage to FHM Program: ADS (from NJ Forest Service in cooperation with FHM) show that SPB has spread northward into New Jersey over the last decade. Approximately 389 potential infestations totaling 14,100 acres were identified in 2010 flights alone, more than twice the damage from wildfire.

b. Significance/Impact of Forest Health Issue: Except for isolated reports from the early 1900s, the New Jersey Pinelands have been beyond the northern range limit of SPB, and have therefore been spared the extensive recurrent outbreaks typical to pine forests in the southern states. A comprehensive assessment of current impacts and and future risks in the Pinelands is needed to guide future management of the NJ Pinelands and other areas of pine (e.g., Long Island and southeastern Pennsylvania) that have been historically beyond the distribution of SPB but are now at risk due to amelioration of climatic constraints on northern populations of SPB. Over 40% of NJ is forested. These forests are a valued resource for over 50 million people that live within about 100 miles of the Pinelands. The New Jersey Pinelands represent a unique state-federal partnership designed to preserve and protect over 1.1 million acres of land, the largest area of open space on the eastern seaboard between Richmond and Boston. Established as the country’s first National Reserve in 1978, the Pinelands have also been recognized as a U.S. Biosphere Reserve by UNESCO. 43 animal species and 92 plant species within the Pinelands have been identified as threatened or endangered. Virtually all taxa inhabiting the Pinelands—from lichens and mosses, to tree frogs, soil arthropods, and the trees themselves—can be affected by SPB epidemics. Because the incursion of SPB epidemics represents a dramatic departure
from historical conditions in the Pinelands, new data are urgently needed to devise appropriate management plans that can be utilized by the federal, state, and private landowners under Pinelands jurisdiction.

c. **Scientific Basis/Feasibility** – The project leader has extensive experience in SPB research throughout the southern states, and began working with NJFS during 2011. NJFS flies ADS weekly during the summer months, enabling researchers to target potential SPB areas of infestation more efficiently. NJFS is experienced in communicating management recommendations based on scientific findings to private landowners within the Pinelands.

d. **Cost/Economic Efficiency:** Due to independent, concurrent funding for SPB work already obtained by the Project Leader from USDA AFRI, this project hits the ground running with personnel and contacts in place in New Jersey beginning in 2011. EM Base funding allows us to efficiently expand our data collection and analysis to meet the objectives of this EM base project to monitor impacts of SPB in the NJ Pinelands.

e. **Priority Issues:**
   a) Climate change: While SPB impacts are currently low or moderate throughout the historically vulnerable regions in the southeastern US, they have arisen and persisted in New Jersey; this has been permitted at least in part by warmer winters, which have not been dropping below the lower lethal temperatures for SPB as in the past. New information regarding SPB in this “naïve” system will enable public and private landowners to devise management strategies based on sound science.
   b) Validating or filling data gaps in insect risk models: Reasonably well validated risk-assessments are available for the southern states, but applicability to NJ is not known.
   c) Tree mortality: SPB has already done considerable damage in southern counties of NJ, where the forest is quite fragmented by urban and suburban land use. More information is urgently needed on the spread of this insect before the outbreak spreads to the extensive contiguous forests of the central counties.

**DESCRIPTION:**

a. **Background:** The southern pine beetle (*Dendroctonus frontalis* Zimmerman) is a native bark beetle that can kill many millions of board feet of timber during its periodic outbreaks. Though this species has been regularly monitored and targeted for management action in R8, it has recently moved north into New Jersey, which has not historically experienced extensive outbreaks. ADS in New Jersey between 2002 and 2012 show a northward spread of SPB “spots,” or localized infestation. With the northward movement, SPB transitions from its usual hosts—loblolly and shortleaf pine—to pitch pine. Although pitch pine has been noted as a host species, no previous research has documented the species’ defense mechanisms against SPB, and little is known about potential mortality rates. Anecdotal evidence indicates that unlike those in the southern states, spots in New Jersey often remain active over two or more years. In the south, spots usually die out over winter. Because there are no previous studies of SPB in pitch pine systems, we know little about pitch pine defenses against SPB, and we know little about natural controls on SPB populations from predators and competitors. Rather extensive previous research in the southern states has demonstrated that tree defenses, predators, and competitors exert important controls on SPB in the southern states, where knowledge of these controls has been important for short and long-term predictions of risk and management tactics for suppression and risk aversion. Improved understanding of biological controls on SPB in NJ are crucial to implementing and refining management strategies in the presence of SPB.

b. **Methods:** Working from NJFS ADS, active areas of infestation ("spots") will be identified. Stand characteristics for each spot will be measured, including: density, tree species
composition, dbh, basal area, height per species, gap light index, understory percent cover and height, soil organic matter depth, and soil moisture. A subset of trees will be measured for age and growth rate. Standard methods will be used to measure constitutive and induced resin flow in pitch pine, to compare its defenses relative to other pine species. Measurements will be taken in both unaffected stands and in affected stands at the active front of the spot. Using protocols as have been employed in the south, we will quantify the abundance of predators, competitive antagonists (most importantly blue-stain fungus and the mites that propagate the fungus), and other associates of SPB. The growth vs decline of local SPB populations (spots) will be compared to the local abundance of predators and competitors to parameterize SPB population models that can be employed for risk assessment and compared to relationships known from the southern states.

c. Products: A final report including management recommendations will be produced, in addition to at least two peer-reviewed research publications. Cooperators will work together to determine what modes of communication and products will work best for informing public land managers and private landowners of scientific findings and management options. Community outreach activities will continue, incorporating research findings as they are completed.

d. Schedule of Activities: Summer 2013: Detailed measurement of stand characteristics within SPB spots, expanded sampling of tree resin defenses based on summer 2012 data collection; measurement of the abundance of predators and competitors; Fall 13-Spring 14: Data analysis, design of further field sampling and lab experiments for bark community ecology; Summer 2014: Continue measurement of stand characteristics and tree resin defenses; parameterize and validate models relating predators and competitors to SPB population growth; Fall 14-Spring 15: Complete modelling and data analysis, write final report and submit manuscripts for publication.

e. Progress/Accomplishments: Due to some administrative delays, the first year’s funding only became available to us in Sept 2012 (< 1 month ago), so the project is still young. However, progress is already good. Maps, data figures, and raw data described below are available upon request.

1. We have collated, and made spatially explicit, beetle trapping data in the Pinelands from all known sources (at least 5 projects, some going back 10 years).

2. With the cooperation of NJ Forestry, we have developed GIS data layers for SPB spots since 2001. We are proceeding with analyses of the relative spatiotemporal patterning of SPB in monitoring traps and SPB spots. It is already evident that there is strong patterning (e.g., advancement northward of beetles in monitoring traps, followed with a delay of 1-3 years of northern advancement in the occurrence of SPB spots. The 2012 spot data (> 300 spots) have been ground-truthed and mapped with much higher resolution than previous years, which will facilitate more robust analyses of patterning in SPB damage.

3. We have developed and merged the beetle data with GIS data layers for soils, and forest types. Analyses have revealed clear associations among forest types and soils (e.g., high density pines tending to be associated with Woodmainsie sand and mixed pine-hardwoods being more associated with Berryland and Mullica soils). These analyses have also revealed pine stands that are “off-site” and may be more susceptible because of it.

4. We have collected > 500 measurements of pitch pine resin defenses (and loblolly and white pine) across soil types, stand age, and stand densities in the Pinelands. Analyses thus far indicate that pitch pine has lower resin defenses than loblolly or longleaf pines, but much more than white pine, red pine, or jack pine. Continuing measurements will also characterize seasonal patterns in pine defenses relative to activity levels of attacking beetles (at cool temperatures
beetles bore more slowly and resin flows more slowly but it is not clear yet whether beetles or trees are aided more by cool temperatures.

(5) Progress on items 1-4, including the quality control checks, which have all been encouraging so far, will permit us to test with good statistical rigor how regional beetle abundance in spring, forest types, soils, and tree defenses interact to influence the patterning of SPB damage in summer.

f. Relevant Citations:

COSTS: < Budget estimates for each year of project.>

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