Stand level impacts of *Ips* and *Dendroctonus* bark beetles in pine forest types of Northern Arizona

Joel McMillin1, John Anhold1, Neil Cobb2, Jose Negrón3, Jesse Anderson2

1USFS Region 3 FHP, Flagstaff, AZ; 2MPCER, NAU, Flagstaff, AZ; 3USFS RMRS, Ft. Collins, CO

INTRODUCTION

Record low precipitation, increased temperatures, and dense forests have led to tremendous bark beetle incidence across the Southwest. Aerial Detection Surveys detected bark beetle activity on more than 2 million acres, killing more than 20 million pine trees in Arizona during 2002 and 2003 (Figures 1 & 2). The extent and severity of this mortality, and site factors contributing to mortality, remain undetermined at the Forest and stand level. This information is needed to accurately describe ecosystem changes that are occurring and to develop predictive models for future disturbance events.

OBJECTIVES

1. Quantify stand level impacts of bark beetles on ponderosa and piñon pine ecosystems in Arizona's National Forests.
2. Describe the forest and site conditions that have experienced tree mortality caused by drought and bark beetles.
3. Determine correlations between stand and site conditions and pine mortality.

METHODS

1. GIS maps used to determine plot location on 5 National Forests (***Figures 3 & 4*** *show Coconino NF*). Coconino, Kaibab & Prescott NF's completed 2003. Tonto and Apache-Sitgreaves NF's completed 2004. All plots on all Forests will be revisited in 2005.
2. Single (measures extent of outbreaks) and three plot clusters (stand level impacts) installed. Plots are 1/20th acre fixed radius (***Figure 5***).
3. Mensurational (tree size, density and damages) and regeneration (species and abundance) data collected from plots.
4. Bark beetle-attacked trees tallied in 1-ac swath between plot centers.

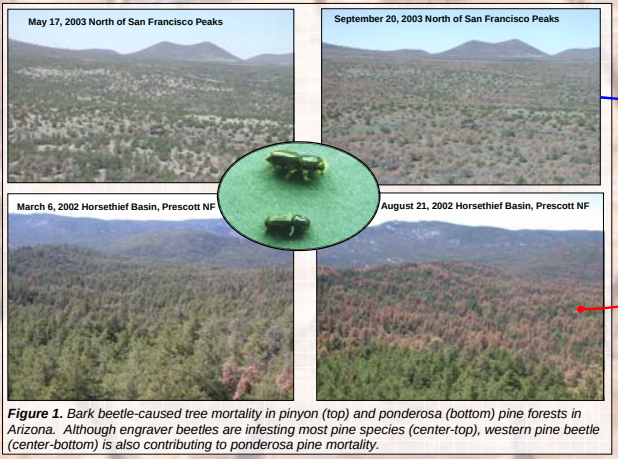
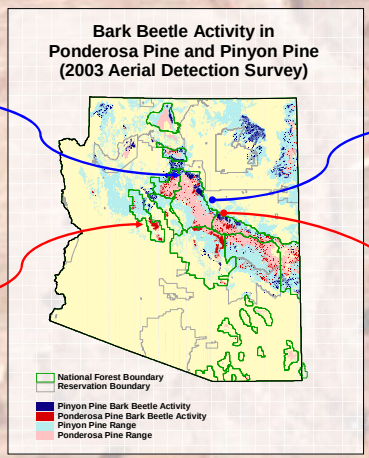


Figure 1. *Bark beetle-caused tree mortality in pinyon (top) and ponderosa (bottom) pine forests in Arizona. Although engraver beetles are infesting most pine species (center-top), western pine beetle (center-bottom) is also contributing to ponderosa pine mortality.*



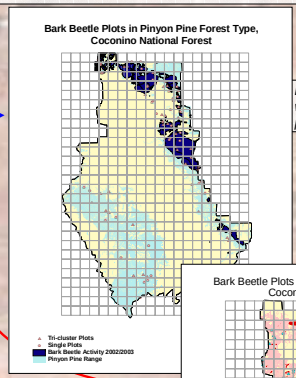


Figure 3. *Plots installed within a 3 mile grid over pinyon pine stands.*

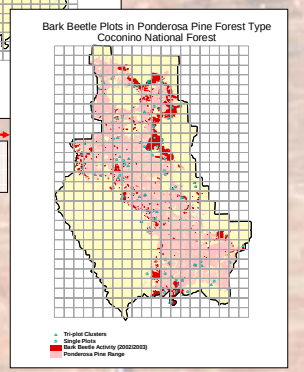


Figure 4. *Plots installed within a 3 mile grid over ponderosa pine stands.*

RESULTS

1. There have been **402** ***Pinyon pine*** and **779** ***Ponderosa pine*** plots established on five National Forests in Arizona during 2003 & 2004.
2. **401 plots** were revisited in 2005 on the Prescott, Kaibab & Coconino NF's.
3. 2003 & 2004 plot data indicate basal area mortality rates on some Forests as high as 48 percent in pinyon pine and 23 percent in ponderosa pine, Figures 6-9.

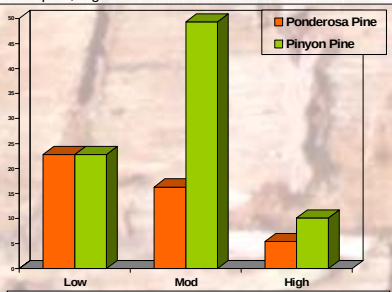


Figure 10. *Average percent mortality over all Forests for Ponderosa and Pinyon by at Low (<6000'), Moderate (6001'-7000') and High (>7000') elevation.*

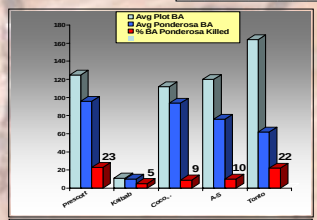


Figure 6. Ponderosa pine *plots on Arizona National Forests showing basal area parameters and percent mortality.*

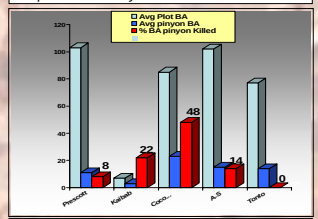


Figure 7. Pinyon pine *plots on Arizona National Forests showing basal area parameters and percent mortality.*

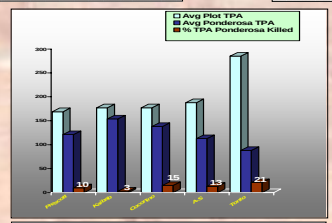


Figure 8. Ponderosa pine *plots on Arizona National Forests showing trees per acre parameters and percent mortality.*

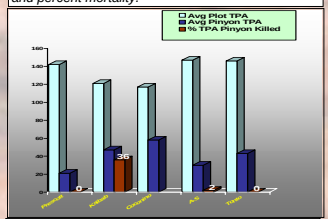


Figure 9. Pinyon pine *plots on Arizona National Forests showing trees per acre parameters and percent mortality.*

CONCLUSIONS

1. Results will be incorporated into Regional strategic communication plan to provide land managers and the public with better and consistent information.
2. Development of predictive models relating stand and site conditions to bark beetle-caused tree mortality.
3. Low to mid elevation pine forests were impacted greater than high elevation forests, Figure 10.
4. Overall pinyon woodlands were impacted more severely than ponderosa pine forests.

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