

The Response of Saprotrophic Beetles to Coast Live Oaks Infected With *Phytophthora ramorum*¹

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Abstract

Saprotrophic ambrosia and bark beetles (Coleoptera: Scolytidae) tunnel into the bark overlying cankers caused by *Phytophthora ramorum* in coast live oaks, *Quercus agrifolia*. These insects are characteristically reported to colonize freshly dead or moribund trees (Furniss and Carolin, 1977). However, the initial attacks by these beetles on *P. ramorum*-infected coast live oaks are limited to the bleeding cankers. In a disease progression study (McPherson and others, 2005), we found that beetles were present in about 50 percent of all bleeding trees in each of four years and every bleeding tree that died following beetle colonization had been attacked while the foliage was healthy. We have several lines of evidence from field studies suggesting that beetles play significant roles in sudden oak death (SOD). Beetles preferentially colonize bleeding cankers, catastrophic bole failure of bleeding trees is strongly associated with beetle tunnels, ambrosia beetles, particularly *Monarthrum* spp., require sound, undecayed wood, and the development of *Hypoxylon thouarsianum* fruiting bodies consistently follows beetle colonization.

The study described here was designed to quantify the attraction of these beetles to *P. ramorum*-infected trees. In July 2002, mature *Q. agrifolia* were 1) inoculated with *P. ramorum* (80), and 2) wounded but not inoculated (40). Half of each group was sprayed with insecticides to prevent beetle colonization. Wire traps coated with Tanglefoot were placed on the insecticide-treated trees to catch insects and monitored throughout 2003. Beetles were identified to species and to sex where possible. Infected trees attracted significantly more beetles than mock-inoculated trees. Of the seven beetle species most commonly trapped, six

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were in the family Scolytidae. Strongly skewed sex ratios were found for two of the four most abundant species. The greatest response to inoculated trees occurred within the first year following inoculation. Beetles had colonized more than half the bleeding trees not treated with insecticide through July 2004, killing 13 percent of this group within two years of inoculation.

Because only 72 percent of inoculated trees developed bleeding cankers, we analyzed beetle responses to bleeding vs. non-bleeding trees. Repeated measure analyses of various insect counts showed significant treatment (bleeding vs. non-bleeding) and treatment by insect species interaction effects. Bleeding trees attracted significantly more beetles than non-bleeding trees for the five collection periods in 2003. Beetle abundance was greater for the July-October period than during other months. We trapped five ambrosia beetle species (*Monarthrum scutellare*, *M. dentiger*, *Xyleborinus saxeseni*, *Xyleborus californicus*, *Gnathotrichus pilosus*), one bark beetle species (*Pseudopityophthorus pubipennis*) and one false powderpost beetle species (*Scobicia declivis*). For each species, significantly more beetles were trapped on bleeding than on non-bleeding trees (Fig. 1). Abundances of *X. californicus* were insufficient for analysis. Sex ratios were strongly male biased in the *Monarthrum* spp. and female biased in *X. saxeseni*. Through July 2004, four (14 percent) of the bleeding trees that were not sprayed with insecticides had died, in contrast to one sprayed tree.

The study provides direct evidence for the association of saprotrophic beetles with the death of trees infected by *P. ramorum*. The principal host materials of *P. pubipennis* are dead branches on live trees, and severely weakened, or recently killed trees. In Europe, false powderpost beetles are known to attack well-seasoned, dead timber. The roles that these beetle species play in SOD are not clear. However, their consistent association with discrete cankers on live native trees infected with an introduced pathogen suggests that these insects affect the etiology of the disease.

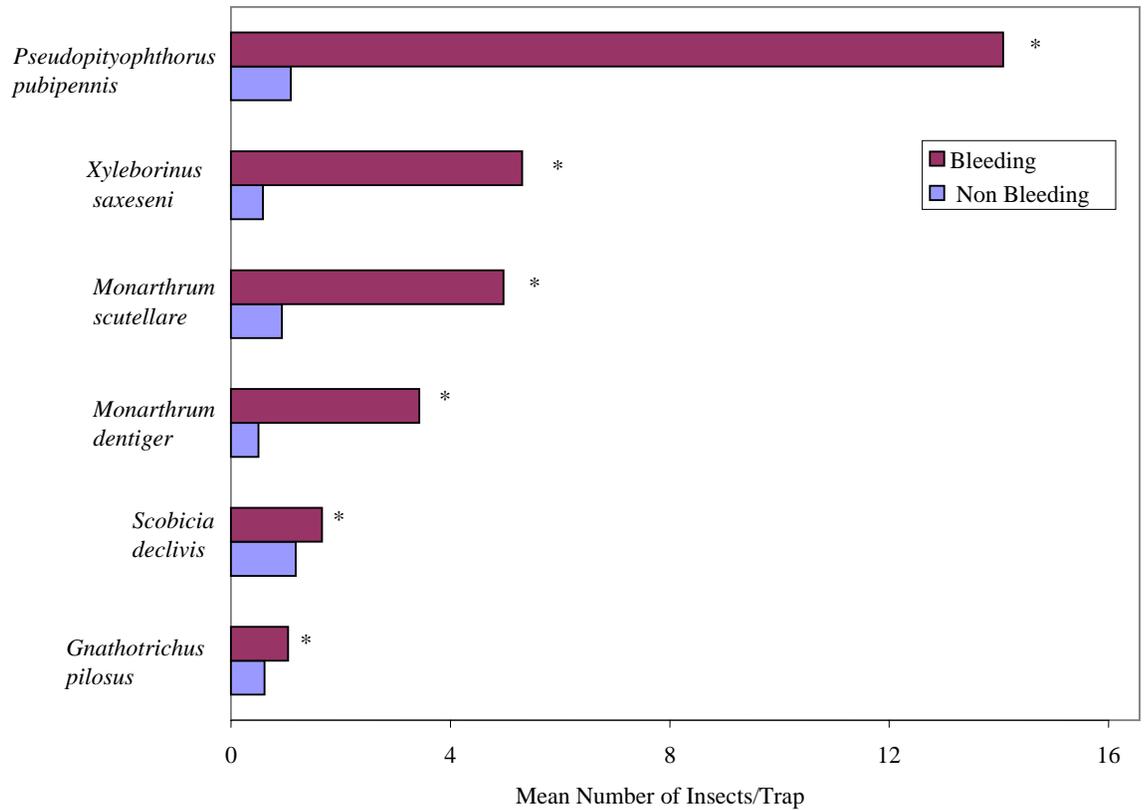


Figure 1— Species composition of bark, ambrosia & false powderpost beetles trapped at bleeding and non-bleeding trees; asterisks denote statistically significant differences ($p < .05$).

References

- Furniss, R.L. and Carolin, V.M. 1977. **Western Forest Insects**. USDA, Forest Service, Washington, 654 pp.
- McPherson, B.A.; Mori, S.R.; Wood, D.L.; Storer, A.J.; Svihra, P.; Kelly, M.; and Standiford, R.B. 2005. **Sudden oak death in California: disease progression in oaks and tanoaks**. *Forest Ecology and Management* 213:71-89.