

THE GOLDSPOTTED OAK BORER: AN OVERVIEW OF A RESEARCH PROGRAM FOR “CALIFORNIA’S EMERALD ASH BORER”

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ABSTRACT

A new threat to oaks in California was identified in June 2008 following years of misdiagnosis. The goldspotted oak borer (GSOB), *Agrilus coxalis auroguttatus* Schaeffer (Coleoptera: Buprestidae), is aggressively attacking and killing three species of oaks in San Diego County (Coleman and Seybold 2008a, b; Hespenheide and Bellamy 2009). About 20,000 coast live oaks, *Quercus agrifolia*, California black oaks, *Q. kelloggii*, and canyon live oaks, *Q. chrysolepis*, have died in a 4,903-km² area centered near the Descanso Ranger District of the Cleveland National Forest and Cuyamaca Rancho State Park. Oak mortality has been continuous for the past 8 years and occurs on all land ownerships. Because the two subspecies of GSOB are native to southeastern Arizona, Guatemala, and southern Mexico, and the indigenous populations have never been reported to be associated with extensive tree injury or mortality, we hypothesize that elevated oak mortality in southern California has occurred because of an absence of evolved host resistance in native oaks and/or an absence of natural enemies found in GSOB’s native range. The native distributions of the California hosts of GSOB extend north through most of the state along the coastal foothills and the Sierra Nevada. Thus, this new pest to oaks has the potential to cause a more widespread decline of oaks in more northerly regions in California and perhaps beyond. The recognition of the national significance of this new mortality agent was highlighted in the most recent annual National Forest Pest Risk Assessment (U.S. Forest Service 2009).

To address this critical problem, we have drafted a research plan to stimulate and organize collaborative work among scientists from the U.S. Forest Service, Forest Health Protection-R5 and R-3, and the Northern, Pacific Southwest, and Southern Research Stations; USDA APHIS-CPHST, and the University of California, Davis and Riverside. The principal participants from the agencies are Tom Coleman, Joel McMillin, and Sheri Smith (FHP); Nancy Grulke and Steve Seybold (PSW); Rob Venette (NRS); Brian Strom (SRS); Damon Crook (USDA APHIS-CPHST); Mary Louise Flint (UCD), and Mark Hoddle, Tom Scott, and Richard Stouthamer (all UCR).

PROGRAM CONTENT SURVEY AND DETECTION

- Establishing the distribution of GSOB (2009-2010)
 - We are trapping at more than 40 sites with unbaited purple prism traps to infer the current distribution and population densities throughout southern California, the Central Valley, and the central and southern Sierra Nevada.
 - Current Progress: In 2009, the distribution of GSOB continued to be confined to San Diego County, although new finds were made to the north, south, and west of the initially delineated distribution and the size of the infested area increased from 1,200 to 4,903 km². A satellite location was discovered near La Jolla through ground survey. Sites were selected and traps

installed before May 15 each year, and traps were sampled following peak activity of GSOB (late July)

- Products/Measures: This work will delimit the current extent of the infestation in California and provide the justification and scope for a proposed quarantine.

- Collaborators: Coleman and Seybold

- Supported initially in part by a Detection Monitoring grant from the National Forest Health Monitoring Program and Forest Health Protection (FHP), Region 5.

- **Improving GSOB survey techniques (2009-2011)**

- We are assessing various trapping treatments that vary trap color, trap height, and potential lures in the field. We are conducting electroantennal detection and retinalgram work on GSOB adults following volatile and bark/foliage reflectance assessments.

- Current Progress: Trap color and height were assessed between January and September 2009; trap bait type was assessed between June and September 2009. In July 2009 and March 2010, oak bark volatiles were sampled from coast live, canyon live, and Engelmann oaks to guide us in future bait development.

- Products/Measures: Initial trapping results suggest that trap color (purple vs. green) and height do not have a strong effect on trap catch. None of the commercial emerald ash borer lures were very attractive.

- Collaborators: Crook, Coleman, and Seybold
Supported by APHIS-CPHST (2010-2011) through a cooperative agreement with UC-Davis.

BIOLOGY

- **Establishing the life cycle and flight period for GSOB**

- Adult trapping is being conducted at two elevational levels (1,000 and 1,800 m) in GSOB-infested areas in California.

- Current Progress: Flight activity in California began during the week of May 22, 2009, and continued through October 2009. A method was

developed for separating the sexes of adult GSOB based on external morphological characters (Coleman and Seybold 2010b).

- Products/Measures: The results of this work will allow us to more accurately time future surveys and management activities.

- Collaborators: Coleman and Seybold

- Supported in part by a Detection Monitoring grant from the National Forest Health Monitoring Program

- **Surveying the native distribution of GSOB in Arizona (2009-2010)**

- Current Progress: With the assistance of Coronado National Forest staff, we monitored purple EAB traps at seven sites in the Santa Rita and Huachuca Mountains from February to August 2009. No specimens of GSOB were recovered from these traps. Forest stand data were also collected to compare to California forest conditions (see “impact” below). Ground surveys were conducted in Arizona to determine the native hosts of GSOB and its impact in the native forest stands. Infested trees were examined and infested bark was collected.

- Products/Measures: We have determined native oak hosts in Arizona and found several natural enemies (Coleman and Seybold in prep.). Collections of GSOB from this area will also allow us to determine the source of the California population (see below).

- Collaborators: Coleman, Seybold, McMillin, and Coronado National Forest staff.

- This work is being supported by the U.S. Forest Service FHP Forest Health Technology Enterprise Team and the Pacific Southwest Research Station.

IMPACT AND MANAGEMENT

- **Evaluating impact of GSOB in forest stands (2008-2010)**

- Long-term plots have been established in southern California and Arizona to record tree mortality, percentage of infested trees,

species composition, diameter class, tree health, regeneration, etc.

- Current Progress: Plots have been established on the Cleveland and the Coronado National Forests. Additional forest stand data are being collected this year.

- Products/Measures: Current GSOB infestation rates are reaching ~90 percent in areas with tree mortality around Pine Valley, CA. The GSOB infestation is expanding to the north, south, and west from the Descanso Ranger District (Coleman and Seybold in prep.). In Arizona, infestation and mortality rates are very low, but native hosts have been identified.

- Collaborators: Coleman, Flint, McMillin, and Seybold

- Supported in part by a cooperative agreement between the U.S. Forest Service, Pacific Southwest Research Station, and UC-Davis.

- **Evaluating the development of GSOB in firewood and evaluating firewood treatments for GSOB survival (2009-2010)**

- We developed a series of treatments of oak firewood (solar exposure, tarping + solar, shaded) at two elevations with two species of oak firewood (Seybold et al. 2010).

- Current Progress: The 2009 study has been evaluated and emergence of adult GSOB from firewood was proved. None of the treatments were effective at completely preventing GSOB emergence from firewood.

- Products/Measures: This study has determined that GSOB will emerge from firewood and that firewood movement will be a threat to expand the current distribution in California. In 2010, we plan to assess the effectiveness of chipping firewood for GSOB survival and to integrate chipping and firewood tarping into a management tool for stakeholders.

- Cooperators: Coleman, Flint, and Seybold

- Supported in part by a cooperative agreement between the U.S. Forest Service, Pacific Southwest Research Station, and UC-Davis.

- **Biological Control: Evaluating the population genetics of GSOB and its potential natural enemies**

- Current Progress: Molecular analyses are being conducted on California, Arizona, and Mexican populations of GSOB by Stouthamer's lab in the Department of Entomology at UC-Riverside to establish the source of the California population. Contacts have been made with Mexican partners to evaluate the impact of GSOB in Mexico. Surveys were conducted in Arizona for natural enemies, and wasps were reared from parasitized GSOB larvae collected from an Emory oak in Arizona. Specialists have identified two species: *Calosota* sp. (Eupelmidae) (more abundant) and *Atanycolus simplex* Cresson (Braconidae) (less abundant) (Coleman and Seybold in prep.). The former species appears to be new to science and is being described. Survey trips to discover additional natural enemies have been made to Arizona and Mexico by Hoddle and Coleman.

- Products/Measures: This study represents a potentially long-term management solution by reuniting the parasite complex from verified source populations of GSOB in Arizona with the introduced population of GSOB in California.

- Cooperators: Hoddle, Stouthamer, Seybold, and Coleman

- Supported by U.S. Forest Service FHTET, USDA FHP, U.S. Forest Service FHP International Activities and Travel, and the U.S. Forest Service Western Wildlands Environmental Threat Assessment Center (WWETAC). Funding is being used to support the Ph.D. program of a UC-Riverside graduate student, supplies, and travel to Arizona and Mexico.

- **Evaluating the drought stress status of oaks within and outside of the zone of infestation (2009-2011)**

- We are assessing drought stress in uninfested and infested coast live oaks at four sites along a north-south transect that passes through the zone of infestation.
- Current Progress: Plots were established in June 2009 and one season of data were collected. Data collection will continue in 2010 and 2011.
- Products/Measures: Initial results suggest that oaks in the survey plots are not significantly water stressed, which implies that GSOB is injuring and killing healthy trees.
- Cooperators: Grulke, Coleman, and Seybold.
- The U.S. Forest Service FHP National Forest Health Monitoring Program began supporting this work in 2010.
- **Developing technology to more accurately determine the potential distribution and impact of GSOB (2010-2013)**
 - We are determining the intrinsic flight dispersal of GSOB by mark-recapture of beetles marked with fluorescent powder; establishing the physiological host range by using lab rearing studies; and conducting a pest risk assessment for California and Oregon.
 - Products/Measures: Project will begin in June 2010.
 - Cooperators: Venette, Coleman, Flint, and Seybold.
 - Project is being supported by the U.S. Forest Service Special Technology Development Program (2010-2013). Funding will support the research of a postdoctoral associate (A.D. Graves) from the UC-Davis Department of Entomology.
- **Testing the efficacy of systemic and topically applied insecticide treatments**
 - Three systemic insecticides are being assessed to prevent tree mortality from GSOB.
 - Current Progress: Trees were treated in 2009 and 2010, and foliage was sampled three times in 2009 for efficacy. In 2009, systemic insecticide treatments included soil and stem injections, whereas in 2010, two types of stem injections are being assessed. Topically applied insecticides are also being tested in 2010.
 - Products/Measures: This study will determine the effectiveness of systemic insecticides in preventing tree mortality and provide insight on treatment timing and duration.
 - Cooperators: Strom, Smith, and Coleman.
 - Supported by U.S. Forest Service FHP, R5.
- **Evaluating tree health and time of mortality following GSOB infestation**
 - Current Progress: Tree health and time of mortality are being assessed to determine management strategies. A health class rating system has been developed to determine tree decline in coast live oak. Trees were tagged across a range of health classes and will be followed in the future.
 - Products/Measures: Information from this project will allow land managers to determine the probability of whether a tree can be treated and saved.
 - Cooperators: Coleman, Grulke, and Seybold.
 - Supported by the U.S. Forest Service FHP National Forest Health Monitoring Program and the Pacific Southwest Research Station.

PROGRAM PRODUCTS

Forty-one presentations (scientific/technical or outreach) on GSOB have been delivered since late 2008 by Coleman, Seybold, or Flint. Three trainings have been held to “train the trainer” on the Cleveland National Forest. A Pest Alert, several outreach and educational materials, six symposium proceedings, and three peer-reviewed publications were produced between 2008 and 2010.

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