Tree Notes #30

Identifying Dead and Dying Conifers on Private Land in California

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The first section of this document will help property owners and others identify when a conifer is dead. The second section discusses the more challenging task of determining if a tree is dying. The definition of "dying trees" as stated in the **California Forest Practice Rules** is used as a basis for this discussion. Although the concepts discussed in this Tree Note are generally applicable to all dying conifers, the discussion does not specifically address trees that are dead or dying from fire-damage. A separate Tree Note on evaluating fire-damaged trees is being prepared.

Dead Trees

Identifying a dead tree is, for the most part, relatively straight forward, but there are situations where a live tree may appear to be dead. One of the first clear signs that a conifer is dead is a uniform change in foliage color throughout the entire crown of the tree. The foliage of most conifers first turns yellow and later light brown and reddish/brown. Eventually the needles begin to fall, leaving behind bare branches. If some portion of the crown retains green needles, then part of the tree is still alive.

Some needle diseases and winter damage can cause foliage throughout the crown of a tree to change color. This change in color is typically noticed in the spring of the year, a time when these trees are often mistaken for dead trees. If you look closely at the foliage on these trees, it is usually possible to find some green remaining - the bases of needles may be green or there may be green needles interspersed among brown needles (hence, the change in color is not uniform throughout the crown). If the tree is dead, there will be no green left in the foliage. Living trees that suffer from needle disease or winter damage will produce new green needles when they break bud and renew growth inthe spring. Hence, these trees will "green-up" during the growing season. Conversely, a tree that fails to break bud and produce new growth is dead.

Another condition that often erroneously leads to the conclusion that a tree is dead or dying is fall color change. Conifers typically retain needles for several years, but each fall the oldest needles change color and are shed. The amount of foliage shed from year to year can vary considerably. When trees are under drought stress, a large complement of older needles may change color, causing a large portion of crown to look yellow. The youngest needles, however, remain green - a sure sign the tree is still alive. Heavy cone crops may also create the appearance that the top of a tree is dying.

If there is doubt as to whether a tree is alive or dead, a simple test is to cut or chop into the inner bark or phloem. The phloem is the living portion of the bark immediately adjacent to the wood. On a live conifer, the inner bark is cream-colored, often with a tinge of pink, and moist. Dead inner bark is brown and may appear moist, dry, or resin-soaked. When the inner bark is dead around the entire circumference of the tree trunk, the tree is dead. It is possible to find trees that have a portion of the inner bark that is alive and a portion that is dead. Such trees may have received a non-lethal injury that killed only a portion of the bark, or they may have received a lethal injury and are still in the process of dying.

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Dying Trees

Determining if a tree is dying can be considerably more difficult than determining if it is dead. While the foliage of a dead tree will have changed color uniformly throughout the crown, the foliage of a dying tree will be green in whole or in part. The California Forest Practice Rules defines a dying tree as one that meets one or more of the following criteria:

- Fifty percent or more of the foliage-bearing crown is recently dead (as indicated by a uniform change in color over that part of the crown). ***Dead tops that have no foliage do not count toward this 50%.***
- Successful bark beetle attacks with indications of dead cambium and brood development are distributed around the circumference of the bole. ***The key concept here is that the beetles have successfully girdled the tree. Evidence of beetle attack such as pitch tubes or pitch streamers, even if they extend around the tree, do not necessarily mean that the attacks have been successful.***
- Seventy-five percent or more of the circumference of the lower bole is girdled by wildlife. ***This principally relates to bear damage.***
- The tree is designated by a Registered Professional Forester as likely to die within one year. ***This is a professional judgment based on training and experience.***

The 50% and 75% criteria are straight forward, but determining if a tree is dying from bark beetle attack requires expertise and careful inspection of the tree. A green tree can be dead or dying from beetle attack, but such a determination needs to be made by a qualified evaluator. Different tree species are attacked by different beetles, more than one species of beetle will attack an individual tree, and the different beetle species vary in their ability to kill trees. Similarly, the indicators of beetle attack will differ based on beetle and tree species.

Evaluating Bark Beetle and Wood Borer Attacks

Beetle attacks on a healthy conifer typically produce some sort of resin (pitch) flow from the attack site. This may be in the form of pitch streamers, pitch tubes, or pitch granules. The pitch is the tree's defense against the invading beetles and a sign that the tree is fighting back. It takes large numbers of beetles to kill a relatively healthy tree and it is not uncommon to find trees that have successfully repelled attack and survived. If all attacks produce resin flow, there is no reason to believe the tree is dying.

Trees under stress may not be able to adequately defend themselves. Beetle attack is a dynamic process and the tree's defenses may fail as more and more beetles attack the tree. Quite often the initial beetle attacks will produce resin flow, while later attacks produce no resin. If a tree has pitch tubes or pitch streamers, it is a good idea to look closer to see if other attacks are present. If there are numerous attacks with little or no resin flow, the tree most likely is dying. The ultimate test involves cutting into the tree bole and inspecting the inner bark, preferably at a spot where dry boring dust has accumulated - indicating the site of an attack with no resin flow. If beetle larvae are present, the tree is most likely dying.

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Evaluating Bark Beetles Continued...

Following are some general guidelines for evaluating beetle attacks on various conifers species.

Incense-cedar

The beetles that attack incense-cedar are not considered tree-killers. Incense-cedars will be very close to death by the time bark and wood boring beetles colonize them. Generally, there will be little or no external evidence of beetle attack. Cedar bark beetle attacks may produce small amounts of yellow boring dust, but it is difficult to see. If there is some doubt as to whether an incense-cedar is dying, cutting into the bark and finding beetle larvae and/or brown inner bark will indicate it is already dead or likely to die. Because incense-cedars are not attacked by aggressive beetles, they tend to die more slowly than other conifers.

True firs

The fir engraver beetle, Scolytus ventralis, is the principal beetle attacking red, white and grand firs. It is a tree-killer, but not an especially aggressive one. It can cause top-kill and branch dieback but such damage does not always indicate that the tree is dying. Fir trees need to be under drought or some other stress to be killed by the fir engraver. Trees are attacked and killed during the summer, but the foliage on some of these trees will not change color for many months. Many dead trees are not identified until the following spring. Attacks on relatively healthy trees will produce ribbons of pitch running down the bole of the tree (pitch streamers). Do not assume these trees are dying. At the end of a drought when beetle populations are still high but tree resistance has improved, it is common to find many trees with pitch streaming. Successful fir engraver attacks are indicated by small piles of yellow-brown boring dust in bark crevices. In the late summer and fall, look for this boring dust as an indicator the tree is dead or dying. By winter, this dust may be gone and you may need to look for other indicators, such as foliage color changes and woodpecker feeding. If you suspect a green tree is dead or dying, cut into the bole and examine the inner bark to confirm this.

Douglas-fir

A number of beetles attack stressed Douglas-fir, but significant tree mortality due to these beetles is uncommon in California. The Douglas-fir beetle, Dendroctonus psuedotsugae, is most likely to kill trees after its populations have built-up in windthrown timber or trees damaged by fire, defoliation or other factors. Orange-brown boring dust in bark crevices is a sign the tree has been attacked and is dying. Pitch streaming may or may not be present on the upper half of the bole. The Douglas-fir engraver, Scolytus unispinosus, rarely kills trees, but occasionally it will kill young, drought-stressed Douglas-fir after beetle populations have increased in logging slash. Look for boring dust in bark crevices.

Douglas-fir on drier sites are often attacked by the flatheaded fir borer, Melanophila drummondi. Branches and tops are often killed, but tree mortality is rare or may take many years to occur. Attacks are marked by pitch streaming, although severely stressed trees may show little or no external evidence of attack.

Pines

The bark beetles that attack pines are among the most aggressive. The western pine beetle, Dendroctonus brevicomis, attacks ponderosa and Coulter pines; the mountain pine beetle, Dendroctonus ponderosae, attacks many different pines, including sugar, ponderosa, Coulter, western white and lodgepole pines. A related beetle, the Jeffrey pine beetle, Dendroctonus jeffreyi, attacks only Jeffrey pine. All native pines in California are also attacked by one or more species of Ips or engraver beetles, as well as the red turpentine beetle, Dendroctonus valens. All of the preceding beetles, except for the engraver beetles, produce pitch tubes when they attack a relatively healthy pine. When attacks produce dry boring dust instead of pitch tubes, this is an indicator the tree may be dying or is already dead.

When evaluating bark beetle attacks, it is useful to distinguish between current attacks and old attacks. Fresh pitch tubes are soft and somewhat shiny, while old tubes are dull and hard. Old tubes on ponderosa pine often have a yellowish color. Old pitch tubes on a tree are generally of little concern because they represent past attacks that failed.

Fresh attacks, in contrast, provide information on the tree's current condition. Individual attacks may produce a pitch tube, crumbly resinous material, and/or dry boring dust. If all the attacks are marked by either a pitch tube or crumbly resinous material, it should not be assumed that the tree is dying. If little or no resin is being released by the tree, attacks will be marked by dry boring dust. Because a tree's condition can change over time, it is typical to have some resinous attacks and some dry attacks on trees that are dying.

Although dry boring dust is a good indicator that a treeis dying, there are exceptions. Dry dust can be produced by red turpentine beetles as they bore through the thick outer bark at the base of the tree. They must bore through the outer bark before reaching the phloem and in doing so can produce noticeable amounts of dry dust. Pitch is not released until the beetles reach the phloem/cambial region. Small amounts of dust may also be produced by relatively harmless caterpillars that bore into the bark of pines and other conifers.

Trees with large amounts of dry boring dust in bark crevices and/or scattered around the base of the tree are likely dead or dying. Still it is a good idea to confirm the tree's condition by cutting into the bark at a point where dry dust has accumulated and looking for beetle larvae.

Woodpecker feeding can also be an indicator of a dying tree. If a tree is infested with beetles, woodpeckers may chip off bark to feed on beetle larvae and pupae. Small amounts of woodpecker feeding often can be seen on perfectly healthy trees, but extensive feeding on a green tree most likely indicates the tree is infested with beetles and is dead or dying. Most bark beetle broods will be exiting the tree at about the time the foliage is changing color, leaving behind small round exit holes in the bark.

Wood borers are sometimes the principal insect attacking the main trunk of pine trees, filling a niche that is typically occupied by bark beetles. A good example of this is found on Jeffrey pines in San Diego County and in the San Jacinto Mountains of Riverside County, where the Jeffrey pine beetle is absent. The red turpentine beetle may attack the base of these trees, but attacks higher on the bole are often made by the California flatheaded borer, Melanophila californica. No pitch tubes or boring dust are associated with borer attacks. On live trees, borer attacks are recognized by the presence of pitch streaming down the bole of the tree. These attacks are difficult to interpret because the insect does not need to kill the tree in order to survive. Larvae of M. californica may be pitched out and killed by the tree or they may survive in an incipient stage for many years beneath the bark.

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Pines Continued...

Numerous pitch streamers may be an indicator the tree is under stress, but the pitch streamers do not mean the tree is dying. If numerous streamers are present, look for other indicators of the tree's condition - red turpentine beetle attacks, foliage color changes, and woodpecker feeding. Most dead or dying pines will have successful red turpentine beetle attacks. If you suspect a green tree is dying, look for dry boring dust around the base of the tree and cut into this area to determine if beetle larvae are present.

Acknowledgements and Disclaimer

Thanks to staff of the California Department of Forestry and Fire Protection and the USDA Forest Service for reviewing this manuscript. These guidelines are for use on state and private lands, but are not intended to be a substitute for the California Forest Practice Rules or any related policies of the California Department of Forestry and Fire Protection. National Forests and other Federal lands have separate guidelines for identifying dead and dying trees.

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