

WC-EM-F-10-01: Monitoring oak health and decline before and after infestation by the goldspotted oak borer (GSOB), *Agrilus auroguttatus*



Tom W. Coleman¹, Nancy E. Grulke², and Steven J. Seybold³

¹USDA Forest Service, Forest Health Protection, San Bernardino, CA,
Corresponding author: twcoleman@fs.fed.us or 909-382-2871

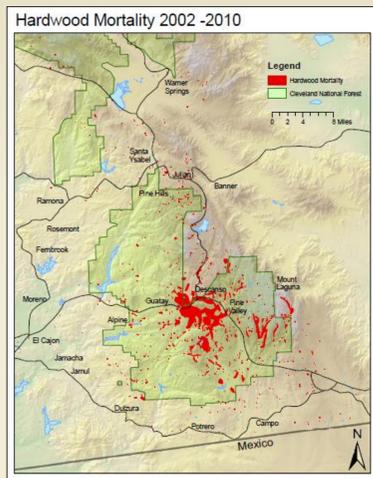
²USDA Forest Service, Western Wildland Environmental Threat Assessment Center, Prineville, OR

³USDA Forest Service, Pacific Southwest Research Station, Davis, CA



INTRODUCTION

- The goldspotted oak borer, *Agrilus auroguttatus*, is a new threat to native oaks in California. Two species of oaks, coast live oak, *Quercus agrifolia*, and California black oak, *Q. kelloggii*, are the primary hosts of GSOB in San Diego Co. Across 525,000 acres, an estimated 21,500 trees have been killed since 2002.

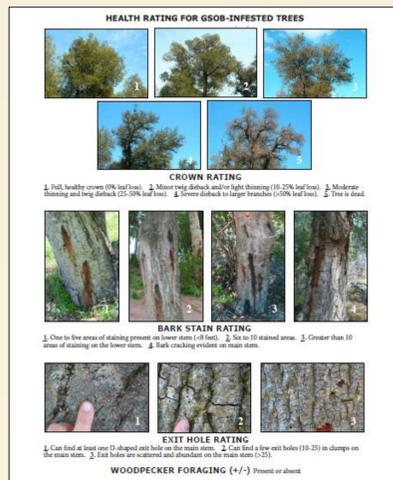


- Elevated levels of oak mortality have been continuous for the past nine years. The goldspotted oak borer is the most significant insect pest of oaks in California.

- Drought was considered to be the sole cause of this mortality for many years, but now the beetle is clearly the primary mortality agent. Various aspects of oak physiology were assessed to determine if drought stress is required for initial beetle colonization and tree mortality.

- Determining the time to tree mortality following GSOB infestation and the density of beetles required to kill trees will facilitate management efforts and likely reduce the cost of management and reduce environmental impact by avoiding the use of unnecessary insecticidal and mechanical treatments.

METHODS



- Objective 1.** We assessed oak health and tracked decline of GSOB-infested and uninfested coast live oaks in permanent plots that span the current zone of infestation in a north-south direction. Sixty-seven coast live oaks were followed.

- Decline ratings were determined by the degree of crown die back (rating 1-5), adult exit hole density (0-3), bark staining from larval injury (0-4), and presence/absence of woodpecker foraging holes in the outer bark (see the figure to the left).

- Physiological assessments occurred four times annually throughout the summers of 2009 and 2010. They included measurements of water potential (e.g. pre-dawn vs. solar noon branchlet xylem water potential and solar noon leaf cellular osmotic potential = turgor potential), water use efficiency, tree respiration, leaf and root carbon and nitrogen content, and soil moisture.

- Objective 2.** A 147 coast live oaks were tagged to assess the time to mortality following GSOB injury. Infested and uninfested trees were tagged on the Descanso RD, Cleveland NF in areas where tree mortality and beetle population densities are high. Tree tagging and health ratings began the fall of 2009 and were re-assessed in 2010.

OBJECTIVES

- Validate a health rating system for GSOB-infested trees by linking visual observations with physiological data. To accomplish this, we:**

- Monitored the physiological health of uninfested and infested oaks;
- Tracked the decline of oaks at varying stages of GSOB injury; and
- Monitored GSOB landing rate on uninfested and infested oaks.

- To measure beetle success, the total number of D-shaped exit holes were counted on the main bole below <2 m. D-shaped exit holes were assessed across each ranking of crown thinning/die back.

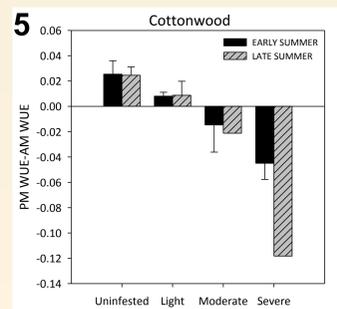
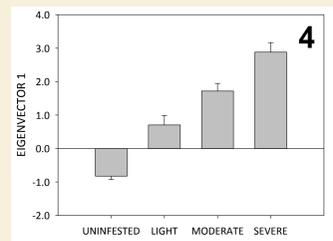
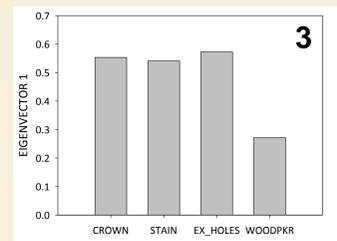
- Additional exit hole assessments included determining the density of exit holes on GSOB-killed trees at 0, 1.5, 3, 4.6, and 6.1 m from the ground in a 0.61 cm² area.



- Objective 3.** Forty coast live oaks were affixed with clear plastic panel traps (30.5x35.6 cm) on the northern and southern aspects of the bole at 140 cm from the ground. Traps were placed on all trees of all crown health classes. Traps were placed on trees during May and monitored until September 2010.

PRELIMINARY RESULTS

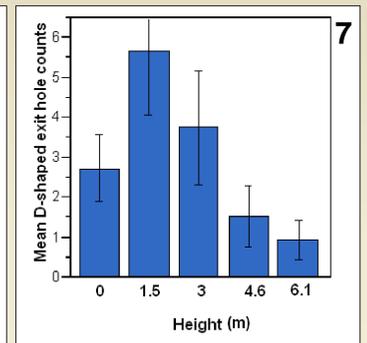
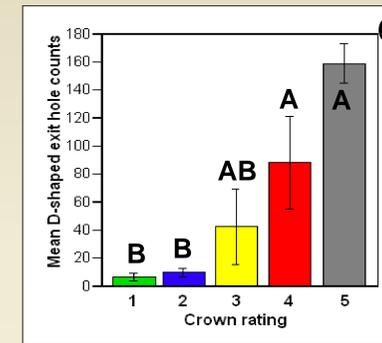
- Objective 1.** Principal component analysis was used to determine how much variance was explained by the four injury symptoms across all tree health ratings. Crown thinning, bark staining, and exit holes loaded high along the first eigenvector with woodpecker foraging explaining less variance (Fig. 3). The four injury attributes increased with each increasing level of injury (Fig. 4).



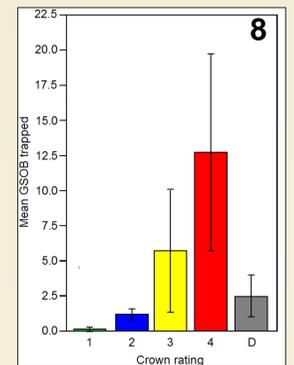
- Seasonal changes in leaf water use efficiency (WUE) for uninfested, lightly, moderately, and severely injured coast live oak (Fig. 5). Positive WUE indicates that uninfested and lightly infested trees are not showing significant water stress. Thus, GSOB is aggressively attacking healthy hosts.

- Objective 2.** In 2009, 80% (117) of 147 trees sampled in the CNF had evidence of infestation by GSOB. In 2010, GSOB was present in 87% (130) of the 147 trees, representing a 7% increase during one generation of beetles. In the fall of 2010, 53 additional trees were tagged in each crown class and given a health rating.

- There was an increasing trend between declining crown rating and the number of GSOB exit holes on the main stem (Fig. 6).
- The density of GSOB exit holes was highest at 1.5 m along the main bole (Fig. 7). Exit hole densities decreased from 1.5 m to 6.1 m.



- Objective 3.** GSOB adult landing rate was approximately 10-times higher on infested trees (Fig. 8). Landing rate increased across with each crown class designation until tree death, but these increases were not significant. Landing rate was highest on trees showing severe crown thinning and die back (crown classes 4 and 5).



SUMMARY

- Objective 1.** Each health rating attribute contributed to explaining the decline of tree health from GSOB injury. First year results suggested that uninfested and lightly infested trees are not suffering from significant drought stress. However, physiological drought stress increased with each crown severity level.
- Objective 2.** First year results suggested that trees with a crown rating of "3" or "4" show significant injury from GSOB. These trees can likely not be saved by insecticide application due to the extensive injury present and should be considered for removal and mechanical treatment to reduce local GSOB populations.
- GSOB exit hole densities were greatest on the lower bole (1.5 m). Thus, ground surveys for infested trees and insecticide applications should focus on the lower bole.
- Objective 3.** GSOB adult landing rate increased with each crown rating up to the most severe crown rating. Trees with moderate and severe thinning and die back are very attractive to GSOB adults and should be considered for removal in high-value settings.

ACKNOWLEDGEMENTS

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