Monitoring white pine blister rust in the Southwest

Chris Looney[1,3], Kristen Waring[1], and Mary Lou Fairweather[2]

1. School of Forestry, Northern Arizona University, Flagstaff, AZ
2. Forest Health Protection, US Forest Service, Flagstaff, AZ
3. Email: christopher.looney@nau.edu

Introduction

In 1990, white pine blister rust (WPBR) was discovered causing disease in southwestern white pine (*Pinus strobiformis*) in the Sacramento Mountains of south central New Mexico. 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) predicted 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 (Fairweather and Geils 2011).

Successful prevention and mitigation of WPBR needs to be proactive and should occur immediately (Chornesky et al 2005). Permanent monitoring plots are being established to better understand the distribution and effects of this pathogen in the southwest. Specifically, our objectives are to:

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

Figure 1 (left). Flagging due to WPBR infection in southwestern white pine.

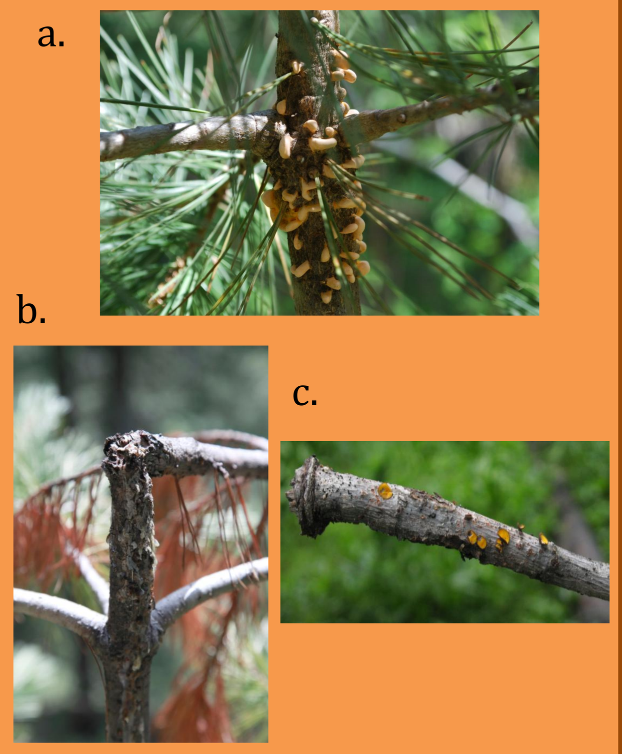

Figure 2 (right). a. and b. Symptoms of disease in southwestern white pine. a. WPBR aecia; b. dead leader resulting from WPBR; and c. apothecia of *Atropellis piniphila* canker

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 (50x20m), 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 western New Mexico 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. Fuel loads are assessed on 3 transects radiating from plot centers. Additional stands are examined using walk-through surveys for blister rust presence or absence.

Table 1. Summary characteristics of plots established during 2010; numbers represent either % of plots or means (std error).

# Plots	Elevation (ft)	WPBR (% of plots)	*Ribes* (% of plots)	*Pedicularis* (% of plots)	Live basal area (ft^2/ac)	Stand density index	Snag basal area (ft^2/ac)
26	8467 (137.6)	11.4	3.8	3.8	154.7(29.7)	267.5 (18.5)	29.7 (7.2)

Results

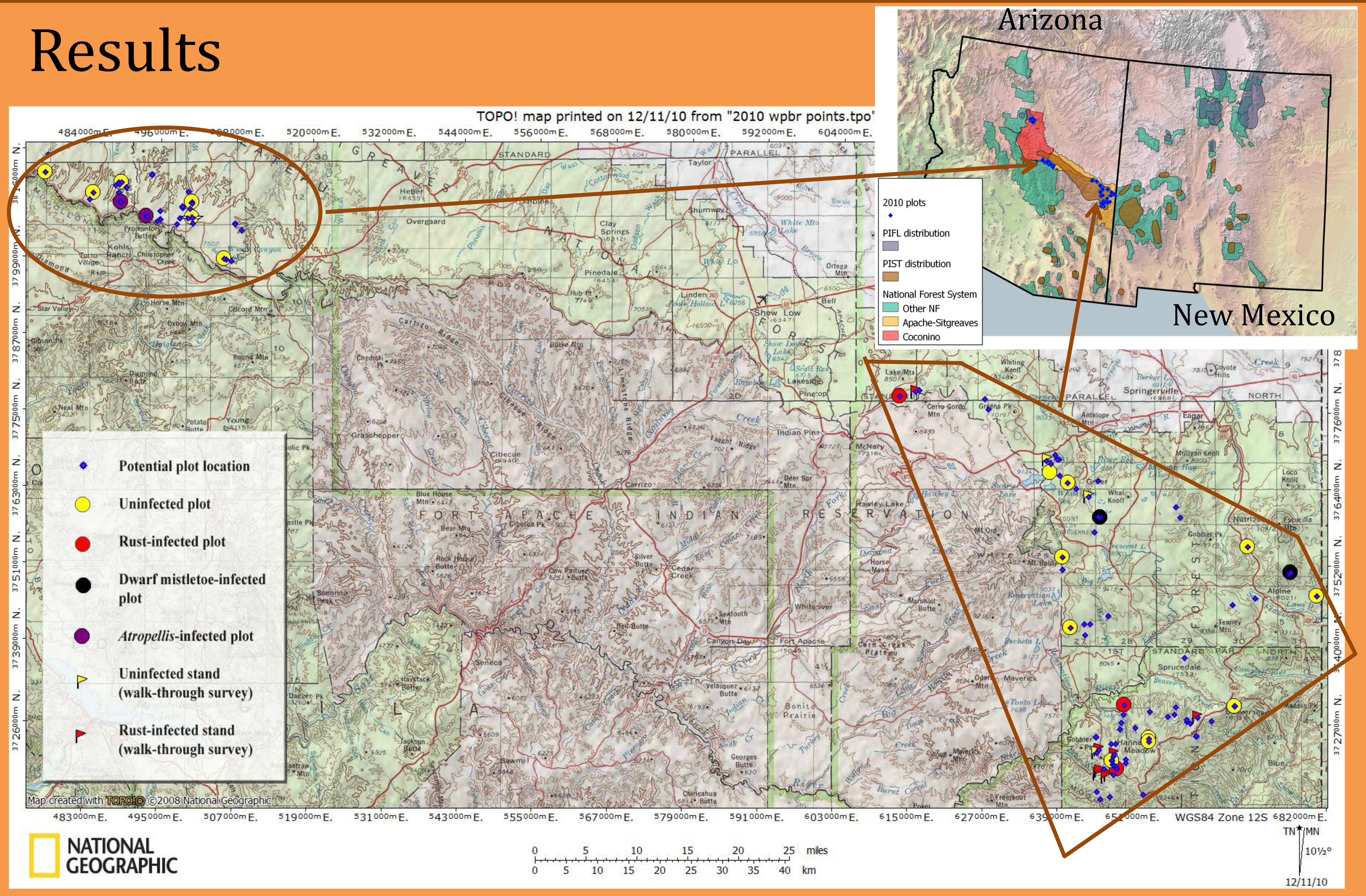

Figure 3. Location of potential and established plots in northern Arizona mixed conifer stands with >40ft2 basal area/acre in white pine. We did not sample the middle of Apache-Sitgreaves National Forest due to recent fires and low white pine abundance.

We established 26 plots during 2010 (Figure 3). Our efforts were focused on the Apache-Sitgreaves and Coconino National Forests; in our random plot locations, only three plots were confirmed to have WPBR present (Table 1). None of the infected plots were located west of the Fort Apache Indian Reservation. Diagnosis of WPBR in the southwest is difficult following the onset of monsoon season in early July; thus, we have a few plots to re-visit in late spring 2011 to confirm presence/absence of WPBR. Other pathogens cause similar symptoms when spores are not present, such as *atropellis* canker. However, with fruiting structures present, the *atropellis* is relatively easily distinguished from WPBR (Figures 1 and 2).

We found very little *Ribes* or *Pedicularis* present in our plots (Table 1). However, plots contained high tree density (Table 1) and were dominated by Douglas-fir, ponderosa pine, white fir, and southwestern white pine (Figure 4a). Understory dead fuel loading was concentrated in 1000-hr fuels with small proportions contained in fine fuels (100- and 10-hr fuels), litter and duff (Figure 4b).

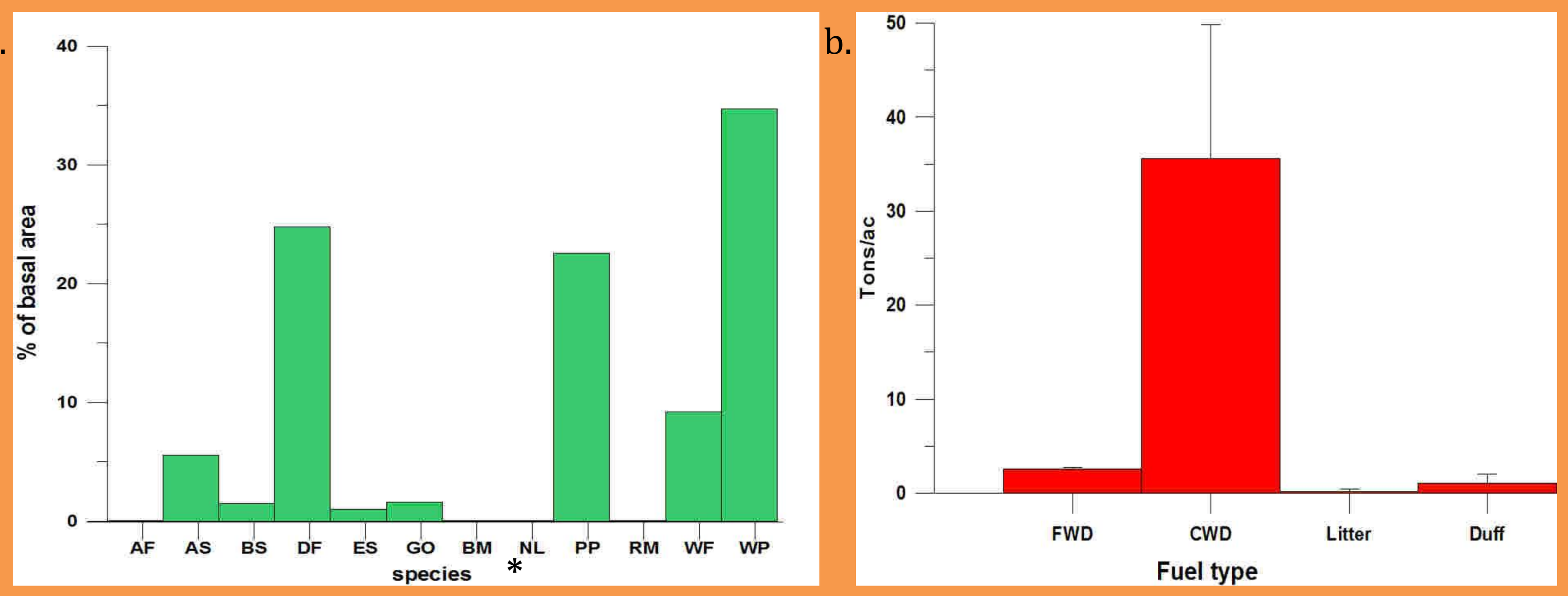

Figure 4. a. Mean species composition of plots by percent total basal area and b. Tons/ac fuel loading by category. FWD = fine woody debris; CWD = coarse woody debris. *WF=white fir; AF=subalpine fir; BS=blue spruce; WP=white pine(limber and southwestern white); DF=Douglas-fir; AS=aspen; PP=ponderosa pine; RM=Rocky Mountain juniper; ES=Engelmann spruce; GO=Gambel oak; NL=New Mexico locust; BM=bigtooth maple

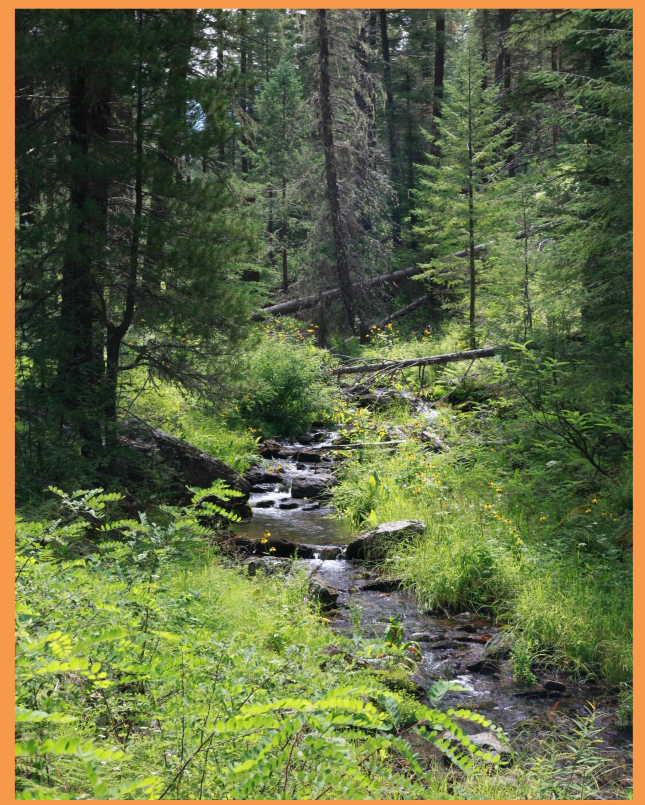

Figure 5. Mixed-conifer stand along stream channel; moist sites such as these tend to be more susceptible to WPBR.

Figure 6. Arizona mixed conifer stands can also be quite arid, as shown here in this view adjacent to a xeric hilltop mixed conifer plot bordering a montane grassland in eastern Arizona.

Future Plans

We plan to continue plot establishment during 2011, focusing on the Fort Apache Indian Reservation (eastern AZ) and the Gila National Forest (western NM). As time permits, we will also establish plots on the Coronado National Forest in southern AZ. We expect to find higher incidence of WPBR on the Gila NF with continued findings of higher incidence near streams (Figure 5) and at relatively high elevations. However, the high degree of variation in microclimates will likely lead to equally high variation in our results (Figure 6).

Acknowledgements

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References

Chornesky, E., A. Bartuska, et al. (2005). Science priorities for reducing the threat of invasive species to sustainable forestry. BioScience 55(4): 335-348.
Conklin DA. 2004. Development of white pine blister rust outbreak in New Mexico. USDA Forest Service, Southwestern Region, R3-04-01.
Dahms, C. and B. Geils (1997). An assessment of forest ecosystem health in the Southwest. General technical report RM-GTR-295: 97.
Fairweather ML, Geils BW. 2011. First report of the white pine blister rust pathogen, *Cronartium ribicola*, in Arizona. Plant Disease(In Press)
Hoff, R. and S. Hagle (1990). Diseases of whitebark pine with special emphasis on white pine blister rust. USDA Forest Service General technical report INT 270 (USA): 170-190.
Tomback DF, Keane RE, McCaughey WW, Smith CM. 2007. Methods for surveying and monitoring whitebark pine for blister rust infection and damage. USDA Forest Service R6-NR-FHP-2007-01: 143-145.