Jeffrey Pine Beetle

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The Jeffrey pine beetle (*Dendroctonus jeffreyi* Hopk.), one of the bark beetles that kill trees by mining between the bark and the wood, is the principal insect enemy of Jeffrey pine. The beetle is of economic importance chiefly in California, where most of the Jeffrey pine grows, and is most destructive in old-growth stands in the timber-producing areas of northeastern California. It also causes a great deal of damage to forests reserved for recreational use, such as those in the national parks.

In the eastern part of Lassen and Plumas Counties, where about one-third of the timber is Jeffrey pine, losses have been especially severe. In the nearly pure stands farther south, the Jeffrey pine beetle sometimes takes a tremendous toll. One outbreak on the Inyo National Forest that developed from timber blown down in 1923 subsequently caused the death of more than 13 million board feet of standing timber on a 32,000-acre area in 1924-26. Over the entire State, the volume of Jeffrey pine timber killed since the 1930's averages about 55 million board feet annually.

Normally the Jeffrey pine beetle, like the western pine beetle (*Dendroctonus brevicomis* Lec.), breeds in slow-growing trees of reduced vigor. These are usually large, mature, or over-mature trees that generally occur singly rather than in groups. When epidemics occur, the beetle may attack and kill trees upward of 8 inches in diameter regardless of age or vigor. The infested trees during outbreaks tend to be distributed in groups, with from 2 or 3 to 20 or 30 trees in each group. The larger groups frequently occur in pole-size stands. The beetle does not breed in slash but often infests lightning-struck or wind-thrown trees.

The Jeffrey pine beetle is a native insect. It is distributed throughout most of the range of its hosts from the border of southwestern Oregon southward through California and western Nevada to the San Pedro Martir Mountains of northern Mexico (fig. 1).

Host

Jeffrey pine (fig. 2) is the only tree that the beetle breeds in successfully. Early publications that

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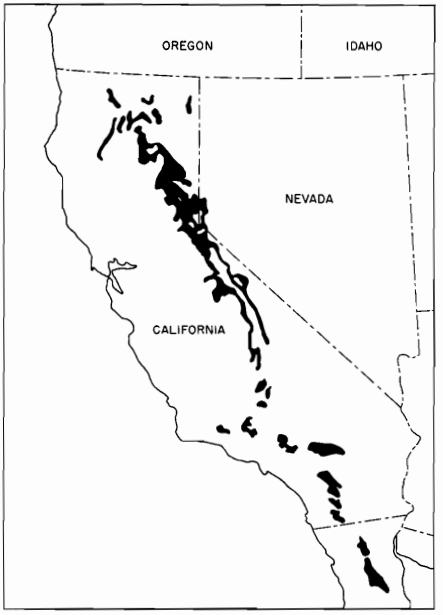

Figure 1.—Distribution of the Jeffrey pine beetle in North America.

list ponderosa pine and sugar pine as hosts are probably in error. On rare occasions the insect attacks ponderosa pine, but it is unable to develop in this tree. Jeffrey pine grows in extensive natural stands only in California, where it is an important source of lumber and a valued tree in recreational forests. Of the 67 billion board feet of ponderosa and Jeffrey pine sawtimber in the State, about one-fifth is Jeffrey pine.

Evidence of Attack

Trees attacked by this bark beetle are not usually detected until their foliage begins to change color. This change makes them conspicuous. Color changes are related to the progress of the beetle as it destroys the cambium area. They take place very slowly in Jeffrey pine but follow a fairly typical sequence. Beginning at the top of the crown and gradually extending downward, the normal green of the needles gives way to greenish yellow, to sorrel, and then to reddish brown. Fading does not start until after the attacking beetles are well established, and their progeny partly developed. By the time the crown turns sorrel, the new broods are usually about full grown. When the foliage reaches the reddish-brown stage, the beetles have usually abandoned the tree.

Large, reddish pitch tubes (fig. 3) can be found projecting from the bark on the middle and lower trunk of an infested tree. Pitch tubes consist of boring dust and

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Figure 2.—Jeffrey pine killed by the Jeffrey pine beetle.

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Figure 3.—Pitch tube on outer surface of bark.

resin pushed out by the beetles when they bore into the tree. These tubes mark the first points of attack. By careful examination of the trunk they can be found long before the foliage begins to fade.

To make certain that a tree having the outward symptoms of bark beetle attack is infested by the Jeffrey pine beetle, a section of bark should be removed so that the gallery pattern on the inner bark can be examined. The egg galleries of the Jeffrey pine beetle can be recognized by their characteristic "J" shape, their size, and their being packed with frass (fig. 4). No other insect that breeds in Jeffrey pine makes galleries like this. If the broods are fully developed, larval mines will be seen extending across the grain and ending in open, oval-shaped pupal cells. If the beetles have matured and left the tree, the outer bark will contain many scattered, circular holes. These are made when the adults burrow out from the pupal cells and disperse to attack other trees.

In diagnosing Jeffrey pine beetle as the cause of damage, it is important to establish the infested tree is Jeffrey pine. The mountain pine beetle (*Dendroctonus ponderosae* Hopk.), a closely related insect, is practically indistinguishable from the Jeffrey pine beetle, and the two species make similar galleries. The mountain pine beetle has been reared experimentally on Jeffrey pine logs, but it is not known to attack the living tree. It does, however, breed in other pines that grow in association with Jeffrey pine.

Description of Stages

The Jeffrey pine beetle is one of the larger species of *Dendroctonus*. In the adult stage it is a stout, cylindrical beetle about five-sixteenths of an inch long and black when mature (fig. 5,*A*). The egg is oval and pearly-white (fig. 5,*B*). The larva is a curved, white, legless grub with a yellow head (fig. 5,*C*), and, when grown, it is about the same size as the adult. The pupa also is white but is slightly smaller than the mature larva (fig. 5,*D*).

The life stages can be observed in an infested tree by cutting off a section of bark. On newly attacked trees, parent adults and eggs can usually be found in the egg gallery. As the insect develops, immature larvae can be found in galleries on the inner surface of the bark. Finally, mature larvae, pupae, and new adults occur

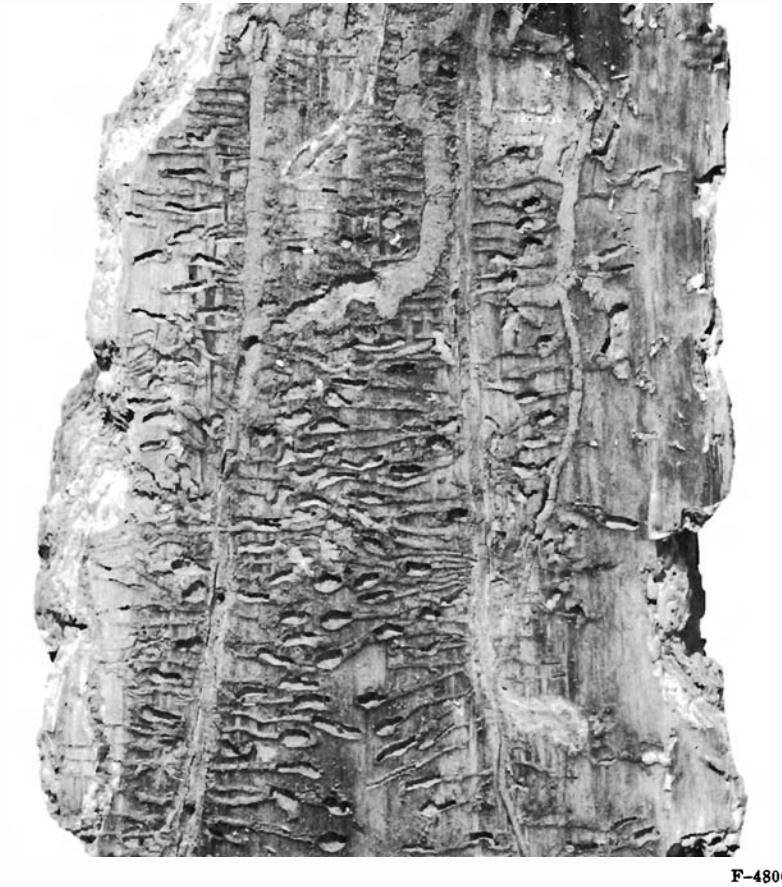

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Figure 4.—Egg galleries, larval galleries, and pupal cells on inner surface of bark.

in cells at the ends of the larval tunnels.

Biology and Habits

Like most *Dentroctonus* bark beetles, Jeffrey pine beetle adults fly to a tree and attack it by boring into the trunk through the outer bark. They usually attack along the middle and lower bole, where the trunk diameter is 12 inches or larger. About 10 percent of the time, however, they infest smaller material and sometimes attack stems as small as 4 inches in diameter. Ordinarily, only the first attacks are marked by pitch tubes. As the work of the beetles progresses, the tree becomes incapable of producing resin, and later attacks are marked only by reddish borings pushed out by the beetles.

After the beetles penetrate the bark and reach the junction of bark and wood, they construct their egg gallery by boring diagonally upward across the grain of the wood for 2 or 3 inches, then vertically parallel to the grain for an additional 2 to 4 feet. Each egg gallery is made by a single pair of beetles. As construction of the gallery progresses, the female lays her eggs singly in niches along the sides (fig. 5,*B*), and the gallery is then packed solidly with borings and frass.

The eggs require 1-3 weeks to incubate. When they hatch, the larvae tunnel through the inner bark, away from the egg gallery, across the grain of the wood. The length of the larval period varies considerably, because the insect may overwinter in the larval stage. When the larvae become full grown, they construct cells at

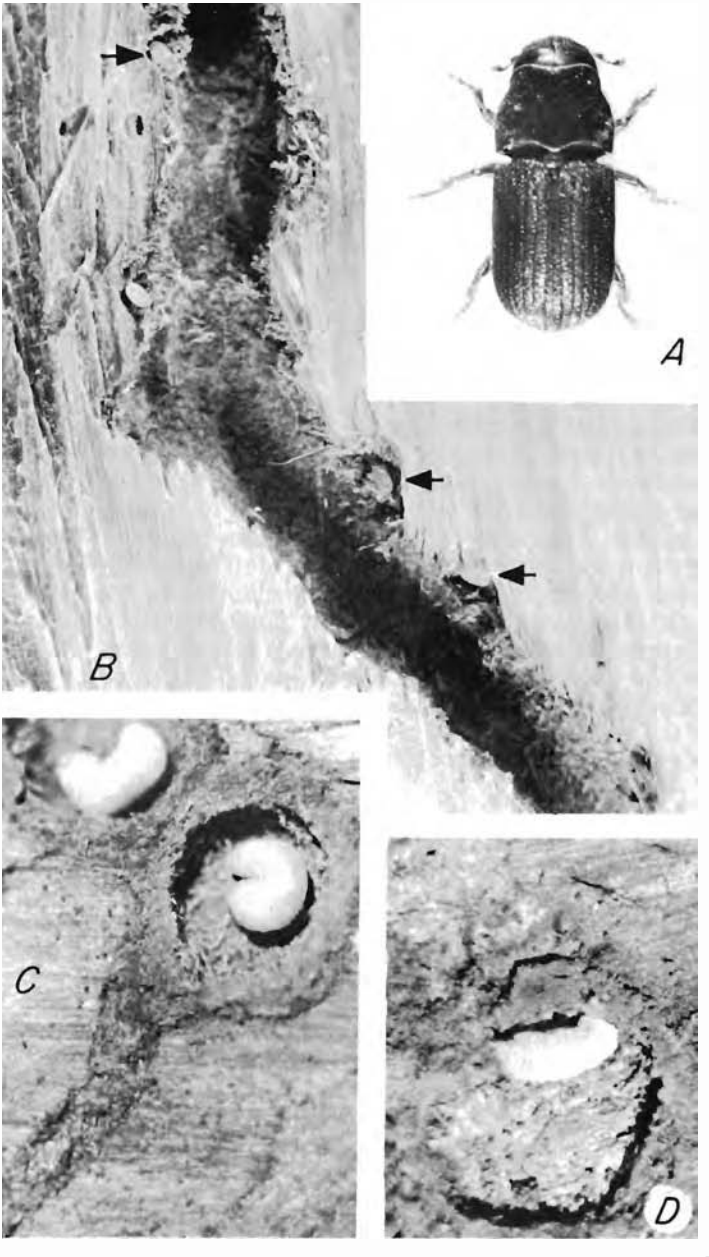

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Figure 5.—Life stages of the Jeffrey pine beetle: *A*, Adult (5/16 in.); *B*, eggs in niches in sides of egg gallery; *C*, full-grown larvae; *D*, pupa in pupal cell.

the ends of their galleries, where they pupate.

The pupae mature in about 10 days and then transform to adults. The adults emerge from the pupal cells by tunneling out through the bark.

The life cycle of the Jeffrey pine beetle is ordinarily completed in 1 year in the northern part of the range, but in the southern part two generations per year may occur. Frequently, one complete and a partial second generation develop. The principal period of attack is in June and July, but attacks also are numerous in late September and early October. The beetle overwinters in the larval and adult stages, but these stages also can be found almost any month in the year.

Many organisms are associated with the Jeffrey pine beetle. Yeasts, bluestain fungi, and probably other fungi are carried into the tree by the attacking adults. These organisms find a fertile medium for development in the inner bark and outer wood, and they help prevent the flow of nutrients in the tree. Other insects, mostly minor species that invade after the tree has been killed, are also associated with this bark beetle.

A few insects precede the Jeffrey pine beetle or attack the tree at about the same time, notably the California flatheaded borer (*Melanophila californica* Van Dyke), the pine engraver (*Ips pini* Say.), and the emarginate ips (*I. emarginatus* Lec.).

Since the California flatheaded borer can exist in the living tree, it attacks earlier than the Jeffrey pine beetle. Usually about 80 percent of the Jeffrey pine infested by the beetles is also infested by this borer. The Oregon pine engraver may precede the Jeffrey pine beetle or attack at about the same time. It mines in the upper part of the stem between 2 and 8 inches in diameter, above the area usually infested by the Jeffrey pine bettle. The emarginate ips generally attacks shortly after the Jeffrey pine beetle and works in the lower part of the stem where its galleries are often intermingled with those of the beetle.

The California flatheaded borer and the two species of *Ips* are associated with the Jeffrey pine beetle in about 40 percent of the trees killed.

Control

Normally, the Jeffrey pine beetle is kept in check by its natural enemies, climatic factors, and the resistance of its host. However, very little specific information is available concerning the relative importance of these factors or how they operate.

Losses in old-growth stands can be kept to a minimum by removing the types of trees in which the Jeffrey pine beetle normally breeds. Trees that are obviously in poor health, that is, high-risk trees, are most frequently infested. Lightning-struck and windthrown trees are also common sources of infestation. High-risk trees can be recognized by their poor vigor, declining growth rate, dying tops and twigs, and short, sparse foliage. These trees make up nearly 90 percent of the ones normally killed by this bark beetle. About 50 percent of the trees killed and a much higher proportion by volume are overmature, high-risk trees.

To protect the remainder of the stand, trees susceptible to beetle attack should be harvested through a sanitation-salvage cutting comparable to that made in ponderosa pine stands to control the western pine beetle. Degrade due to bluestains and borers is rapid in Jeffrey pine lumber and is especially serious if trees are

not cut soon after they become infested. Lumber of much higher quality and value can be obtained if susceptible trees are logged before they are attacked.

When it becomes necessary to destroy the beetles in infested trees, as it often does during outbreaks, several methods can be used: Salvage logging of infested trees is effective if the logs can be converted into lumber before the beetles emerge. Felling the infested tree then burning it, peeling the bark, or spraying—usually done from fall to spring—are also useful methods if salvage logging is impractical. Burning should be used where the fire hazard is not great. Peeling to expose the insects to the effects of weather and to predation by birds, ants, and other agents is also satisfactory, but should not be employed if the beetles have reached the pupal stage.

When none of these methods is feasible, spraying with the insecticide lindane in either a 1.5 percent solution in diesel oil or as a 1.5 percent water emulsion will kill the beetles in infested bark. The emulsion is not quite as effective but is safer to handle and less injurious to vegetation. The prepared spray should be applied to the infested bark at the rate of 1 gallon to 100 square feet of bark surface or until the surface is thoroughly wet. More of the emulsion is required to wet the surface than the oil solution. Spraying should not be done when the bark is wet, when the weather is rainy, or when the temperature is below freezing. Stumps should not be sprayed because several insect predators of the beetle hibernate there.

Caution:

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or if they may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.

Use Pesticides Safely

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