

Introduction and establishment of Natural Enemies of the Eucalyptus Longhorned Borer

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Eucalyptus species are planted in most of the world's temperate and tropical regions and are valued for their vigor, tolerance of drought and poor soil conditions, and rapid growth rates. The trees have a large complex of insect pests and diseases in their native Australia. Because the trees were often propagated from seed in the new regions, they have escaped from many of the pests. In many of the areas where they have been planted, they are resistant to most of the native herbivores and diseases. However, the Eucalyptus longhorned borer (*Phoracantha semipunctata*), a cerambycid beetle, has been introduced into many of these areas, including southern California sometime before 1985, and has been responsible for killing large numbers of trees.

The Eucalyptus longhorned borer utilizes broken limbs, logging residues, burned trees, or highly stressed trees in its native Australia, rarely killing healthy trees. However, adult beetles are attracted to trees suffering from water stress, and many *Eucalyptus* trees in California are growing in unmanaged or minimally managed environments with no supplemental irrigation. As a result of their use in these stressful environments, there are large numbers of susceptible *Eucalyptus* trees in the state that are at risk of being killed by the beetle.

Adult beetles arrive on stressed trees in response to volatile chemicals, mate on the bark, and the females lay egg batches of up to 40 eggs under loose bark or in crevices on the bark surface. Eggs hatch in 3-5 days and the first instar larvae mine short distances in the outer bark layers before turning inward to mine at the inner bark-cambium-xylem interface, effectively girdling the tree. Trees show symptoms of thin, wilting or dry crowns with leaves remaining attached, cracked bark with packed larval excrement visible in the cracks, and often, the clearly audible rasping sound of chewing beetle larvae. The larvae excavate pupal chambers in the wood at the end of the feeding period. Adult beetles emerge from the tree over a prolonged period, often beginning in late spring and early summer. A beetle generation takes about 8-9 weeks during the summer and longer during the winter.

Reduction in beetle-caused tree mortality involves managing tree stress, planting resistant species, direct reduction of beetle populations, and biological control. Well watered trees have bark moisture content such that young larvae are unable to penetrate to the cambium, but larvae are readily

able to mine through drier bark. Thus, trees under moisture stress are both more attractive and much more susceptible to attack. In addition to managing water stress, preventing other types of stress, including pruning stress when the beetles are active in the environment, will reduce the probability of tree death.

All *Eucalyptus* species can be colonized and killed by the beetle. *Eucalyptus saligna*, *E. globulus*, *E. nitens*, *E. viminalis*, and *E. diversicolor* are highly susceptible to *Eucalyptus* longhorned borer in California. *Eucalyptus robusta*, *E. sideroxylon*, *E. camaldulensis*, *E. cladocalyn*, *E. citridora* and *E. trabutii*, appear to be relatively resistant. However, even trees of a resistant species should be kept in vigorous condition. A tree of a susceptible species that is well cared for may be at less risk of infestation than a neglected tree of a resistant species.

Treatment or disposal of wood that contains larvae, pupae, or adult beetles waiting to emerge, is critical for reducing beetle numbers and limiting the number of trees that are killed each year. However, action must be taken before the new generation of adult beetles emerges. Infested wood may be treated by burning, burying, chipping, or solarization (wrapping piles of cut wood in plastic exposed to direct sun for 10-12 weeks). Chipped *Eucalyptus* wood makes excellent mulch and solarized wood can be safely stored for firewood. Uninfested wood may be attractive and used by the beetle until the wood dries out. Removal of bark from freshly cut uninfested *Eucalyptus* logs prevents beetle infestation of the wood by reducing the available food and increasing the rate of drying of the wood. Anything that can be done to speed the drying process (e.g. cutting and splitting the wood) will also help reduce the length of time it can support beetle development.

In Australia, the borers are preyed upon by a number of predacious and parasitic insects that are also native to that continent. We have introduced a tiny parasitic wasp in the genus *Avetianella* from Australia that lays its eggs within the eggs of the beetle. Each female wasp lays up to 250 eggs during her 20-day adult life. We have conducted releases at

nine sites in southern and northern California. Between 1 July and 1 October 1993, over 53,000 individuals of the egg parasite were released. The parasites have dispersed from the release sites; we have observed parasitized egg masses of the beetle at eight of nine sites and up to ten miles distant from the release point. We have released or plan to release four species of braconid wasp parasites of *Eucalyptus* longhorned borer larvae. Adults of two *Jarra* spp., *Syngaster lepidus* and *Callibracon limbatus*, are attracted to borer-infested *Eucalyptus* trees and use long egg-laying structures to paralyze the developing larvae and lay one or more eggs on each one. These eggs hatch and the developing parasite larvae feed on the borer larva, eventually killing it. A total of approximately 1000 *S. lepidus* were released in 1993 at six sites throughout the state.

A combination of tree management, tree species selection, beetle population management, and biological control will not eradicate the *Eucalyptus* longhorned borer, but these measures should reduce tree mortality to an acceptable level. It is important to implement all of the strategies because no single strategy can be completely effective. Some stressed or highly susceptible *Eucalyptus* trees will still be killed by the beetle. However, these losses can be reduced through active management. It is critical that protection of valued urban tree species like *Eucalyptus* be viewed as part of a management system rather than a reliance on a single approach.

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