Forest Insect
& Disease
Leaflet 13

U.S. Department
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Fir Engraver

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The fir engraver, *Scolytus ventralis* LeConte, belongs to the family of insects called bark beetles, which live between the bark and wood of host trees.

A wide-ranging, native beetle, the fir engraver attacks most species of fir in the Western United States. Epidemics can cause severe tree mortality. From 1977 to 1978, for example, the fir engraver killed an estimated 1.2 million trees, totaling 114 million board feet (650,000 m^3), on the National Forests in northern California. Other outbreaks have been more localized, but the resulting losses have still been

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Figure 1—*Grand fir killed by the fir engraver during the 1974 outbreak on the Nezperce National Forest in Idaho.*

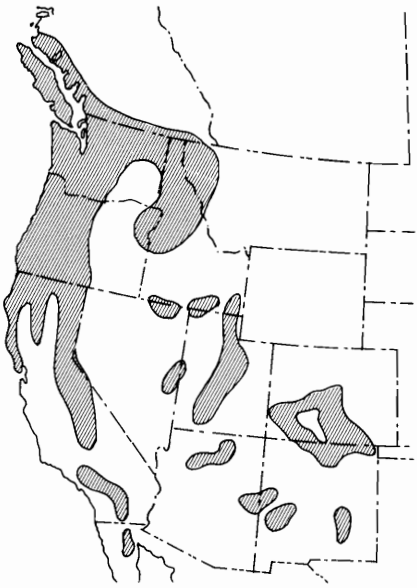

Figure 2—*Distribution of the fir engraver.*

severe. In New Mexico, some 37,000 trees were killed in 1954 on about 700 acres (2,800 ha) in the Cibola National Forest.

Outbreaks characteristically occur at irregular intervals and have been recorded at least once a decade over the last 60 years (fig. 1). Although no one knows exactly when outbreaks will develop, lowered resistance of the trees appears to be a contributing factor. Some outbreaks, such as the 1977–78 outbreak in northern California and the 1954 one in New Mexico, have coincided with periods of drought. Other outbreaks, such as the one that occurred in 1974–76 in the Blue Mountains of Oregon and Washington, have taken place after outbreaks of defoliating insects.

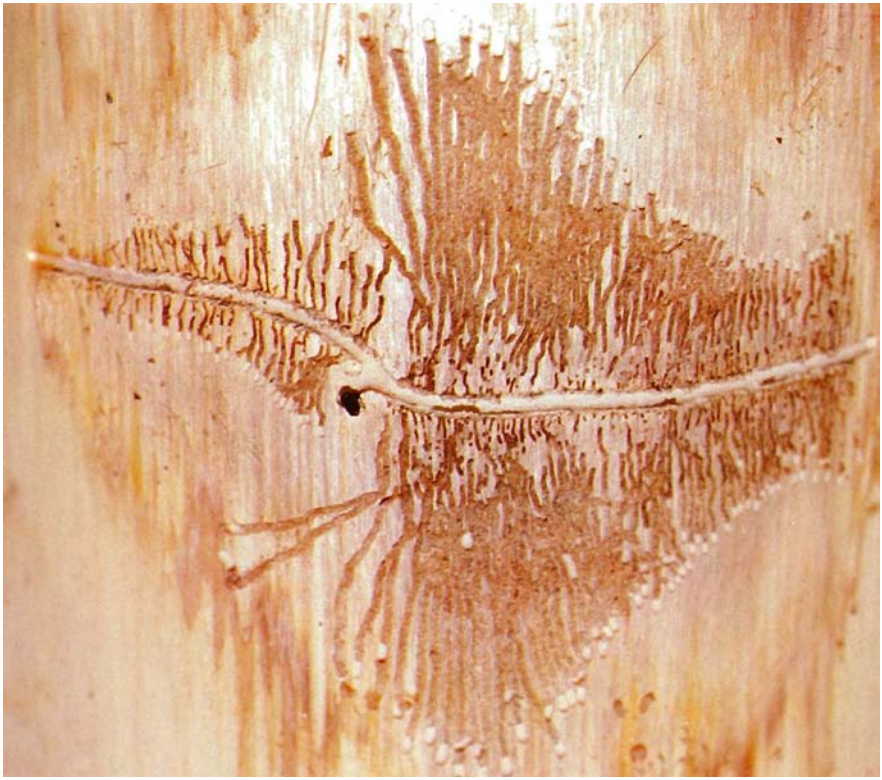

Figure 3—*An egg gallery with an adult fir engraver and larvae at the end of their parallel galleries.*

When fir engraver populations are endemic, trees are still killed, but losses are less severe.

Hosts and Distribution

The fir engraver attacks primarily white fir, grand fir, and red fir; its range coincides with the distribution of these three species. Fir engravers are found from British Columbia south to Baja California and east to the Rocky Mountains (fig. 2).

The fir engraver also occasionally attacks Douglas-fir, subalpine fir, mountain hemlock, and Engelmann spruce.

In addition to infesting standing green trees, the fir engraver will attack freshly cut logs and recent windthrows.

Evidence of Attack

Fir engravers bore entrance holes along the main stem, usually in areas that are greater than 4 inches (10 cm) in diameter. These holes are about 0.1 inch (2 mm) wide and are most often located in bark crevices or in the roughened bark at the junction of a branch and the trunk, but other sites may be attacked as well.

Reddish-brown or white boring dust may be seen along the trunk in bark crevices and in cobwebs.

Streams of clear pitch often flow from the entrance holes down the bole, and vigorous firs may exude enough pitch to drown the beetles or cause them to abandon their entrance holes. The creamy pitch tubes

Figure 4—*A group of grand firs in Idaho displaying the variety of attack patterns that characterize the fir engraver. One tree has lost its top and some branches; its neighbor has been killed.*

that are often formed when bark beetles attack pines are not produced on firs.

Once under the bark, the adults excavate egg galleries that engrave the sapwood, the layer of wood under the cambium (cover photo). The egg gallery is horizontal, cutting across the grain; the larval galleries extend at right angles, along the grain. This characteristic pattern can be used to identify the fir engraver (fig. 3).

Initial attacks in the crown may girdle the branches, disrupting the flow of water and nutrients and killing the branch. The appearance of yellowed or red branches in an otherwise green tree, commonly called "flagging," is the first easily seen sign of infestation (fig. 4).

Numerous attacks over part or all of the bole may kill the upper portion of the crown or the entire tree in a single summer. The foliage turns yellow and then red over the 3 to 6 months after an attack.

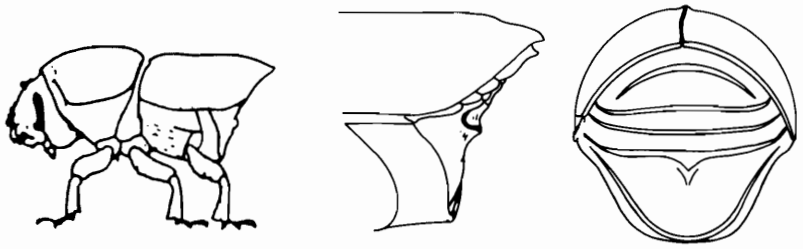

Figure 5—*Male beetle (about 8 times natural size) with its "sawed-off," concave rear end (about 13 times natural size) comprised of segments, the largest of which bears a bump at the center of its upper margin.*

Sometimes, however, only strips or patches of the bole are attacked. A healthy tree can recover if sufficient areas of cambium (the layer of growth cells) remain, and top-killed trees can produce new leaders. When the cambium heals over, a brown pitch pocket marks the injury. The usual evidence of such attacks is roughened patches of bark or scattered dead branches girdled at the base by the egg galleries.

The fir engraver is frequently associated with the roundheaded fir borer, *Tetropium abietis* Fall, or the flatheaded fir borer, *Melanophila drummondi* (Kirby); however, the winding larval galleries of both borers are largely limited to the lower, thick-barked areas of the trunk. During outbreaks, the fir engraver alone is generally responsible for most of the damage.

Life Cycle and Behavior

The adult fir engraver is a shiny black beetle about 0.2 inch (4 mm) long. Viewed from the side, it has an incurved posterior with a small central bump that is more pronounced in the male (fig. 5).

In the summer, adults emerge from infested firs and fly in search of host material—not only standing green trees but also freshly cut logs and recent windthrows. Temperature probably determines when adults emerge. Although flights can occur from June to September, most of them take place during July and August.

Fir engravers seem to attack more or less by chance rather than because of any characteristic of the host. But if the first beetles are able to successfully bore without being "pitched out," they emit an attractant that quickly lures many other beetles. This mass attack will likely occur when trees are already stressed by drought, defoliation, competition, dwarf mistletoe, or root disease and will kill the host.

The female enters the tree first, followed by the male. After the pair mate, the female excavates an egg gallery that is biramous from the central nuptial chamber. The egg gallery is anywhere from 4 to 12 inches (10 to 30 cm) long. During the 5 to 7 weeks after mating, a female will lay between 100 and 300 eggs in niches on either side of the gallery.

Figure 6—*Larvae at the end of their galleries beneath the bark of a California red fir.*

Four to six days after the female begins boring the egg gallery, a yellowish-brown discoloration appears on the surrounding area. The stain is caused by the fungus *Trichosporium symbioticum* Wright, which is carried by the beetles.

The eggs incubate for 9 to 14 days. When they hatch, the larvae mine straight up and down, perpendicular to the egg gallery (fig. 6), and pass through six molts.

Fir engravers overwinter mainly as young or mature larvae. In the spring, they feed for a short period and then construct pupal cells at the end of their galleries. Pupation takes 7 to 14 days; in another 2 weeks, the adults are ready to emerge from the tree.

It may take anywhere from 40 to 380 days for completion of the larval stage. In warm locations, the fir engraver completes one generation and a partial second generation each year. In cooler sites, such as north-facing slopes above 6,000 feet (1,800 m) in the Sierra Nevada of California, the fir engraver needs 2 years to complete its life cycle. Usually, however, the fir engraver is considered to have one generation a year.

Natural Control

Several insect predators and parasites are commonly associated with the fir engraver and occasionally destroy a large part of the brood. The more important predators include two beetles—the black-bellied clerid (fig. 7) and the red-bellied clerid—which prey on larvae and adults. A major parasite of fir engraver larvae is a braconid wasp. The females of this wasp insert their ovipositors through the bark and lay their eggs directly on the developing larvae. A mite and a nematode are

also important parasites on all stages of the fir engraver.

These and other natural enemies, especially woodpeckers, which remove the outer bark to feed on the larvae, may help to control the fir engraver. However, they are not effective in preventing outbreaks.

Control

Fir engraver populations can be effectively controlled in individual trees:

- The infested tree can be felled and the bark burned in place or the bark peeled and then burned.
- The infested tree can be felled, limbed, and left fully exposed to the sun, provided the logs are rolled every few days to expose all parts of the bark.
- The infested tree or log can be submerged in water for at least 6 weeks.
- The infested tree can be felled, and the trunk sprayed with insecticide using a low-pressure sprayer.

Over extensive areas, however, reducing fir engraver populations is more complicated. The fir engraver habitually infests tops and scattered patches of cambium. It is not practical to search out and remove the many trees in a stand that might be infested. Infested trees might contain only a few active broods; such trees often recover completely.

Silvicultural practices aimed at maintaining healthy stand conditions appear to offer the best chance for minimizing engraver-caused losses. Diseased, injured, or decadent trees should be removed, and overly dense stands should be thinned to reduce tree competition.

Figure 7—*Adult black-bellied clerid (two times natural size) which feeds on larval and adult fir engravers. This clerid is also a predator of the western pine beetle.*

Windthrown trees and cut logs should be removed within the year, before the beetles have had time to produce new broods.

Assistance

Guides for assessing the risk or hazard of fir engraver-caused mortality to trees and to stands are available and included in the bibliography.

Information about fir engraver control is also available from Cooperative Extension agents, from State foresters, or from Forest Pest Management, U.S. Department of Agriculture, Forest Service.

Selected Bibliography

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

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

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.

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