



FOREST HEALTH NOTES

- A Series for the Non-Industrial Private Forest Landowner - (Draft)

Western pine beetle (*Dendroctonus brevicomis*)

Host: Ponderosa pine, rarely lodgepole pine

Quick ID:

- Egg galleries winding, branched, crossing
- Small yellow pitch tubes
- Red boring dust in bark crevices and at base of tree
- Larval galleries short, entering bark
- Large patches of bark often removed by woodpeckers
- Foliage discolored

Field Identification:

Tree: Small yellow pitch tubes mark the point of entry of the beetle. Red boring dust may be found in the bark crevices and at the base of the tree. In the phloem (inner bark region), egg galleries wind and branch randomly, crossing over the galleries of other beetles. These galleries will be packed with frass (boring dust and insect droppings). Sapwood markings from larval galleries off the egg gallery will be short as the larvae quickly enter the bark to feed. On a successfully attacked tree, the foliage will discolor first to yellowish-green, then to reddish-brown. By that point, the trunk may have many small round emergence holes indicating the beetles have gone.

Insect: Adults are 3 to 5 mm in length and dark brown, with a cylindrical shape. Larvae are white and resemble grains of rice with a yellow-brown head. Larvae may be found in the inner or outer bark as well as on the cambium.

May be confused with: Mountain pine beetle

Life cycle: Western pine beetles attack and kill living trees. In an endemic (normal) population, adults preferentially choose weakened trees, especially those experiencing water stress. Once an epidemic outbreak gets started vigorous trees may be attacked as well. Western pine beetles prefer trees at least 10" in diameter. Adult insects emerge and attack trees late in spring or in early summer. Females attack the tree, bore through the bark to the phloem (inner bark), and emit pheromones that attract both other females, who also colonize the tree, and males. Attack usually occurs on the midbole. "Mass attack" of the tree by many beetles helps overcome the tree's resistance. Trees resist colonization by pitching out and immobilizing the beetles. Generally, trees that are not under water stress can fend off an attack. During an epidemic, however, all trees can be overwhelmed. Beetles mate inside the tree and the females

construct egg galleries. Niches are cut into the sides of each gallery and eggs are laid singly, about 1/4" apart. These niches and the egg gallery itself are packed with frass behind where the adults are working. Larvae hatch in 7 to 10 days and begin mining the phloem at right angles to the egg gallery. After half an inch or so, the larvae enter the bark where they develop through a number of larval stages. At last, a pupal chamber is hollowed into the outer bark, the larva pupates, and a new adult emerges. Unlike mountain pine beetles, western pine beetles may have two generations develop to maturity and a third overwinter as larvae in the same year.

Predisposing agents: Western pine beetles have greater success in attacking trees that are under water stress. Root rot infections may predispose trees to water stress during drought. Beetles selectively attack trees that have been weakened by drought, lightning strike, or other agents that interfere with the water balance of the tree. A tree is in water balance when as much water is taken up by the roots as is transpired. These trees are preferentially attacked as weakened trees cannot mobilize strong defenses to expel beetles. Historically, epidemics occur as a result of prolonged drought, as drought weakens trees across large areas. Warm temperature aids development of larvae, hence a hot summer will permit faster maturing of a generation and a greater likelihood of multiple generations in a single summer.

Impact: As it prefers ponderosa pine, western pine beetle is somewhat less damaging than mountain pine beetle which preys upon all kinds of pines. According to the USFS, in Washington in 1991 the western pine beetle was responsible for the death of 21,679 trees over 28,159 acres resulting in a loss of 1.267 million cubic feet of lumber.

Management: Methods of control have shifted away from direct control (felling, burning, etc.) and towards indirect methods that discourage beetle habitat and keep populations at endemic (normal) levels. It is possible to prevent infestation with penetrating sprays on individual, high value trees such as those in campgrounds and near houses, but they need to be applied before the tree is infected and the cost of such treatments is prohibitive for any large-scale application.

Western pine beetles are a natural part of western ecosystems; they evolved here together with the pines they feed on. In the forest, they kill slow-growing, drought-

stressed trees and act as natural thinners, opening up the stand for new trees and wildlife. Even outbreak conditions are "normal" as cycles of drought have been predisposing factors for beetle epidemics for thousands of years, as have root diseases. For this reason bark beetle attacks will never be eliminated (nor should they be). The death of a few trees on your property doesn't necessarily herald the beginning of an outbreak; check the trees for signs of root disease (there are other WSU Cooperative Extension "Forest Health Notes" dealing with symptoms of root diseases).

To maintain western pine beetles at their normal levels, predisposing factors for outbreak must be removed. Environmental stresses are not controllable, but many stress factors are associated with stand management practices and therefore may be changed. One important situation that can be addressed is having too many trees to the acre, or stand overstocking. Overstocking creates inter-tree competition for water, light and nutrients, and reduces their ability to resist attack by bark beetles. A judicious thinning can show good results in ponderosa pine stands even 90 years of age. To minimize stand stresses and maintain vigorous growing conditions, stand managers should: (adapted from Berryman: Forest Insects, 1986).

- Choose tree species that are adapted to the area on which they'll be planted.

- Harvest trees in a way that mimics natural processes, such as cutting small patches to mimic a fire (for pine and larch management) or selective or shelterwood cutting (for grand fir and Douglas-fir management).

- Remove diseased and unhealthy trees and logging debris, and minimize damage to residual trees. Salvage logging of beetle-killed trees is fine except in root disease areas where that may worsen the severity of root diseases such as Armillaria and Annosus.

- Encourage diversity in species and age classes.

- Use thinning, fertilization, prescribed fire, etc. to maintain stand diversity and vigor.

- Prevent trees from becoming overmature by harvesting on time.

Patch cutting 6 to 10 acre blocks every few years and managing these as small even-aged stands helps keep the total number of older trees low and creates a variety of age classes that discourages western pine beetle attack. It has additional benefits for wildlife by creating small openings and edges. This may not, however, be a good strategy if trees at the edges of the cut are heavily infested with dwarf mistletoe and the species to be planted or naturally regenerated is the same species.

Use pesticides with care. Apply them only to plants, animals, or sites listed on label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets and livestock.

Insect or disease treatments should always be part of an overall forest management planning process. It's a good idea to have a forest management plan for your property. This tool will help you prevent problems and keep your forest healthy. For more information about this series of publications, please contact Peter Griessmann, WSU Cooperative Extension Forestry Agent, (509) 684-2588 or Donna Dekker, WSU Cooperative Extension, Department of Natural Resource Sciences at (509) 335-2877.



PEST NOTE

WESTERN PINE BEETLE

(Dendroctonus brevicomis)

HOST:

Ponderosa pine

IMPORTANCE:

Western pine beetle infestations are an important cause of tree mortality in mature second growth ponderosa pine. Between 1970 and 1985 western pine beetle infestations occurred on an average of 70,000 acres per year. Second growth ponderosa pine stands growing in the oak zone of southwest Oregon and on the east flank of Mt. Hood appear particularly susceptible to attack. On these dry sites, trees with diameters greater than 14 inches are commonly killed.

LOOK FOR:

- Tree mortality associated with western pine beetle attacks follows two characteristic patterns: 1) overmature trees appear as scattered tree mortality within a stand; 2) overstocked stands of second growth pine are attacked in clumps.
- The foliage of successfully attacked trees first turns pale green then yellow and eventually a brownish-orange. When attacks occur between spring and mid-summer, the foliage will normally fade by fall. Trees attacked in the late summer and fall may not fade until the following spring. The rate at which foliage fades depends on the weather and how rapidly a blue stain fungus introduced into the tree by the beetle blocks the conductive vessels of the sapwood.

APRIL-SEPTEMBER

- The first sign of tree attack, months before any change in foliage color, is the appearance of small pitch tubes (1/4 to 1/2 inch in diameter) on the tree's outer bark. Pitch tubes consist of white to red-brown masses of resin which are often associated with a fine boring dust that col-

lects in bark crevices. Because the western pine beetle has several generations a year, new pitch tubes can appear on trees from early spring through September.

INFESTATION CHARACTERISTICS:

- Frequently, western pine beetle is associated with a complex of beetles that infest ponderosa pine. The Oregon pine engraver kills the tree's crown (top kill), while the western pine beetle attacks the main bole, and the red turpentine beetle colonizes the root collar area (Figure 1). The western pine beetle has two generations a year in most of Oregon except for the southwest where three to four generations are common. Western pine beetle attacks are confirmed by removing the bark from dying trees and exposing the winding, criss-crossing egg galleries (Figure 2). Sometimes the beetle and its larvae are found beneath the bark (Figures 3 and 4). The sapwood of infested trees will show a dark color that is characteristic of the blue stain fungus introduced into the tree by the beetle.
- Infestations of western pine beetle increase dramatically following periods of drought. Other factors such as root disease, soil compaction, and mechanical damage can predispose pine to beetle attacks.

CONTROL:

- Thinning overstocked ponderosa pine stands reduces the hazard of western pine beetle attack. A general guideline is that reducing stocking levels to 55-70 percent of the basal area needed for full site utilizations lowers the risk of beetle infestation. Thinning operations should be conducted so that slash accumulations do not provide breeding sites for another tree pest, the Oregon pine engraver. Contact a Service

Forester, OSU Forestry Extension Agent, or consulting forester to determine an appropriate basal area figure for your stand.

- Salvage of infested trees as a means of removing beetles from the stand is best accomplished during the winter months. During the summer months, beetles often leave the tree before the foliage changes color which makes it difficult to estimate the extent of an infestation. However, trees that change color during the winter months usually do contain beetles. If salvage is attempted during the winter, the operation needs to be completed before beetle emergence in April-May. All green trees with pitch tubes as well as trees with yellow or red crowns should be removed from the site.

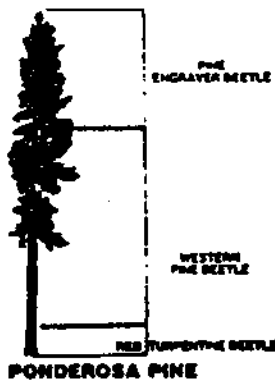


Figure 1 Typical distribution of beetles attacking the crown, trunk and root collar of ponderosa pine.

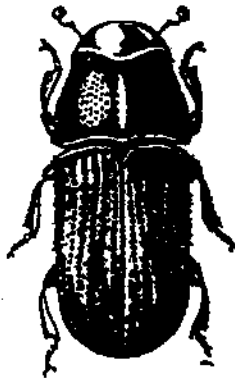


Figure 3 Adult western pine beetles are brown to black, cylindrical shaped and 1/8 to 1/5 inches in length.

- Chemical insecticides can be used to protect high value trees near homes or structures. A two-percent active ingredient solution of carbaryl (Sevin) sprayed to run-off on the trunk of ponderosa pine is an effective preventative treatment. Insecticides should be sprayed as far up the trunk as possible and to a height of at least 30 feet. The insecticide treatment should be made in April, before any beetle flight. However, because of the beetle's multiple generations, treatment of unattacked trees anytime during the summer months may be beneficial.

REMEMBER, WHEN USING PESTICIDES, ALWAYS READ AND FOLLOW THE LABEL.



Figure 2 Western pine beetle infestations are confirmed by removing bark and finding winding, crisscrossing egg galleries on the surface of the sapwood.



Figure 4 Mature larvae are white legless grubs about 1/4 inch in length.



PEST NOTE

PINE ENGRAVER BEETLE

(Ips Pini)

HOSTS:

Ponderosa pine, lodgepole pine, shore pine, and western white pine.

IMPORTANCE:

The pine engraver beetle (*Ips*) is a particular threat to recently thinned ponderosa pine stands where slash accumulation attract beetles. *Ips* is very aggressive in drought years and often kills the tops of mature trees as well as clumps of up to pole size ponderosa pine. Between 1976 and 1985, the pine engraver beetle killed an average of 35,435 acres of pine per year in eastern Oregon.

LOOK FOR:

APRIL-AUGUST

- Orange-brown boring dust in the bark crevices of slash is frequently the first sign of *Ips* activity (Figure 1). When the bark is peeled off near the boring dust, a beetle gallery in the tree's sapwood is usually present (Figure 2). The galleries radiating from a central chamber form an inverted "Y" pattern. Often the adult beetles are found in the gallery (Figure 3).

JULY-AUGUST

- During these months, there are rapid changes in the appearance of an infested tree's crown. The foliage of infested pines changes from green through yellow, and eventually to a red-dish-brown. Pines which have a breast height diameter (dbh) of 2-8 inches are most susceptible to *Ips* attacks. Pine engraver attacks can also cause partial crown dieback on mature pines.

INFESTATION CHARACTERISTICS:

In most areas of eastern and central Oregon, pine engraver beetles have two generations per year (Figure 4). Mild conditions in southwest Oregon allow *Ips* to have three to four generations per year. The overwintering beetles normally seek out fresh slash, windthrown trees, or trees with snow breakage as breeding material in the spring. Pieces

of slash with a diameter as small as two inches can provide breeding sites for *Ips*. It is the beetle generation flying from mid-June to mid-August that often attacks standing green trees.

Ips outbreaks usually occur when the precipitation during the months of April-July is 75% of normal or less. In these years, overstocked second growth pine stands are particularly vulnerable to attack.

CONTROL:

Second growth ponderosa pine should be thinned to maintain trees in a vigorous state which resists beetle attack. Thinning should be conducted during July-December. Contact your Service Forester or OSU Extension Agent for thinning guidelines.

Do not conduct thinning operations during the months of January-June. Slash accumulations during these months are attractive to the first generation of pine engraver beetles. Slash accumulation in January-June is frequently associated with attacks on crop trees.

If slash creation is unavoidable during January-June, the amount of suitable breeding material can be reduced by dozer trampling slash and scattering slash into open areas to facilitate sun drying.

Ips are preferentially attracted to fresh slash rather than standing trees. By providing the beetles with a continuous supply of fresh slash during their flight period, attacks on green trees are avoided. This technique called a "green chain", must be continued throughout the flight periods to be effective.

A chemical insecticide can be used to protect high value ornamental trees near homes or structures. A two percent active ingredient solution of carbaryl (Sevin) sprayed to run-off on the main bole of small ponderosa pine is an effective preventative treatment. Insecticide should be sprayed as far up the trunk as possible. The insecticide treatment should be made in April, before any beetle flight. However, because of the beetles multiple generations, treatment of unattacked trees anytime during the spring and summer maybe beneficial.

REMEMBER, WHEN USING PESTICIDES, ALWAYS READ AND FOLLOW THE LABEL!



Figure 1 Spots of orange-brown boring dust on the bark of pine slash infested by the pine engraver beetle.

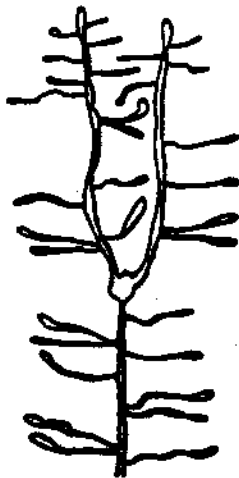


Figure 2 Characteristic shape of a pine engraver gallery (5-10" in length), which runs parallel to the wood grain. Galleries may not be as distinctive several months after the attack.



Figure 3 Adult pine engraver beetles are 1/8 to 3/16ths inch long, with four distinctive spines on the rear of the wing cover.

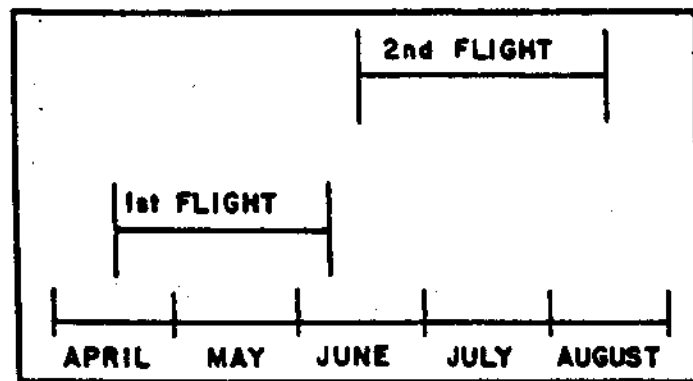


Figure 4 Flight periods for the pine engraver beetle in eastern Oregon. The second flight infests green trees as well as fresh slash.



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Pine Engraver (*Ips* spp.)

Hosts: Ponderosa pine, lodgepole pine, western white pine, occasionally Engelmann spruce.

Quick ID:

- Galleries have a central nuptial chamber from which 2-3 egg galleries radiate
- Galleries free from frass
- Yellow or reddish boring dust in bark crevices or on ground
- Foliage discoloration
- Top-killed trees
- Insects small, dark beetles 1/8 to 1/6" in length.

Field identification:

Tree: Yellow or reddish boring dust is found in bark crevices, around entrance holes, or on the ground beneath. Pitch tubes are seldom formed. After attack, the foliage of the tree discolors from green to yellow, reddish, and then reddish brown. This happens rapidly in the summer and more slowly in fall and winter. Ips beetles typically attack near the top of the trunk, and frequently girdle the tree, causing topkill. Galleries mine the bark and score the sapwood. Unlike the galleries of mountain or western pine beetles, ips galleries are free from frass (boring dust and insect droppings). A central nuptial chamber has several egg galleries leading off in different directions.

Insect: Ips beetles are reddish brown to nearly black and from 1/8 to 1/6" in length. The posterior of the abdomen is notched and has pronounced toothlike "spines."

May be confused with: Mountain pine beetle, western pine beetle.

Life cycle: There are a number of species of ips beetles found in Washington. The most common is *Ips pini*, which is generally found attacking and killing ponderosa and lodgepole pine. Adult insects may attack trees or fresh slash over 2" in diameter. A quantity of fresh slash or debris after a windstorm will almost certainly be used to produce a large beetle population, which may subsequently attack living trees. Fortunately, attacks are of short duration, often confined to a single year. A male bores through the bark to the cambium and constructs a nuptial chamber. Several females then join him and construct separate egg

galleries leading off in different directions. Eggs are laid in niches along the sides of these galleries. Larvae hatch and feed in the inner bark, working away from egg galleries. Larval tunnels are packed with frass. Larvae construct oval pupation cells at the end of their tunnels and pupate, emerging as new adults about 1-1/2 to 2 months after hatching. Between two and five generations can be produced in a single year, depending on altitude, latitude and species. Adults may re-emerge after laying eggs and attack a second or even third time in a year. Insects generally overwinter as adults, either in large groups under the bark or in large stumps or bark crevices. Beetles also overwinter in leaf litter on the forest floor.

Predisposing agents: Large numbers develop in fresh slash. Warm, drought-like spring weather will lead to ips damage. Ips beetles frequently attack the tops of trees recently killed by western or mountain pine beetles. Sufficient host material will lead to epidemics where living trees are attacked in groups. These may resemble mountain pine bark beetle kills.

Impact: In 1991, the USFS estimated that an ips outbreak had affected 23 acres in Washington. However, that doesn't reflect the thousands of single trees that were killed by ips infestations too small to be identified by overflying aircraft. Damage occurs most frequently as killing of trees 2 to 8" in diameter and top-kills on older trees.

Management: Direct means of control (e.g. spraying, felling, etc.) are not useful against pine engravers, especially as outbreaks rarely last more than one season. They may be useful in high-value areas like campgrounds or near houses. Outbreaks may be prevented by appropriate slash disposal and thinning in overstocked immature stands. Lopping and scattering slash is the preferred way to dispose of slash from a nutrient cycling standpoint, but can cause problems with ips. However, scattering slash in the open where the sun will dry it out will make it unsuitable as a breeding medium. During the spring and early summer, particularly when precipitation is below normal, slash disposal is critical. Slash should be scattered, not piled, during these times. Windthrown trees should be salvaged promptly. Low fires in late autumn may kill beetles overwintering in leaf litter.

Note: Use pesticides with care. Apply them only to plants, animals, or sites listed on label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets and livestock.

FOREST HEALTH NOTES

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Red turpentine beetle (*Dendroctonus valens*)

Hosts: Ponderosa pine, lodgepole pine, western white pine, occasionally spruce and larch

Quick ID:

- Large reddish pitch tubes on trunk
- Only in lowermost portion of trunk
- Galleries short, irregular
- Galleries packed with frass
- Adult insect reddish brown, large

Field Identification:

Tree: Large (up to 1 1/2"), globular pitch tubes at point of entry, full of frass (a mixture of sawdust and insect droppings) and reddish. Galleries of the insect are irregular and packed with frass, varying between 1/2 and 1" in width and up to several feet in length. Individual larvae galleries are not constructed; instead, a large cavity is formed. Galleries are usually found only in the bottom six feet of the trunk.

Insect: Adults are reddish-brown and may be 3/8" in length, the largest of the *Dendroctonus* bark beetles. Larvae are up to 1/2" in length, and feed together in a common brood chamber. Pupal chambers may be found at the base of the host tree.

May be confused with: Mountain pine beetle.

Life cycle: Attacks occur through the warm weather and peak in midsummer. Adult turpentine beetles bore through the outer bark and excavate short, irregular, longitudinal to cavelike galleries between the bark and the wood. Eggs are laid in groups packed with frass on the sides of the gallery. When the eggs hatch, the larvae remain together and excavate large cavities while feeding. Further development to pupae and adults takes place in the cavity or in short

galleries along its margin. Larvae and adults overwinter in the tree. Generations per year varies with climate; in the coldest part of the range, one generation is produced every two years, while in the warmest areas, two to three generations may be produced in one year. This is not one of the most aggressive bark beetles and attacks do not become epidemic.

Predisposing factors: Red turpentine beetles commonly attack trees already weakened by injury, other bark beetle attacks, or disease. Freshly cut stumps, exposed roots and the lower trunk of declining trees are all attacked, as are "leave" trees after logging operations and fire survivors. It is commonly associated with attacks of *Ips* or mountain pine beetle, which are usually responsible for the actual death of the tree.

Impact: As this bark beetle does not become epidemic, losses are not as catastrophic as with the mountain or western pine beetles. It is considered one of the "other bark beetles" for which losses in 1990 in Washington ran about 118.9 million cubic feet.

Management: Silvicultural activities designed to maintain vigorous, fast-growing stock will help as these trees are more resistant to bark beetle attack generally. Minimizing injury to "leave" trees during logging and silvicultural operations will keep the tree from being weakened. Pruning dead branches is fine, but pruning live branches opens a wound that may attract turpentine beetles. Bear in mind that root rot diseases often predispose the tree to bark beetle attack; search the roots and root collar for signs of infections. On high value trees near woodland homes or in campgrounds, chemical sprays may be used to prevent attacks. Lastly, salvage logging of beetle-killed trees is acceptable providing root rot is not present.

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PEST NOTE

RED TURPENTINE BEETLE

(Dendroctonus Valens)

HOSTS:

Ponderosa pine, sugar pine, western white pine, lodgepole pine and many ornamental pines.

IMPORTANCE:

Red turpentine beetle is a common pest of pole size and larger pines throughout Oregon. Ponderosa pine is the most commonly attacked host. Beetle attacks usually indicate a tree is suffering stress from drought or some type of site disturbance. If only the red turpentine beetle is attacking a pine, the tree usually survives. However, when red turpentine beetle attacks in conjunction with other bark beetles, tree death is rapid (Figure 1).

LOOK FOR:

Attacks by the red turpentine beetle are concentrated on the lower trunk and root collar of pines. Large white pitch tubes on the bark are usually the first sign of infestation (Figure 2).

If the bark is removed from an infested tree or stump, the adult beetle, the largest bark beetle in Oregon, or its immature stages may be visible (Figure 3).

Removing the bark will also expose an irregular vertical galleries filled reddish-granular frass (Figure 4).

INFESTATION CHARACTERISTICS:

In most areas of Oregon the red turpentine beetle has one generation per year, but in S.W. Oregon two generations are possible. Beetle populations increase dramatically during periods of drought. Trees stressed as a result of thinning operations, fire, or land clearing are often infested by this insect. Outbreaks of more aggressive bark beetles such as logs (pine engraver beetle), western pine beetle, and mountain pine beetle also lead to higher red turpentine beetle populations.

Attacks involving only the red turpentine beetle

are rarely numerous enough to cause tree death. However, when turpentine beetle attacks occur in successive years, trees can be girdled and killed.

CONTROL:

• CULTURAL

Maintain healthy vigorous trees by thinning overstocked stands of pine.

Avoid damaging the lower trunk and roots of leave trees during thinning and land clearing operations.

Avoid placing freshly cut unseasoned pine logs, firewood, or slash near green trees. The odor of fresh pine resin is attractive to the red turpentine beetle.

• MECHANICAL

Fresh cut stumps provide an ideal breeding site for red turpentine beetle. Debarking infested stumps will kill adult beetles and their brood. Do not debark infested areas on live trees.

• CHEMICAL

An insecticide can be used to protect ornamental trees near homes or structures. A two percent active ingredient solution of carbaryl (sevin) sprayed to run-off on the lower six feet of trunk and root collar area will prevent red turpentine beetle attacks for at least a year. The insecticide treatment should be made in April, before beetle flight.

REMEMBER, WHEN USING PESTICIDES, ALWAYS READ AND FOLLOW THE LABEL.

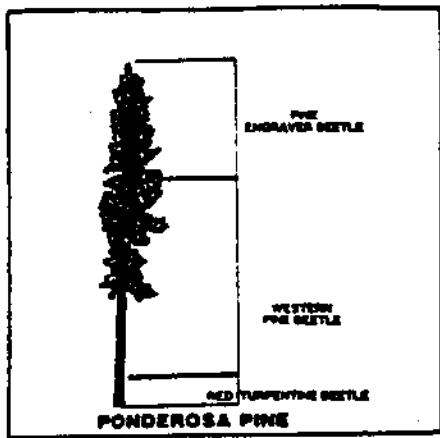


Figure 1 Typical distribution of bark beetle attacking the crown, trunk, and root collar of ponderosa pine.

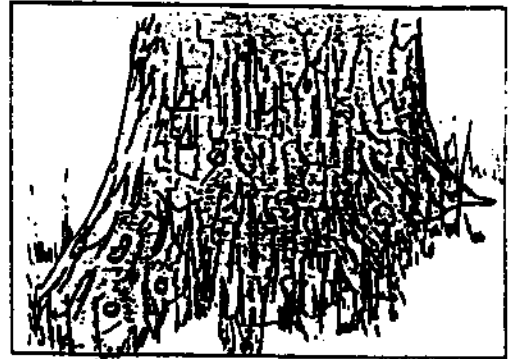


Figure 2 White pitch tubes at the base of a pine are the first sign of red turpentine beetle attack.

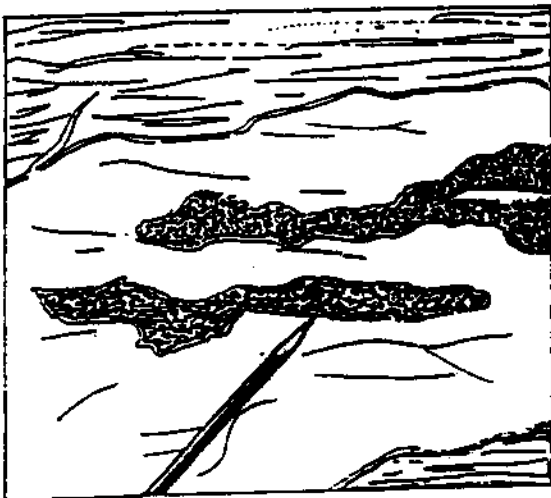


Figure 3 Life stages of the red turpentine beetle. Fully grown individuals at each stage are approximately 3/8" in length.



Figure 4 The irregular shaped vertical galleries produced by this beetle are 1" wide and a few inches to several feet in length.



PEST NOTE

MOUNTAIN PINE BEETLE

(*Dendroctonus ponderosae*)

Hosts: Lodgepole pine, ponderosa pine, western white pine, and sugar pine.

Importance: The mountain pine beetle is one of the most destructive tree-killing beetles in Oregon. Annual pine mortality from this beetle averaged more than one million acres between 1976 and 1985. The threat of beetle infestation in older, unmanaged pine stands is great enough to influence forest management decisions in much of eastern Oregon.

Look For:

- Clumps or large areas of pines with red crowns and tubes of pitch exuding from the trunk. Susceptible pine stands are usually over 60 years old, with a breast height diameter (dbh) between 6"-26" for lodgepole and 6"-40" for ponderosa pine.

- Seasonal changes in the appearance of a tree's crown can indicate beetle attack. During May-June, the foliage of pines attacked the previous year turns yellow. In July-August, pitch tubes are present on the bark of trees being attacked this year, but the crowns remain green. By July, the crowns of trees attacked last year have turned red.

Infestation Characteristics: The cycle of beetle attack and tree decline is shown in Figure 1. Trees attacked during the current year will have pitch tubes on the trunk, but crowns remain green. Pitch tubes do not always mean a tree will die. If the tree survives, salvage should be delayed until the crown changes color. Removing the bark of infested trees will reveal

a gallery pattern characteristic of this beetle (Figure 2). Sapwood from an infested tree shows a dark stain caused by a fungus introduced into the tree by the beetle (Figure 2).

Control:

CULTURAL

- Thin pine stands to reduce the hazard of mountain pine beetle attack. Guidelines on thinning pine stands are available from Service Foresters, OSU Forestry Extension, and OSU Extension Circular 1106 (September, 1982).

- Cut, pile and burn infested trees in the late winter or early spring before beetles emerge. CHECK WITH LOCAL STATE FORESTRY OFFICE ON BURNING REGULATIONS.

CHEMICAL

- Spray a carbaryl formulation (Sevin) onto the trunk of individual high-value pine trees near homesites. Pines are protected only if the spray is applied before beetle flight in July. See OSU Extension Circular 1085 for instructions. REMEMBER, WHEN USING PESTICIDES, ALWAYS READ AND FOLLOW THE LABEL.

Handling Infested Firewood:

- Do not cut firewood when pine crowns are yellow (May-June). Wood cut at this time may carry adult beetles to homesites where they will soon emerge and seek new hosts. Wood cut from declining pine should be stored away from any living pines and covered with clear plastic to destroy emerging beetles. See OSU Extension Publication FS 279 (September, 1981) for procedures.

DEAD CROWN
RED

LIVE CROWN
GREEN

DYING CROWN
GREEN

DEAD CROWN
YELLOW

DEAD CROWN
RED

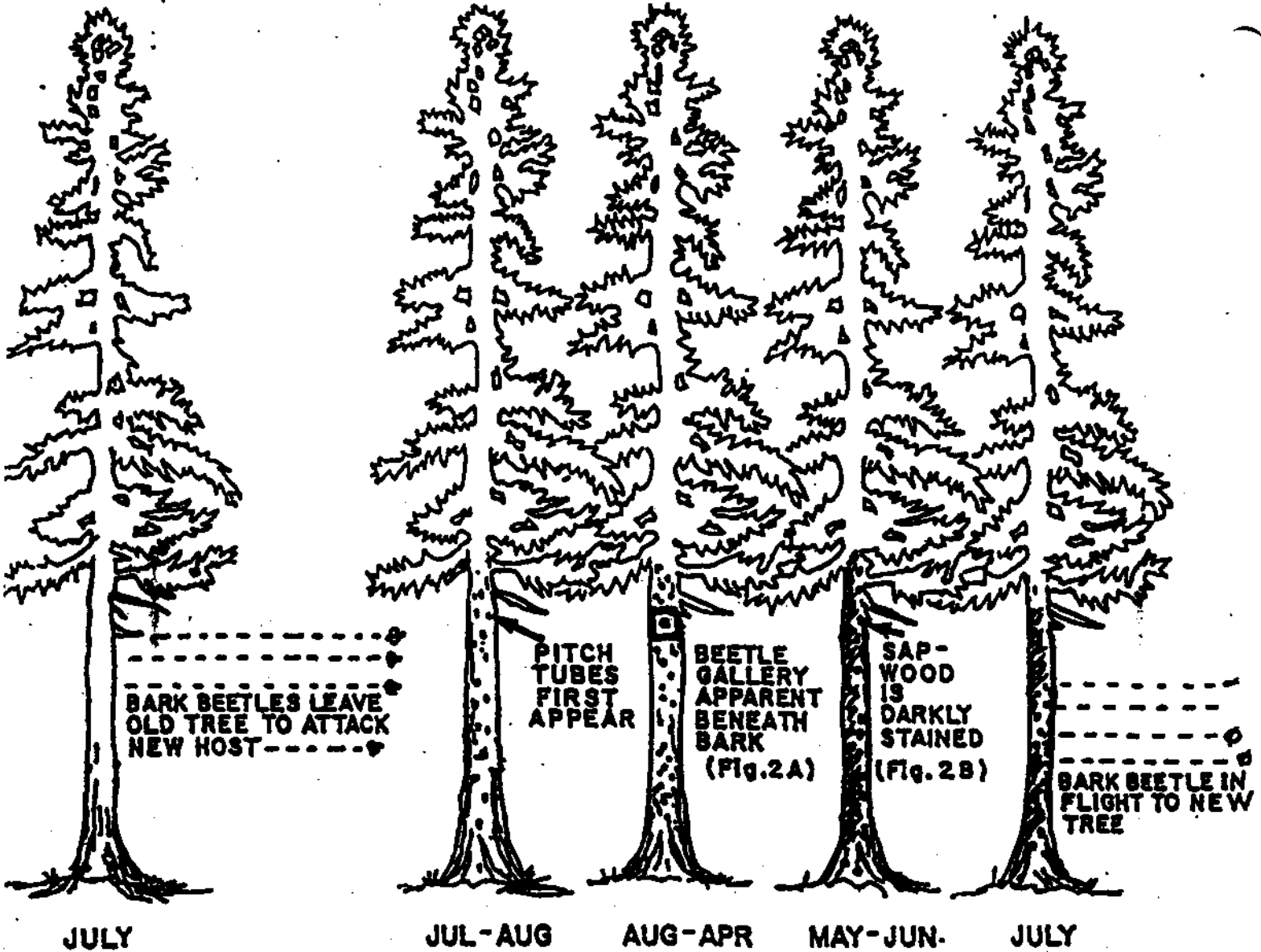


Figure 1 - CYCLE OF MOUNTAIN PINE BEETLE ATTACK AND TREE DECLINE



A.



B.
BLUE STAINED
SAPWOOD

Figure 2 - A., MOUNTAIN PINE BEETLE GALLERY PATTERN LOCATED UNDER THE BARK INFESTED TREE (gallery length 12-36 inches, wood grain runs vertically). B. CROSS SECTION OF BEETLE KILLED PINE SHOWING THE LOCATION OF