TITLE: White pine blister rust in the Southwest: Monitoring the health of southwestern white pine
INT-EM-B-10-01
LOCATION: This project will be located in Arizona and New Mexico (Region 3)

DATE: Original - September 2009; Progress – September 2011

DURATION: Year 3 of 3-year project **FUNDING SOURCE:** Base

PROJECT LEADER: Dr. Kristen Waring, Assistant Professor, Northern Arizona University, (928)523-4920, kristen.waring@nau.edu.

COOPERATORS: Mary Lou Fairweather (FHP Flagstaff), Dr. Brian Geils (RMRS Flagstaff), Dave Conklin (FHP Albuquerque), Ron Miller (Fort Apache BIA).

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PROJECT OBJECTIVES:

1. To assess the status and extent of white pine blister rust in southwestern white pine
2. To establish permanent plots for long-term monitoring of southwestern white pine health

JUSTIFICATION:

a. **Linkage:** White pine blister rust (WPBR) disease is not observed directly during aerial detection surveys. Ground surveys have shown a gradual spread of WPBR through New Mexico, since it was first discovered in 1990. Ground surveys did not detect WPBR in Arizona until 2009 on National Forests and tribal lands on the eastside of the state. The intensity of WPBR infection and impacts are unknown across much of the Southwest. This project will supplement the FIA/FHM plot system.
b. **Significance:** Southwestern white pine is a significant component of many mixed-conifer forests of Arizona and New Mexico, and northern Mexico. WPBR has only recently been located in Arizona (spring 2009), while it was discovered about 20 years ago in New Mexico (Conklin et al 2009). WPBR has not yet been found in Mexico.
c. **Biological impact:** Little is known about the long-term impact of WPBR on white pines of the southwest, nor do we fully understand their ecological importance. The range of white pine extends into northern Mexico, where it is also found growing with Mexican white pine. The ecological implications for Mexico could be tremendous, with political implications for both nations as this pathogen spreads across another international border.
d. **Scientific Basis/Feasibility**: The team working on this project has experience with southwestern forest pathology, WPBR and the ecological impacts of WPBR.
e. **Priority Issues:** This project will examine regional patterns of tree crown decline and mortality of southwestern white pine. Both of these factors are expected to be higher than normal due to WPBR. Permanent plots establishment will also enable future assessment of the interactions between WPBR and potential species compositional changes in response to changing climates.

DESCRIPTION:

a. Background: In 1990, white pine blister rust was discovered causing disease in southwestern white pine in the Sacramento Mountains of south central New Mexico. It is thought that the rust originally became established in the Southwest around 1970 (Conklin et al. 2009, Dahms and Geils 1997). White pine blister rust is not a new phenomenon to the United States; however, this new find was several hundred miles removed from the closest known established population of the rust. Southwestern white

pine is highly susceptible to the rust (Hoff and Hagle 1990) and environmental conditions in the Southwest have been conducive to spread of the pathogen (Geils 2000). Dahms and Geils (1997) predict a severe impact on southwestern white pines in the Sacramento Mountains and elsewhere in the Southwest. WPBR has subsequently been found in the Mount Taylor area in western New Mexico and most recently, in the White Mountains of eastern Arizona (Conklin et al 2009).

Successful prevention and mitigation of WPBR needs to be proactive and should occur immediately (Chornesky et al 2005). The proposed project will begin monitoring to better understand the effects of this pathogen in the southwest. Understudied ecosystems such as these require current ecological information to inform managers and policymakers. Such information can lead to an increase in proactive prevention strategies and appropriate management strategies. We are in the unique situation of being able to establish permanent plots ahead of the pathogen. This will enable before-after comparisons in the future as WPBR continues to spread.

b. Methods: Permanent monitoring plots are being randomly established in stands with more than $40ft^2$ basal area per acre of white pine. Plots are rectangular, a modification of standard protocol (FIA Phase 2 and 3) in order to reduce the influence of elevation. Plots are being established across Arizona and New Mexico in stands with and without WPBR to monitor spread and severity of WPBR in addition to ecological changes through time. Data collected on overstory trees (>5in DBH) includes species, DBH, and status; on a subsample of white pine, height, crown length, and increment cores are also collected. Additionally, presence and severity of WPBR (Conklin 2004, Tomback et al. 2007) is assessed along with any other insect, disease or damages in white pine. Nested plots are being installed to monitor sapling- and seedling-sized trees, with similar measurements as the larger plot, and to assess density of WPBR alternate hosts. Canopy cover is assessed using a densitometer along a center transect line. Additional stands are examined using walk-through surveys for blister rust presence or absence.

The topographic relative moisture index (TRMI, Parker 1982) will be calculated for each plot using elevation, slope aspect, slope position, pitch and configuration. Relative abundance of southwestern white pine and WPBR will then be assessed by TRMI values. The Forest Vegetation Simulator and the Fire and Fuels Extension will be used to model stand growth and fire behavior; this step is critical for management in the Southwest, where fire hazard is a primary management concern.

c. Products: A poster will be presented at the annual FHM Working Group Meeting and a final report provided to the FHM Regional Manager. A MS thesis will result in the School of Forestry at Northern Arizona University. Additionally, we anticipate presenting the results in at least one regional or national meeting and preparing a manuscript for publication in a peer-reviewed journal.

d. Schedule of Activities: This project is proceeding as originally scheduled.
Summer 2010: Initial plot establishment and data collection
Fall-Winter-Spring 2010-2011: preliminary data analysis
Summer 2011: Completion of plot establishment and data collection
Fall-Winter-Spring 2011-2012: Final data analysis and MS thesis writing/completion
Summer/Fall 2012: Project completion and final reports.

e. Progress/Accomplishments:
Year 1: Permanent plots were established in 25 mixed-conifer stands containing white pine densities of at least $40ft^2$ basal area/acre across three national forests in Arizona (Apache-Sitgreaves and Coconino). Most plots were established on the Apache (14), followed by the Coconino (6) and the Sitgreaves (5). An additional six stands were examined for presence/absence of WPBR. WPBR was not detected on the Coconino National Forest. However, WPBR was found infecting trees on the Lakeside District of the Apache-Sitgreaves NF, further west than previously reported. While no additional new infection centers were identified, we now have a better delineation of the extent and severity of known WPBR centers in Arizona. WPBR appeared most common in drainages, and the field crew recorded sapling

mortality and crown dieback on mature trees. The graduate student has begun preliminary data analysis and is working to develop a thesis based on the project.

Year 2: In 2011, we installed a total of 34 plots. The sampling effort in Arizona was distributed between the Fort Apache Reservation (10 plots), the Coronado National Forest (5 plots), and the Alpine Ranger district of Apache-Sitgreaves National forest (5 plots) prior to the Wallow Fire in eastern Arizona. In New Mexico, we focused on the Gila National Forest (7 plots) and the eastern portion of the Santa Fe National Forest (7 plots). We detected WPBR on 10 additional plots, bringing the total number of WPBR-infected plots to 11. Walk-through stand surveys discovered an additional 4 infected stands. All infected plots were within the White Mountains and adjacent Gila Mountains. Investigations within our plot network further constrained the range of WPBR. A possible off-plot discovery in Santa Fe National Forest would be the first report of the pathogen in that area, if confirmed.

The graduate student is in the process of data analysis and writing, with graduation expected May 2012. Preliminary results indicate overstory white pines to be competitive with neighboring species in terms of survival, and we found a low incidence of other damaging agents. However results showed a deficit of small-diameter trees. Growing conditions were mostly dense, with basal area occasionally exceeding $300 ft^2/ac$. Fuel loads were frequently heavy. Humid sites were again where WPBR was most frequent and severe, although we found isolated cankers on xeric sites far from alternate hosts. Damage to large overstory trees was apparently light, while seedlings and saplings displayed the greatest damage. Planned analysis will investigate the impacts of WPBR on crown condition, growth, and vigor.

COSTS: The requested funding for Year 3 includes partial summer salary for the graduate student and project leader and money for page charges, which are becoming more common for open access journals. Summer project time will be dedicated to completing the project, including preparing and submitting results for peer-review publication.

	Item	**Requested FHM EM Funding**	**Other-Source Funding**	**Source**
YEAR: 1				
Administration	Salary	$36,297		
	Overhead	$4,409	$19,160	NAU*
	Travel	$7,545		
Procurements	Contracting			
	Equipment	$250		
	Supplies			
Total		$48,501		
YEAR: 2				
Administration	Salary	$43,223		
	Overhead	$5,086	$25,387	NAU*
	Travel	$7,640		
Total		$55,950		
YEAR: 3**				
Administration	Salary	$8710		
	Page charges	$1000		
	Overhead	$971	$3787	NAU*
Total		$10,681		

*NAU will contribute overhead and graduate student tuition remission

References available upon request.