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By Carol Bell Randall
US Forest Service

Management Guide for

Fir Engraver

Scolytus ventralis (LeConte)

Primary hosts:
- Grand fir (*Abies grandis*)
- White fir (*A. concolor*- Oregon, California, Idaho, Utah, Nevada, Wyoming, New Mexico, Arizona, and Colorado)
- Red fir (*A. magnifica*- Oregon and California)
- Noble fir (*A. procera*- Washington, Oregon, N. California)

Reported infesting:
- Douglas-fir (*P. menziesii*)
- Subalpine fir (*A. lasiocarpa*)
- Western hemlock *(Tsuga heterophylla)*

Rare occasions:
- Spruce (*Piceae engelmanii*)

Topics

Key Points
- Fir engraver needs only to kill a strip of cambium near its gallery to successfully reproduce.
- Fir engraver will attack trees of any size.
- Various defects such as stain, ring-shake, and decay are associated with old attack scars.
- A healthy tree can recover if sufficient areas of inner bark remain.

Damage

Unlike other bark beetles, the fir engraver needs only to kill a strip of cambium near its gallery to successfully reproduce. Because it does not necessarily kill the tree, fir engraver attacks result in a variety of tree symptoms: (1) dead branches, (2) top kill, and (3) complete tree mortality. Trees that appear healthy are rarely killed except when they are affected by root disease or by a severe, temporary stress such as drought or defoliation. Fir engraver attacks that do not kill the tree cause scars clearly visible on the outer bark.

Various defects such as stain, ring-shake, and decay are associated with old attack scars. These defects will reduce the value of true fir for solid wood markets.

Figure 1. Aerial view of the fir engraver beetle damage. Photo by William M. Ciesla

Life History

Throughout most of its range fir engraver has a one- year life cycle; two years may be required at high elevations, and during warmer years, a partial second generation may form.

Adult fir engraver are shiny black beetles about 1/5th inch long (4 mm). Viewed from the side, they have an incurved posterior with a small central bump that is more pronounced in the males (fig. 10).

There is no evidence of aggregation pheromones in fir engraver. The attack dynamics of this species can be explained solely by its sensitive primary attraction response to host volatiles.

Life History

The fir engraver (FE) is a major pest of true firs throughout the West.

Typically fir engraver leaves infested trees from June through September. Temperature probably controls when adults emerge, leading to earlier emergence during warmer springs and at lower elevations.

Female beetles initiate attacks on random standing green trees, freshly cut logs, and recent wind throws. She bores into the tree's bark and is followed by a male which she mates with. The female bores a horizontal gallery which radiates out on either side of a central nuptial chamber. The gallery is excavated between the outer wood and the inner bark, scoring the wood (hence the name "engraver beetle"). The egg gallery may be anywhere from 4 to 12 inches (10-30 cm) long. During the 5 to 7 weeks after mating the female will lay between 100 and 300 eggs along the gallery. Four to six days after the female begins boring the egg gallery, a yellowish brown discoloration appears in the surrounding area. The stain is caused by the fungus *Trichosporium symbioticum* Wright, which is carried by the beetles.

Yearly mortality attributable to the beetle is quite high in parts of its range, especially where root disease is prevalent.

Figure 2. Gallery pattern of the fir engraver is perpendicular to the grain of the wood. Photo: FE Forest Insect and Disease Leaflet

Identification

Figure 3. Red branches within the a green tree, called flagging, is sign of attack. Photo by Ken Gibson.

Fir engraver will attack trees of any size. Often fir engraver will attack the tree crown, killing individual branches in larger diameter trees. The appearance of yellowed or red branches within a green tree, called flagging, is a sign of attack (fig. 3). The branch collar is a favored attack site of these beetles. Clear streams of pitch flowing from the entrance holes down the trunk may be present- firs do not produce pitch tubes. Pitch streaming is not frequently observed in the intermountain West. Reddish brown boring dust in bark crevices of larger diameter trees or cob webs along the trunk is usually present.

Numerous attacks over part or the entire bole may kill the upper portion of the crown or the entire tree in a single summer. The foliage turns yellow, and then bright red over the 3 to 6 months after attack (fig. 4).

Figure 4. Red foliage stage on grand fir. Photo by Dave Powell.

Identification

Figure. 5. Signs of fir engraver attack. Bark is bubbled and rippled from outside.
Photo by Chris Schnepf.

Sometimes only strips or patches of the bole are attacked. A healthy tree can recover if sufficient areas of inner bark remain. Top-killed trees can produce new leaders. When the inner bark heals over, a brown pitch pocket marks the injury. The usual evidence of such attacks is roughened patches of bark (fig. 5) or scattered dead branches girdled at the base by the egg galleries.

The gallery pattern of the fir engraver is unique. Unlike most other bark beetles, the female fir engraver constructs a horizontal egg gallery, perpendicular to the grain of the wood (fig. 6). Eggs are deposited on each side of the gallery and the larvae tunnel at right angles to the egg gallery paralleling the wood grain. The larvae are white, legless grubs, reaching a length of about one -eighth inch at maturity (fig. 7). The pupa is also white and approximately the size of the adult (fig. 8). Adult beetles are shiny, black and about one-eighth inch in length. From the side they have an incurved abdomen, a characteristic typical of all members of the genus *Scoltus* (fig 9 and 11).

Fir engraver galleries may be confused with the gallery pattern of

Figure 6. Fir engraver galleries. Photo by David Beckman, Idaho Dept. of Lands

another bark beetle, *Pseudohylesinus sericens*. The presence of small, shiny black beetles in the galleries will confirm that the attacking insect is fir engraver, *Pseudohylesinus* are dull in appearance.

Fir engraver and another bark beetle, *Pityokteines elegans*, often attack the same grand fir (*Abies grandis*) trees.

Figure 7. Fir Engraver larva.
Photo: National Agriculture Library

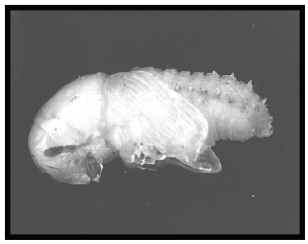

Figure.8. Fir engraver pupa.
Photo: National Agriculture Library

Figure 9. Fir engraver adult
Photo by Donald Owen

Figure 10. The characteristic incurved abdomen
Photo: FE Forest Insect and Disease Leaflet

Figure 11. Photo: University of British Columbia

Identification

Fir engraver caused fir mortality often increases in response short duration stressors, especially drought or epidemics of defoliating insects.

Recent studies show a moderate level of competition between these two bark beetles; they did not partition the bole of the host according to diameter. *P. elegans* would either colonize an area of bark before fir engraver, which would in turn not initiate attack, or in which both species would co-attack a host, but fir engraver would avoid phloem colonized by *P. elegans*.

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

Management Considerations

Overview-

Silvicultural practices aimed at maintaining healthy stand conditions appear to offer the best chance for minimizing engraver-caused losses. Overcrowding, disease, and drought often result in stress. Overcrowded trees compete with one another for limited resources, while diseased trees are unable to fully utilize the resources available to them. If a stress is of sufficient duration and severity, the tree may be unable to resist attack by fir engraver.

Overstocked grand fir stands have the greatest chance of beetle attack.

Hazard rating index--

Schenk et al (1977) developed a stand hazard index to rate grand fir stands for susceptibility to beetle attack based on stand parameters measuring competitive stress and species diversity. This system, which utilizes Crown Competition Factor (CCF) as a measure of stress, and Diversity Index (DI) as a numerical rating for species diversity has shown that pure, overstocked grand fir stands have the greatest chance of beetle attack. As overstocking is relieved and the grand fir component is reduced, the risk of fir engraver infestations is reduced. Data required to derive both the CCF and DI values (species, d.b.h., number trees/plot) are routinely taken during standard timber inventories.

The Under-story

Schenk et al. (1976) have identified groups of under- story plant species which are highly correlated with moisture regimes necessary for the vigorous growth of grand fir. The presence of oceanspray (*Holodiscus discolor*), Dewey's sedge (*Carex deweyana*), sandwort (*Arenaria macrophylla*) or yerba buena (*Satureja douglasii*) on a site was strongly correlated with increased FE caused tree mortality. Sites with queencup beadlily (*Clintonia uniflora*) or pipsissewa (*Chimaphila umbellata*) experienced less FEB caused tree mortality.

Silvicultural Treatment

Schenk et al (1977) developed a stand hazard index to rate grand fir stands for susceptibility to beetle attack based on stand parameters measuring competitive stress and species diversity.

Silvicultural treatment.--

The maintenance of vigorous stands through the elimination of competitive stress, removal of dead and dying trees, and treatment of external stressors is the best means of reducing fir engraver-caused mortality.

- If fir engraver attacks are associated with a root disease pocket, the best strategy is to follow root disease management guidelines.

- Treatment to reduce the level of defoliation caused by forest insects such as the spruce budworm and Douglas -fir tussock moth will reduce the likelihood of subsequent fir engraver mortality.

- Remove injured or decadent true fir that might provide breeding material for the fir engraver. Poor crown condition and live crown ratios have been associated with susceptibility to fir engraver attacks in white and red fir. These declining trees should be harvested whenever possible.

- Fir engraver can breed in fresh slash with a diameter >4 inches. Avoid creating large pieces of true fir slash from January-July and remove or treat wind thrown trees and logging slash before fir engraver flight.

- Overstocked fir stands should be thinned to reduce competition and increase tree vigor.

- Douglas-fir and western larch are major seral components in most grand fir habitat types. Where conditions permit, species conversion or increased species diversity should be considered.

Figure 12
Clerid beetle

Figure 13
Braconid wasp

Natural Controls

Natural control.--

Though a number of insect parasites and predators have been found in association with fir engraver, they are not effective in preventing outbreaks. Two species of C1erid beetles (fig. 12) found preying on various life stages of the beetle and two species of *Braconid* wasps, (fig. 13) parasitic on the larval stage, occasionally destroy large amounts of brood.

Extremely low winter temperatures can kill broods; however, normal snow depths usually protect overwintering larvae. Combinations of adverse weather and natural enemies may result in reduced fir engraver populations, though silvicultural control offers the most reasonable approach to beetle management.

Classical Biological Control. –

No classical biological control program has been mounted against the fir engraver. Although fir engraver is responsible for major losses in western forests, the potential for enhanced biological control through importation of additional natural enemies appears somewhat limited.

Direct control of fir engraver populations over extensive areas in the intermountain west is usually neither warranted nor recommended. Because of the scattered nature of beetle attacks --in tops and portions of trees --identification and treatment of all infested trees would be impractical, if not impossible.

Clean up windthrown trees

The primary factors predisposing trees to attack appear to be related to forest health and tree vigor, not lack of natural enemies of the beetle.

Hazard Trees. —

Many living true fir tree show evidence of past attacks by fir engraver. Some signs of past attacks include: bole irregularities such as bulges and unusual bark relief, dead top, and dead branches scattered throughout the crown. Such dieback is common and may or may not have much bearing on a tree's longevity. A tree's chances for survival are inversely related to the severity of dieback in the crown.

The biggest concern with dead tops and branches is their potential to breakout and fall. Dead branches and tops should be pruned from a tree in areas where their falling presents a hazard. Dead tops in true firs are often replaced by a side branch or branches that turn up and become "volunteer tops." Such tops are not as firmly attached to the bole of the tree as the original top was and have the potential to break out under wind and snow loads.

Other Reading

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Photo Credits

Figure 12. - http://www.ozanimals.com/wildlife/Insect/Beetles.html
Figure 13 - http://bugguide.net/node/view/170

Forest Health Protection and State Forestry Organizations

Assistance on State And Private Lands	Assistance on Federal Lands
Montana: (406) 542-4300	US Forest Service Region One Missoula: (406) 329-3605 Coeur d'Alene: (208) 765-7342
Idaho: (208) 769-1525	
Utah: (801) 538-5211	
Nevada: (775) 684-2513	US Forest Service Region Four Ogden: (801) 476-9720 Boise: (208) 373-4227
Wyoming: (307) 777-5659	