Introduction

Trees in the Lake Tahoe Basin and the Sierra Nevada are turning brown and dying. The culprit? In many cases, the trees are being attacked and killed by small insects called bark beetles.

Bark beetles are natural inhabitants of the forest. Usually, they are present in small numbers, occasionally killing weakened trees. When populations are at their usual low levels, the beetles play a useful role in removing clusters of trees, providing dead trees for wildlife use, and helping to recycle valuable nutrients from diseased and dying trees. Bark beetles also provide food for woodpeckers and other insects. There’s no way to keep bark beetles out of our forests. Even if we could kill all the beetles in a certain area, replacement beetles would just fly in from other locations.

During the eight-year drought of the late 1980’s and early 1990’s, many of the trees in the Tahoe Basin became stressed and more susceptible to attack by bark beetles. Trees can also be stressed by air pollution, diseases, soil compaction from heavy equipment, pavement or frequent foot traffic, high tree densities, and de-icing salts. Because there were so many stressed trees in the Tahoe Basin, bark beetle populations steadily increased, and the beetles killed large numbers of otherwise healthy trees.
There are many different kinds of bark beetles. Some beetles attack only one species of tree, such as the Jeffrey pine beetle, which attacks only Jeffrey pine. Others attack several species of related trees. For example, the fir engraver attacks several species of firs, but doesn’t attack pines. They all have a similar way of attacking trees, however, and all go through a complete metamorphosis from egg to larva to pupa to adult.

**A Year in the Life of a Bark Beetle**

Bark beetles are small insects — not much bigger than a grain of rice. They feed and reproduce in the inner bark layer, called the phloem. The phloem is found between the outer bark and the wood of the tree. For some species, like the Jeffrey pine beetle, when an adult female attacks a tree, she bores through the bark and begins to excavate a tunnel, called a “gallery”, into the phloem and on the wood surface. She then chews pockets in the sides of the gallery, laying one egg in each pocket, until she’s laid several dozen eggs.

If you see wood from a bark beetle attacked tree, it will have a characteristic gallery pattern on its surface. For Jeffrey pine beetles, the adult gallery will have a “j-shaped” hook at the base and then will travel vertically along the trunk for up to three feet. Other species of adult beetles excavate shorter, vertical or even horizontal galleries.

After the eggs hatch, the larvae feed on the inner bark and dig out galleries of their own, often perpendicular to the original gallery of the parents. As the larvae feed, their ever-widening galleries, in addition to the adult galleries, will cut the phloem and outer sapwood all the way around the tree, damaging or killing it. This is called “girdling.” Some beetles also carry a fungus on their body surface or in special pouches on their body. The fungus infects the tree and, in pines, causes a blue-gray staining of the wood. The fungus clogs the tree’s water conducting ability. The physical damage caused by chewing, together with the action of the fungus, may kill the tree.

The larvae feed for several weeks or months before they pupate and transform into adults. The adults chew through the bark of the tree and emerge. Odors released by other beetles cause newly emerged beetles to fly to another tree, attack again and repeat the cycle. When many beetles are attracted to a single tree, this is called a “mass attack.” As many as 100,000 beetles can emerge from a single tree!
In the Tahoe Basin, most of this activity occurs during the spring and summer months from May through September. Beetles will fly during warm and windless days anywhere from 500 feet to two miles to find new trees. During the winter months, most species hibernate as larvae under the bark of trees, although some may overwinter as adults in the forest litter above the soil. A full life cycle usually takes up to one year to complete. However, some Ips (pine engraver) species may go through several life cycles in one season in the Tahoe Basin.

Bark beetles don’t just stumble upon trees to attack. Most of the later-arriving beetles use their senses of sight and smell to cue them in. When the first beetle chews through the bark of the tree, it starts to make an attractive chemical odor, or pheromone, which signals other beetles that food and mates are available. This pheromone is specific for each species of bark beetle, and will only be recognized by that species of bark beetle, although predator insects may also respond. When the tree is jammed full of bark beetles, they will then begin to make a new, different pheromone which signals other beetles to stay away. Scientists are not sure how the first (pioneer) beetles select trees for attack. They may be attracted to odors from stressed trees, or they may just land and taste trees by chance.

Some beetles are also attracted to the appearance of the tree trunk. They seem to be looking for a tall, vertical, dark silhouette. When researchers in the southern United States painted tree trunks white, they found that there were virtually no attacks in the white-painted areas.

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Often, the first sign you will notice when a pine tree has been attacked by the most aggressive species of bark beetles is the appearance of “pitch tubes” of resin (secretions of sap) in the bark crevices. As the beetles bore small (1/16th to 1/8th inch) holes through the bark, the tree secretes sap or resin through the hole which often “pitches” the beetle out of the tree. This is the tree’s natural defense mechanism.

When a tree is weakened by drought, or otherwise stressed, it may not be able to secrete enough resin to protect itself from attack by beetles. Jeffrey pine beetle pitch tubes often contain borings of sawdust from the tree, called “frass,” which turn a rust color when they are exposed to air. You can therefore recognize Jeffrey pine beetle attacks by the large masses of thick, reddish pitch. Fir trees attacked by fir engravers will ooze long streams of clear sap along the trunk. There may also be a lot of woodpecker holes on the trunks of heavily infested trees. The birds are feeding on the soft larvae and pupae beneath the bark.

As bark beetle attacks become numerous, the tree’s needles may still be green, and you will not be able to tell at a glance whether or not it will survive. To determine if the tree is dead when green foliage is present, remove a three inch square of bark near a pitch tube. If eggs and larvae are present, the tree should be removed. If not removed, in the second year following attack, the needles will turn yellow or red, and in the third and fourth years, they will drop off the tree and it will finally appear to be dead.
Now that you know that bark beetles will attack stressed trees, you can help reduce the threat by cultural practices that contribute to high plant vigor, such as thinning, watering, and fertilizing. Lack of periodic forest fires combined with a lack of thinning practices. When trees grow close together, they compete with one another for moisture, nutrients, and sunlight. If there has been no rain for three to four weeks, water your trees beyond the drip line of the branches so that the soil is damp eight to ten inches below the surface, even during the cold season. Preventing beetle attacks by cultural practices that contribute to high tree vigor makes good sense.

Another way to protect unattacked conifers is to use insecticides registered by the EPA to prevent attack by bark beetles. These insecticides should be applied to the bark surface of the main stem and large branches of the tree, and should only be used with extreme care according to EPA regulations. Surface-applied insecticides have been shown to be effective at saving high value trees before bark beetles have fully invaded them, and they should be applied just prior to the May to September flight period in the Tahoe Basin. Injectable insecticides have not been scientifically shown to protect trees.

If a pine tree has only a few large (1 to 3 inch) pitch tubes located on the lowest six feet of the stem, it still might be possible to use an insecticide to prevent further attacks and death of the tree. If you observe only these large tubes on the tree, consult the Nevada Division of Forestry (775-849-2500) before applying an insecticide.

What if you have a tree that has many pitch tubes along its main stem? Remove the tree and dispose of the infested bark and wood so the beetles will not be able to attack other trees. Request Fact Sheet 98-42, “Thinning and Sanitation: Two Components of Integrated Pest Management of Bark Beetles in Residential Landscape and Forest Settings in the Lake Tahoe Basin”, for information on handling infested materials. You must consult the Nevada Division of Forestry and the wood of the tree. For some species, like the Jeffrey pine beetle, when an adult female attacks a tree, she bores through the bark and begins to excavate a tunnel, called a “gallery”, into the phloem and on the wood surface. She then chews pockets in the sides of the gallery, laying one egg in each pocket, until she’s laid several dozen eggs.

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Researchers from the University of Nevada Department of Biochemistry and the USDA Forest Service are studying bark beetle chemistry and behavior to learn how beetles find, attack, and kill trees. They are studying a number of airborne pheromones—natural
chemicals produced by bark beetles — to determine which odors attract beetles to new trees, and which odors are unattractive and may even repel the beetles. During summer months, they study these pheromones in areas in which bark beetle attacks have already occurred. The chemicals are placed in a special funnel trap which allows the insects to enter, and then collects them for study.

A number of pheromones have been tested at UNR in the hope that we will find a way to use these natural, non-toxic chemicals to help protect valuable trees, such as those in state parks and other public areas. The research is very complicated, since each type of beetle makes its own set of chemicals. The odors are produced in such low levels (less than one millionth of an ounce per beetle) that finding them can be like searching for a needle in a haystack. More work is needed before these products can be put into use in Tahoe Basin Forests.

Further Reading


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