Effects of the Goldspotted Oak Borer, *Agrilus auroguttatus*, on the Health of Coast Live Oak, *Quercus agrifolia*, in Southern California Before and After Treatment With Two Systemic Insecticides[1]

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Abstract

The invasive goldspotted oak borer, *Agrilus auroguttatus* (Coleoptera: Buprestidae), is threatening the health and survival of oak trees in San Diego County, California (Flint and others 2013). The primary oak species colonized and killed in this area include coast live oak (*Quercus agrifolia*), California black oak (*Quercus kelloggii*), and canyon live oak (*Quercus chrysolepis*). The high amount of damage recorded on these hosts suggests that the association between *A. auroguttatus* and these oaks is recent. Damage by *A. auroguttatus* in its native range in Arizona to Emory oak (*Quercus emoryi*) and silverleaf oak (*Quercus hypoleucoides*), is much less severe (Coleman and others 2012), suggesting a longer co-evolutionary relationship.

Preventive and suppressive chemical treatment techniques have not previously been tested for the control of *A. auroguttatus* in California. Management activities have focused primarily on treatment of infested oak wood (Jones and others 2013). We report on a 3.5-year investigation of the efficacy of two systemic insecticides, emamectin benzoate (EB) and imidacloprid (IC), for controlling *A. auroguttatus* in *Q. agrifolia*, in San Diego County.

Trees at two study sites (Japatul Valley, IC and Deerhorn Valley, EB) were treated in April-May 2011 by tree injection, and over 300 study trees were monitored at the locations between April 2011 and October 2014. These sites (on private lands) were characterized by relatively open stands of *Q. agrifolia* and Engelmann oak (*Q. engelmannii*), the latter of which is not considered a host of *A. auroguttatus*. The key elements of the health of *Q. agrifolia* monitored annually by the project team were the number of D-shaped emergence holes (Figure 1A; Flint and others 2013) and the crown condition of the trees (Figure 1B; Hishinuma and others 2011).

There was no tree mortality through the early stages of the study. However, between October 2013 and 2014, eight trees died in the EB study. No mortality was recorded during the IC study. In the test of EB, uninjected trees had an elevated and sustained level of annual increases in *A. auroguttatus* emergence holes recorded 1.5 years after the initiation of the study, whereas EB treatment yielded annual increases that remained lower and constant. In the test of IC, treated trees had a significantly greater annual increase in *A. auroguttatus*

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emergence holes than untreated trees during the third survey period (October 2012-2013). Annual increases in *A. auroguttatus* emergence holes in the uninjected control group of trees for the IC study did not differ during the three survey periods; treatment with IC resulted in an annual increase in *A. auroguttatus* emergence holes that declined consistently over the survey periods. Crown ratings of most trees at both study sites remained unchanged, regardless of insecticide treatment.

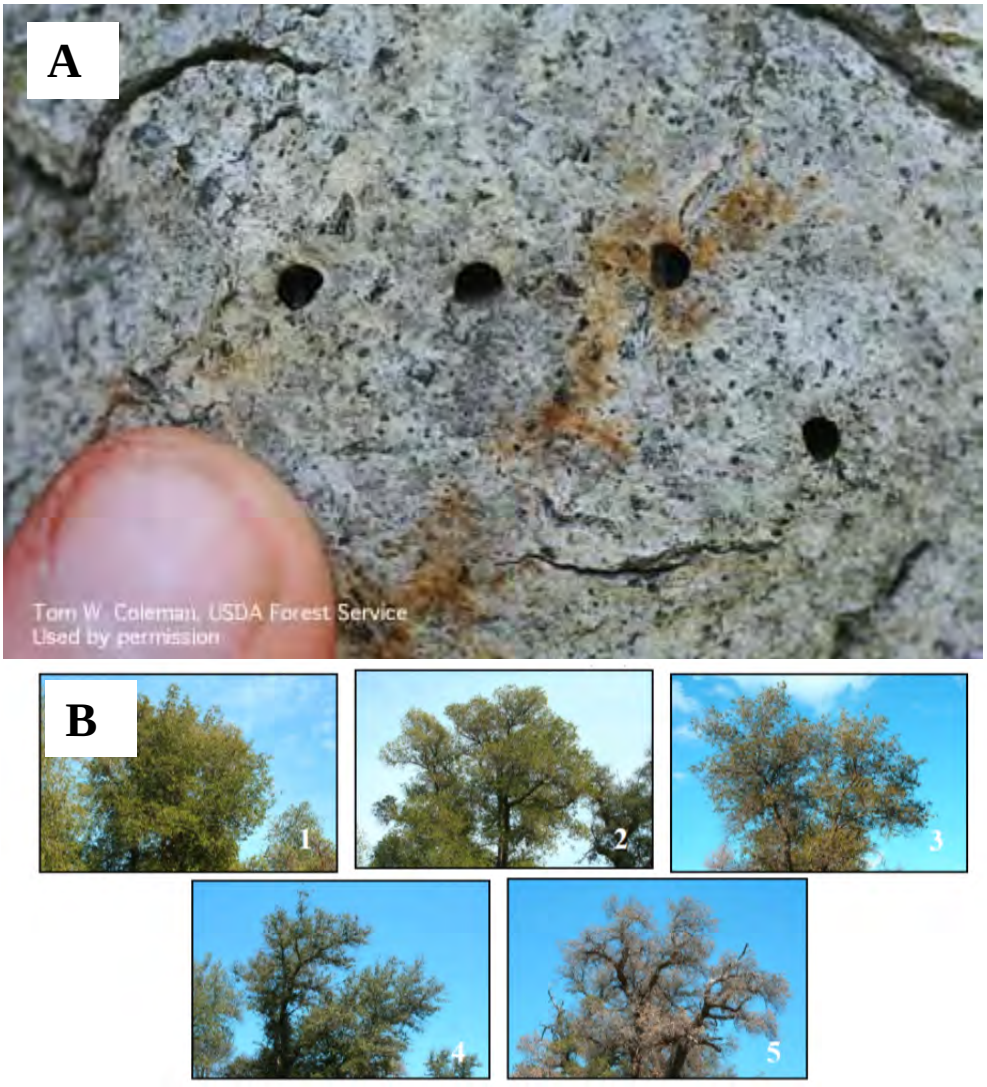

Figure 1—Two elements of assessment of the health of coast live oak (*Quercus agrifolia*) in this study were the number of goldspotted oak borer (*Agrilus auroguttatus*) D-shaped emergence holes (A; Flint and others 2013) through the bark surface, and the condition of the crown (B; Hishinuma and others 2011) based on a 5-part rating system where 1 is a healthy crown and 5 is the crown of a dead tree.

In both tests, a higher cumulative increase in *A. auroguttatus* emergence holes was observed from trees that were more severely infested at the beginning of the study. The greatest cumulative increases in *A. auroguttatus* emergence holes were observed in trees with larger diameters at breast height.

Because of the rather gradual decline in the health of *Q. agrifolia* in both treatment groups at both study sites, we conclude that the impact of *A. auroguttatus* is a relatively slow process. Thus, unlike the situation with pests such as tree-killing conifer bark beetles, land managers

may have more time to respond to evidence of new infestations by *A. auroguttatus* in an area to execute tree removals and proper wood sanitation. Although systemic insecticides such as EB have been shown to be efficacious for the control of other similar species such as the emerald ash borer (*Agrilus planipennis*) in the eastern United States (McCullough and others 2011, Smitley and others 2010), our study does not provide evidence of strong efficacy for these materials in the control of *A. auroguttatus* in California.

Key words: coast live oak, emamectin benzoate, goldspotted oak borer, imidacloprid, invasive pest, systemic insecticide

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