TREE NOTES

CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION

Edmund G. Brown
Governor
State of California

Ken Pimlott
Director
Dept. of Forestry & Fire Protection

John Laird
Secretary for Resources
Natural Resources Agency

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Managing Bark Beetles in Urban and Rural Trees

Kim S. Corella[1], Don R. Owen[2]

[1]Pathologist, CAL FIRE, Los Osos, CA, 93402, [2]Entomologist, CAL FIRE, Redding, CA 96022

Bark beetles (family Curculionidae, subfamily Scolytinae) are common but destructive insects that damage or kill conifers and some broadleaf trees in California. Adult beetles bore into the inner bark where they lay eggs and their offspring feed, effectively girdling the tree. Trees stressed by unfavorable conditions such as drought, disease, defoliation, high stand density or poor tree care are most susceptible. Most bark beetles are fairly specific as to their preferred host tree(s), and to the location where they attack on the tree. For instance, it is not unusual to find one species of beetle attacking the top and large branches, (Tree Note #28) another attacking the main trunk, (Tree Note # 13), and yet another attacking the tree base (Tree Note #9).

Resistance to bark beetle attack in pines and other conifers involves sustained pitch flow which floods the beetles' tunnels as they bore into the tree. In this manner, attacking beetles are repelled or 'pitched out'. Drought, root disease or high stand density, may affect pitch flow and limit the tree's capacity to resist attack. Healthy trees with an adequate water supply are seldom killed or seriously injured. Attacking bark beetles produce a powerful volatile attractant (pheromone) which draws additional beetles from the surrounding area and precipitates a 'mass attack' on the tree. Host resistance can be overcome if there are sufficient numbers of attacking beetles.

Bark beetle populations can increase dramatically when sufficient food is available. Forests experiencing severe and prolonged drought coupled with high tree densities are one example where bark beetles can cause increased tree mortality in a short amount of time.

Life History

Attacking beetles tunnel through the bark to the wood surface. In pines, this often releases pitch, which may form a `pitch tube' (Figure 1) around the tunnel entrance. Fungi, introduced from the bodies of the colonizing beetle, invade the tree's conducting system and inhibit water and pitch flow. This symbiotic relationship helps ensure the beetle's reproductive success by disabling the tree's defenses. As tunnels are extended under the bark, boring dust is expelled through the entrance hole. This fine, reddish brown dust accumulates in bark crevices, drops on the ground or collects in spider webs (Figure 2)

Figure 1. Mountain pine beetle and pitch tube on lodgepole pine

Pitch tubes, pitch streaming down the trunk and boring dust are signs of bark beetle attack on conifers. On hardwoods, the signs are bleeding, frothy or wet spots on the bark, or powdery boring dust.

Figure 2. Boring dust accumulation on spider web (left) and branch (right)

When a tree dies from attack, its foliage changes color from green to yellow and eventually reddish brown. This change takes time. Immature beetles may complete their development, emerge as adults and fly off before symptoms are noted.

Figure 3.
(a) Western pine beetle adult
(b) Red turpentine beetle larva

Attacking female beetles lay their eggs along tunnels constructed in the moist inner bark next to the wood. Once the eggs hatch, the larvae burrow away from the parent or egg tunnel. When fully grown, the larvae transform to pupae and then adults. Each beetle species has a characteristic tunneling pattern, which often can be used for identification. Emerging adults bore out through the bark, leaving it riddled with a 'shot hole' appearance. Depending on the species, bark beetles produce one to several generations a year. The last generation typically overwinters under the bark, emerging the following spring. Adult bark beetles are cylindrical, brown, dark reddish brown or black and typically about the size of a grain of rice (Figure 3a). The larvae are grub-like, white, legless, and 'C'-shaped with a distinct light brown head (Figure 3b).

Figure 4. Bark beetle-killed ponderosa pine

Signs and Symptoms of Bark Beetle Attack and Infestation

Initial Signs

* Bleeding or frothy wet material on hardwood trunks
* Pitch streaming on the trunk of some conifers
* Pitch tubes that can vary in size and color, from white to reddish brown or pinkish brown
* Cinnamon-colored, fine sawdust-like boring dust that collects in bark crevices and spider webs

Figure 5. Bark beetle galleries

Subsequent signs and symptoms

* Tree death appears to happen quickly
* Foliage changes color from green to yellow to reddish
* brown throughout the crown (Figure 4)
* Beetle galleries (adult and larval tunnels) are under the bark – insects are usually present (Figure 5)
* Wood surface may be engraved by tunneling activity and stained by fungi (Figure 5)
* Small, round emergence holes in the bark
* Outer bark punctured or chipped away by woodpeckers (Figure 6)

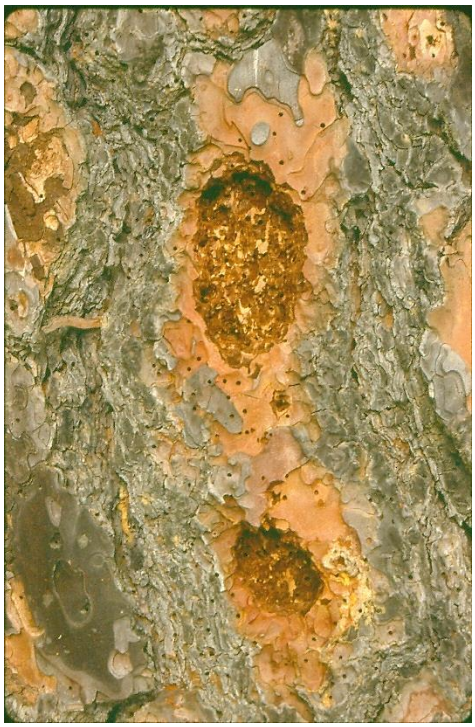

Figure 6. Outer bark partially removed by woodpeckers

Management Options

Prevention of tree injury and stress is the most prudent method to minimize tree loss. This is best achieved by preventing or minimizing root injury and other damage during construction, road building or logging; reducing water stress during droughts and in hot, dry inland areas by periodic, deep watering; and selectively removing trees (thinning) to reduce

competition for water and nutrients. Drought is one of the most common factors predisposing trees to bark beetle attack. During drought, periodic deep irrigation of landscape trees beginning in the late spring and continuing through the summer can decrease water stress and improve their resistance to beetle attack.

During construction, avoid grade change (the removal or addition of soil close to trees). Excavation and trenching can sever roots, while the addition of fill-soil can suffocate them. Fill-soil can impede water infiltration and or drainage, leading to drought conditions or waterlogging. If possible, fence off the root protection zone(s) (radius of dripline plus 50%) during construction to avoid soil disturbance and soil compaction from heavy equipment. Compaction destroys the soil's natural porosity, reducing its capacity to hold air and water. Hard, dry and poorly aerated soil impairs tree health and pest resistance. Soil can also be compacted by vehicles, livestock, and foot traffic. Try to eliminate or at least limit these activities within the dripline. Mulch the impacted area with up to six inches of wood chip mulch or coarse, ground bark to reduce further compaction and help improve soil conditions.

Cultural practices such as tree selection, timing of pruning, watering, weed and brush control, and selective removal (thinning) are perhaps the most effective, least expensive methods to prevent bark beetle problems:

* Plant trees that are well adapted to local environmental conditions. When planting native trees, make sure the seedlings are grown from seeds collected in a seed zone compatible with your locality (latitude and altitude).
* Selectively remove trees (thin) to improve spacing, reduce competition, improve tree vigor and reduce susceptibility to bark beetles. The recommended time to thin is during non-drought years.
* Most conifers require little or no pruning, however if it is necessary to remove live lower limbs or shorten limbs for clearance, prune from Nov. 1st to March 1st when most beetles are inactive.
* Remove weeds, brush and dense ground covers from around trees. Such plants compete for available water and nutrients.
* Native oaks are particularly susceptible to root disease and should be irrigated no more than 2 to 3 times during the dry season.
* During drought, and if water restrictions allow, consider supplemental irrigation for high value conifers. Deep water on a regular, but infrequent basis. Use a soaker hose to apply water to a depth of at least 12". This may take 3 to 4 hours or longer. Apply the water to the outer half of the dripline and at least 10' beyond (area under the tree) every 4 to 6 weeks during the dry season.

Sanitation - Once a tree is fully infested by bark beetles, there is no hope of saving it. However, if only a limb or top is involved, the tree has a chance of recovering. If a dead, infested tree is detected early, prompt tree removal and proper treatment of the infested stem and branches can eliminate the beetle brood, reducing the chance that neighboring trees will become infested. Unfortunately, beetle-killed trees are often not detected until after the beetles have flown. Standing dead trees that are a fire or safety (falling) hazard should always be removed.

The wood from trees containing live beetle brood can be kept if it is cut, stacked, and carefully tarped with clear plastic sheeting to contain beetles (see Tree Note #3). The tarping must remain intact and form a tight seal against the ground to prevent beetle escape. Store the wood in direct sunlight, well away from other trees of the same or related species. High temperatures develop within tarped woodpiles exposed to direct sun, killing the trapped beetles (see Tree Note #3).

Other methods to kill beetles in infested wood are to debark or burn the wood or bury it at a sanitary landfill. This includes the main stem and larger severed branches. Green pine slash (woody material recently cut from a live, un-infested tree) is a favored breeding material for pine engravers and should be treated to prevent a population buildup. Chipping is very effective for this purpose. Alternatively, larger pieces of wood can be cut into 2 feet lengths, lopped (remove all branches), and scattered in a sunny location. This causes heating and drying, making the wood less suitable for colonization.

Chemicals - Certain insecticides can be applied directly to the bark of high value landscape trees to prevent attack. The entire trunk, exposed root collar near the base of the tree, and large branches should be thoroughly treated at the recommended rate. The material must be applied before the new adults penetrate the bark surface of the tree. *Note:* Preventative insecticide treatments are appropriate for individual high value trees and are not practical or intended for use on a larger forested landscape. These products must be applied by a professional pesticide applicator and are not available to home users. Pesticide treatments are temporary and are not a substitute for proper long-term cultural care.

Chemicals which modify the behavior of bark beetles (pheromones) have also been used to prevent tree mortality. These chemicals don't have the same level of effectiveness as preventative insecticides and should only be applied by someone well trained in their use.

Drought stress and bark beetles are largely responsibility for the increased mortality seen in conifers, particularly pines. To reduce tree mortality, homeowners and small landowners should take an active role in managing their trees.

This Tree Note is a revision of the original:
Hagen, B. W. 1995. Managing Bark Beetles in Urban and Rural Trees. California Dept. of Forestry and Fire Protection. Publ #19.

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