



TREE NOTES

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Goldspotted Oak Borer *Agrilus coxalis* Waterhouse

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Introduction/Summary

The Goldspotted Oak Borer (GSOB), *Agrilus coxalis* Waterhouse, is in the family Buprestidae, a group of insects commonly known as flatheaded wood borers. It was first detected in 2004 in San Diego County California by the California Department of Food and Agriculture during an exotic woodborer survey. In 2008 it was found in the same county attacking coast live oak, *Quercus agrifolia* Nee, California black oak, *Q. kelloggii* Newb. and canyon live oak, *Q. chrysolepis* Liebm. Flatheaded borers are a diverse and important family of beetles that commonly attack trees and woody plants. A few species are known to attack and kill apparently healthy trees, but most attack weakened, dead or recently felled trees (Furniss and Carolin 1977). Larvae commonly bore under the bark into the cambium region of the trunk, branches and roots, often penetrate the wood where they can feed extensively and sometimes mine extensively (Borrer and White 1970, Furniss and Carolin, 1977). Woodborer adults frequently emerge in the spring and summer, feed and lay eggs in crevices of the bark, wood or on outer surfaces (Furniss and Carolin 1977). GSOB larvae have not been found attacking branches smaller than 12.5cm. Larvae feed within tree tissue and are the damaging life stage. Extensive mining by larvae disrupt flow of water and nutrients in the tree. GSOB injury is found on healthy-looking trees, but additional factors may be increasing the tree susceptibility to injury and mortality. Symptoms of injury are twig dieback, crown thinning, bark staining, and adult exit holes which progress to eventual tree death. Topical and systemic insecticides, in conjunction with applied cultural control

methods and not moving firewood may be beneficial for controlling of GSOB.

Identification of the Goldspotted Oak Borer

Goldspotted Oak Borer adults are about 10 mm in length and 2 mm wide, Figure 1 (Coleman and Seybold 2008). Adults are compact and bullet-shaped, with a dull metallic-green color with three prominent golden yellow spots located on each forewing for easy identification. Mature larvae are about 18 mm in length and 3 mm wide. They are white and legless with an elongated slender shape with two pincher-like spines located at the tip of the abdomen. (Coleman and Seybold 2008). Larvae feed primarily on the surface of the sapwood where feeding galleries can be extensive. Larval galleries can be up to 3mm wide, are black in color and packed with frass. Pupae are found only in the outer bark and resemble the adults, but are white in color during early development. Eggs are probably laid in bark crevices like other *Agrilus* spp. but this has not been observed (Furniss and Carolin 1977 and Coleman and Seybold 2008).

Figure 1: Goldspotted Oak Borer, adult and larvae.



Photo by Tom Coleman, USDA Forest Service, FHM.

Symptoms and Signs of Infestation

On the bark surface of the main stem and larger branches, GSOB injury can be detected by extensive bark staining. Staining can appear as black regions or red blistering with sap oozing from under the bark (Coleman and Seybold 2008). When the outer bark is removed from stained regions, large amounts of accumulated water can drain from areas of cambium mortality. Larvae galleries are abundant in patch-killed areas. Stained areas can vary from dime-size (0.6 cm) to 20 cm, and are common from the root collar of the stem to larger branches, Figure 2.

Figure 2: Bark Staining and exposed patch-killed cambium (base of tree) on coast live oak.



Photo by: Tom Coleman, USDA Forest Service, FHM

Adult exit holes are D-shaped and signify completed development. These emergence holes are about 3 mm in width (Coleman and Seybold 2008). On coast live oak, the bark is frequently removed by woodpeckers as they forage for

larvae and pupae. This reveals the deep red-colored inner bark that contrasts with the dark grey bark exterior. If the GSOB behavior is similar to those of other flatheaded borers in this genus, the adults likely feed and mate on the foliage.

Larvae construct galleries primarily on the sapwood surface along the main stem from the base of the tree up to the larger branches. The galleries are dark in color with a general meandering pattern and sometimes vertical in orientation, Figure 3. Extensive larval feeding can strip or patch-kill areas of the cambium. (Coleman, and Seybold 2008).

Figure 3: Larvae galleries



Photo by: Tom Coleman, USDA Forest Service, FHM

GSOB injured trees often progress through several stages of crown thinning, beginning with premature leaf drop, twig and tip dieback and eventual branch dieback. Crown thinning may only be evident after several years of injury. Coast and canyon live oaks with extensive thinning appear gray when compared to the dark green color of healthier crowns. Coast and canyon live oak tend to retain their leaves longer than California black oak until tree mortality occurs and foliage turns brown. Injured trees can flush new foliage in the spring when attacked. A large amount of foliage is retained on coast and canyon live oak until tree mortality occurs and the foliage turns brown. California black oak leaves will turn a tan brown and do not remain on the tree until leaf abscission in the fall, Figure 4.

Background and distribution

The first known collection of GSOB in southern California was on the Cuyamaca Rancho State Park in 2004 as part of an exotic wood boring survey by the California Department of Food and Agriculture. The tree host species and larval habitats were unknown until June 2008 when it was linked with oak mortality in San Diego County. The species has been collected previously in Arizona, Guatemala and Mexico.

Figure 4: Crown dieback of California black oak (top) and coastal live oak (bottom).



Top photo by: Kim Camilli, Cal Poly/Cal Fire

Bottom photo by: Tom Coleman, USDA Forest Service, FHM

The presence of GSOB in southern California is presumably a range expansion or an introduction on firewood. The point of establishment may have occurred around Descanso, CA where initial oak mortality was mapped. The distribution of coast live oak, canyon live oak and California black oak extend over a large area of California and there is a high concern for this insect spreading into these areas.

Limited host resistance to larvae feeding and low natural enemy populations may contribute to tree mortality. Additional research is focusing on stressors which may be increasing susceptibility of tree to GSOB injury and mortality. Initial data suggest that the root pathogen *Phytophthora* spp. is present in soil and on roots of oak trees. Current research is being undertaken to determine the epidemiological role this pathogen is having on oaks attacked by GSOB.

Biology

Initial observations suggest that most of the GSOB population completes one generation per year with mature larvae present in the tree during the fall to the spring (Coleman and Seybold 2008). Preliminary flight trapping found that adult activity occurs from June to November with peak flight in mid-June. However, a full season of observations will likely reveal the presence of young larvae prior to May and adult flight that begins earlier than June. Coast live oak, canyon live oak and California black oak are the only confirmed hosts of GSOB, but other oak species may be susceptible as well. GSOB attacks have only been observed on older, mature oaks larger than > 12.5 cm at breast height (Coleman and Seybold 2008). Additional research and observations are needed to clarify the life history and host range susceptibility.

Management

The goldspotted oak borer has a life history and impacts that are similar to several other *Agrilus* spp.; bronze birch borer (*Agrilus anxius*), emerald ash borer (*Agrilus planipennis*), and twolined chestnut borer (*Agrilus bilinaetus*). Insecticides recommended for the control of these insects are being considered for use to control of GSOB (McCullough, D.G. et al, 2004), (Katovich, S.A. et al, 2000) (Haack, R.A., 1992).

Research is currently assessing the efficacy of systemic insecticides by stem and soil injections for protecting high-

value trees against GSOB.

Cultural control is also an important part of reducing the spread of GSOB. Logs and firewood from GSOB killed trees or green infested trees should not be removed from infested areas. Transporting infested firewood may present a significant pathway for introducing GSOB into non-infested areas. Removal of dead and/or dying trees infested with GSOB can reduce localized populations. Within the infested areas, tarping oak wood with thick clear plastic sheeting (Sanborn, S.R., 1996) or exposing cut wood to direct sunlight may kill GSOB larvae and pupae. When tarping cut wood, plastic should be 6mm thick, exposed to direct sunlight and soil should cover the edges of the tarp to limit beetle emergence. Research on emerald ash borer has shown that chipping wood into 2.5 cm pieces is the best method to kill all beetles and will drastically reduce *Agrilus spp.* survival in cut logs (McCullough et al., 2007). Other effective methods to render material unsuitable for GSOB are lop and scatter, piling and burning, and debarking logs (Sanborn, S.R., 1996).

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