



TREE NOTES

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Gray Davis
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State of California

Andrea E. Tuttle
Director

Mary D. Nichols
Secretary for Resources
The Resources Agency

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The Fir Engraver Beetle

Donald R. Owen

Forest Pest Management Specialist, 6105 Airport Rd., Redding, CA 96022

The fir engraver beetle (FEB), *Scolytus ventralis*, is the bark beetle most frequently found attacking and killing true fir trees, such as white, red, and grand fir, in California. Bark beetles are small insects that attack living or recently dead trees. The beetles tunnel into the inner bark of the tree where they mate, lay eggs, and their offspring feed. FEB attacks can result in the death of the tree's top, a patch of bark, or the entire tree. In order to kill a tree, a large number of beetles must attack the tree over a relatively short period of time. FEBs attack and kill trees that are under stress. Trees that appear healthy are rarely killed, except when they are affected by a severe, temporary stress such as drought.

Life Cycle and Identification

Throughout most of its range, FEB has a one-year life cycle. Adult FEB are shiny black beetles approximately 4mm long (Fig. 1). During mid to late June, they begin to fly in search of trees suitable to breed in. Trees 4



Figure 1. Adult fir engraver beetle.

inches in diameter or greater are preferred. Most attacks occur in July and August, with some attacks extending into September. The female beetle initiates attack and is soon joined by a male that mates with her. Attractants produced by attacking beetles lure additional beetles, resulting in a mass attack. Each female beetle constructs a horizontal

tunnel or gallery in the inner bark, along the sides of which eggs are laid. Egg galleries vary in length from a few inches to nearly a foot. Larvae hatch from the eggs and feed at right angles to the maternal gallery, producing parallel individual tunnels of their own (Fig. 2). The larvae are legless, cream-colored grubs with a brown head. They reach maturity by late spring or early summer of the following year, and then transform into pupae which in turn become the next generation of adult beetles.



Figure 2. Fir engraver galleries. The horizontal lines are egg (maternal) galleries. Larval tunnels run perpendicular to these.

Galleries of the female beetle and her offspring etch the outer sapwood, hence the name "engraver" beetle. Although the pattern is fairly distinctive, it may be confused with the gallery pattern of another bark beetle, *Pseudohylesinus sericens*. The presence of small shiny black beetles in the galleries will confirm that the attacking

insect is FEB (*Pseudohylesinus* are dull in appearance).

Characteristics of Attack

Overcrowding, disease, and drought often result in tree stress. Overcrowded trees compete with one another for limited

resources, while diseased trees are unable to fully utilize the resources available to them. If a stress is of sufficient duration and severity, the tree may be unable to resist attack by FEB.

A typical symptom of chronic stress is reduced foliage, including a small live crown ratio (height of live crown/height of the tree), an excessive number of dead or dying branches often in combination with a dead top, and poor needle retention (cf. Ferrell 1989).

A tree defends itself from FEB attack by producing resin or pitch in response to the beetle's tunneling activity, killing the beetle before it can reproduce. A sign that a tree is being or has been attacked by the FEB is the presence of pitch streamers (fig. 3), long, thin ribbons of pitch that originate where the beetles have entered the bark. *Pitch streamers alone do not indicate that the tree is in imminent danger of dying.*



Figure 3. Pitch streamers on a downed log of white fir.

A tree of low vigor (poor health) cannot defend itself from attack, and will not produce sufficient quantities of pitch to kill attacking beetles. When this happens, it will be possible to find small piles of yellowish-brown boring dust (generally no larger than a fingernail) at points where the beetles have tunneled into the bark. If numerous piles of boring dust are found on the tree, this usually means the tree is dead even though the tree's foliage may still be green. A knife or axe can be used to cut into the bark to confirm that the tree is dead. The presence of larvae and/or extensive discoloration of the inner bark are good indicators that the tree is dead.

A uniform change in foliage color throughout the tree's crown indicates that the tree has died, but this visual change often follows the physiological death of the tree by a number of months. Although FEB attacks and kills trees during the summer, a smaller tree's foliage will not begin changing color until the late fall, and for many larger trees the color change will not begin until the following

spring. The foliage of dead trees gradually fades from green to yellow to reddish brown. If some foliage remains green, then the tree is not completely dead. In some cases, only the top of the tree or individual branches may be killed as a result of FEB attack.

Management Considerations

Hazard Trees

Many living true fir trees show evidence of past attack by FEB, such as a dead top and/or dead branches. Such dieback is common and may or may not have much bearing on a tree's longevity. A tree's chances for survival are inversely related to the severity of dieback in the crown—with increasing dieback, less foliage is available to supply the energy needs of the tree and the tree's chance for survival decreases.

The biggest concern with dead tops and branches is their potential to breakout and fall. True firs are especially prone to this, although it can happen with any tree. Large dead branches and tops should be pruned from a tree in areas where their falling presents a hazard. Dead tops in true firs are often replaced by a side branch or branches that turn up and become "volunteer tops." Such tops are not as firmly attached to the bole of the tree as the original top was and have the potential to breakout under wind and snow loads.

Drought

Periodic drought is a fact of life in California and outbreaks of FEB are closely aligned with the widespread tree stress that results. During drought, the carrying capacity of the land is reduced. Tree mortality is a natural thinning process that reduces competition between trees and establish a stocking level that is more compatible with available water. Unfortunately, nature rarely thins trees to our liking. Fir trees that are suffering from a combination of drought and other stresses have an increased risk of being attacked and killed by FEB. However, even trees that do not show evidence of chronic stress may be killed during periods of drought.

In some of California's drier forests, the dominance of white fir appears incongruous with the amount of precipitation received in the area. Past logging and fire control may have favored reproduction of white fir, although other conifer species may be more tolerant of drought.

We can thin trees before nature does and by doing so increase the resistance of the stand to bark beetles. On drier sites, pine should be favored since it is more drought resistant than

true fir. The preferred time to thin overstocked stands is during non-drought years. When thinned at this time, trees are better able to adjust to and take advantage of the added space. Heavy thinning or logging in fir stands during a drought may actually promote beetle activity. Consult with a forester for advice on thinning or other tree harvesting.

Supplemental Water

For high value trees on non-timberland sites, supplemental irrigation may help alleviate stress resulting from drought and increase the tree's ability to resist bark beetle attack. During periods of average or above average precipitation, however, it is not necessary to water native forest trees and generally it is not recommended. Spring precipitation is especially important to native trees since it helps them survive California's long, dry summers. When spring precipitation is below normal, this is a good time to provide supplemental water.

When irrigating, it is important to deliver a sufficient amount of water to a location where the tree can utilize it. For native trees, this generally means deep irrigation. Frequent, superficial irrigation that penetrates only a few inches in to the soil is not likely to benefit these trees and may have negative impacts such as promoting disease, decreasing oxygen exchange for deeper roots, and encouraging shallow rooting. As a rule of thumb, a single irrigation should penetrate 1-2 feet into the soil and the upper foot of soil should be allowed to thoroughly dry before repeating. Soil conditions and other factors will determine the appropriate time between irrigations - in general, allow at least a couple of weeks. It is also important to keep water away from the main stem or bole of the tree. Water should be applied to an area that encircles the tree beneath or just to the inside of the drip line (fig. 4). It is OK to water outside the drip line, but avoid watering in the other direction, i.e. toward the bole. Water should be applied continuously, but not running off, until it has soaked in to the desired depth. Under all but the harshest drought conditions, it is best to cut back and cease supplemental irrigation by early to mid-summer. Watering into the fall may hinder a tree's natural cessation of growth in preparation for winter.

Other

If disease appears to be the cause of tree stress, steps should be taken to identify the pathogen and control or manage its effects. Root disease and mistletoe are common tree diseases that can predispose fir to FEB attack. When green conifer trees are cut in high use/

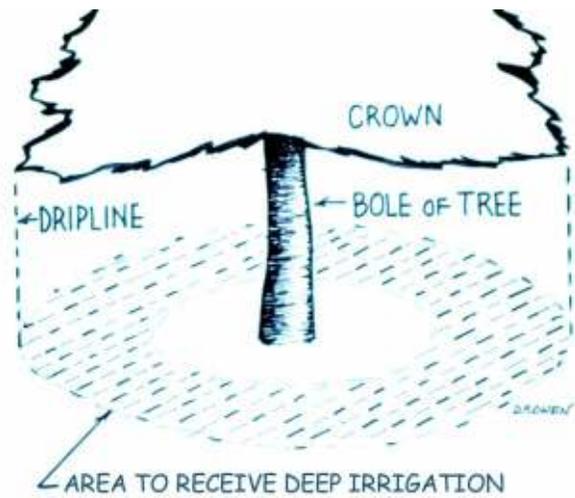


Figure 4. Area to receive deep irrigation.

high value areas, it is common practice to treat the stump surface with borax. This is a preventative measure that decreases the likelihood of annosum root disease, one of our most serious conifer diseases, from becoming established in the stand. Because borax is being applied as a pesticide in this situation, use a formulation of borax that is intended and labeled for this use. It is not necessary to apply borax to the stump of dead trees.

Dwarf mistletoe, the most damaging type of mistletoe, spreads only a short distance between trees of the same species or closely related species. Having a mixture of tree species interspersed among one another can greatly reduce or prevent the impacts of this disease.

Logging, in the form of sanitation salvage, is a way to recover the value of dead and dying trees, reduce hazard, and remove trees that are likely to die in the near future. Logging operations should create a minimum amount of damage to the residual stand (i.e. avoid basal wounds, root damage and soil compaction). Operations conducted in the fall and winter have less potential for aggravating beetle problems than those conducted in the spring and summer. If beetle infested trees are to be salvaged, the timber marker must realize that infested trees may still have green foliage, depending on the time of year.

Because FEB typically attacks trees under severe stress, direct control of beetle populations, e.g. pesticide treatments, is not advised. No pesticides are registered for use against the FEB in California.

Further Reading

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