



Fir Engraver Beetle

About Fir Engraver Beetle

Fir engraver (*Scolytus ventralis*) is a bark beetle that attacks and kills true fir tree species (*Abies* spp.) in western North America. The beetles spend their lives within the bark and wood of host trees, feeding and developing on the inner layer of the *phloem*, or vascular tissues. The only life stage found outside of the bark occurs when adults reach maturity and emerge from trees to seek new trees to attack.

Fir engraver is a native insect and an integral part of Colorado's mixed-conifer ecosystems, playing a key role in the dynamics of these ecosystems. The beetle is found from southern British Columbia south to Baja California Norte, Mexico, and as far east as Montana, Colorado and New Mexico. Fir engraver is considered the most significant bark beetle pest of true fir forests in western North America. Attacks can cause top-kill, branch dieback or death of entire trees. Larger outbreaks, which typically develop during and following periods of below-normal snowpack and precipitation, can cause extensive tree mortality.

In Colorado, white fir is the only host tree of fir engraver beetles. White fir is a component of southern Colorado's mixed-conifer forests, where it occurs in

association with Douglas-fir and ponderosa pine trees. Outbreaks have occurred throughout the range of white firs in the south-central and southwest portions of Colorado. Subalpine fir trees, the other species of true firs native to Colorado and a component of the state's high-elevation forests, generally are not subject to attacks by fir engraver. Attacks occasionally occur on Douglas-fir trees when populations of the beetle are high and where both white fir and Douglas-fir grow together.



Figure 2. An identifying characteristic of white fir trees is light bluish-green or silver needles that are flat and curve out from the tree. Photo: CSFS



Figure 1. Fir engraver beetle-killed trees around Ouray. Photo: Dan West, CSFS

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Figure 3. A fir engraver beetle larva.
Photo: Dan West, CSFS



Figure 4. An adult fir engraver beetle.
Photo: Dan West, CSFS



Figure 5. Adult beetle exit holes on a white fir tree. Photo: Ryan Cox, CSFS



Figure 6. Galleries or tunnels underneath the bark of a tree, with darkened areas of the wood due to associated fungi. Photo: Dan West, CSFS

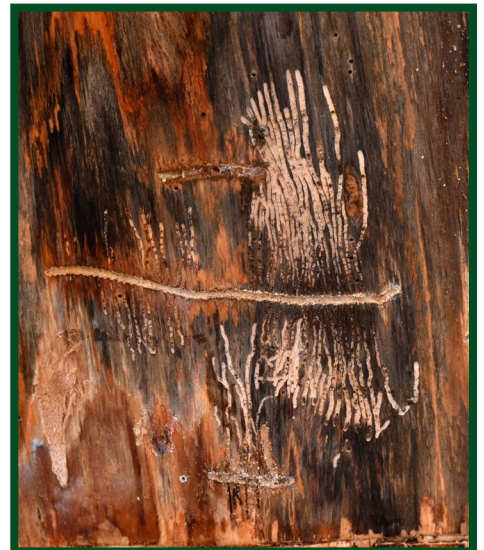


Figure 7. A close-up picture of the gallery pattern. Photo: Dan West, CSFS

Life History

Fir engraver beetles typically produce one new generation per year. In warmer locations they can produce one full and partial second generation annually, while in cooler climates and at higher elevations, two years may be required to complete a single generation.

Adult flight period typically occurs from June to September, with peak activity in July and August. Females enter a fir tree and construct a nuptial chamber between the bark and *xylem* (inner wood of the tree that transports water and nutrients), and are soon followed by a male. After mating, females construct a horizontal egg gallery perpendicular to the main tree stem. The gallery can range in length from about 4 to 12 inches (10-30 cm). Each female deposits 50 to 300 eggs, laid singly in niches on either side of the gallery. Eggs are nearly microscopic and pearly white. A yellowish-brown discoloration of the *xylem* just under the outer bark may appear in the area of the egg gallery, caused by a fungus (*Trichosporum symbioticum*) transported by the attacking beetles, and which is vital to the development of their offspring.

Eggs hatch within 9 to 14 days to reveal legless larvae that are white and C-shaped, with an amber-colored head capsule. The larvae feed on the tree *phloem* (conductive tissue containing carbohydrates) and construct additional side galleries that are oriented vertically, or perpendicular to the original egg gallery. Larvae feed for between 40 and 380 days, depending on temperature for development and nutrient availability. Pupation then takes place in cells at the end of the larval galleries and lasts from seven to 14 days. The young adults remain under the bark for another two weeks before emergence. Adults are shiny, dark-brown to black beetles, $\frac{1}{6}$ -inch (4 mm) long, or about the size of a small grain of rice.

Signs and Symptoms of Infestation

As is the case with most bark beetles, the most conspicuous evidence of fir engraver infestation is the occurrence of dead and dying trees. In Colorado, the foliage of dying white firs fades from a typical blue-green color to a light orange. Outbreaks may consist of a scattering of dead and dying trees, or small groupings of five to 10 trees. Trees with either top-kill or dying branches often can be seen in combination with dead and dying trees.

Fir engraver prefers trees that are stressed by other causes, such as root diseases, prolonged periods of drought, defoliating Douglas-fir tussock moths and western spruce budworms, or physical wounds from lightning, snow breakage, other trees falling against them, or human activity. These beetles typically prefer trees greater than 4 inches (10 cm) in diameter. Entrance holes are frequently located in bark crevices and furrows, and successful attacks are accompanied by the presence of reddish-brown boring dust in bark crevices. Streams of clear resin also may flow from entrance holes, and more vigorous trees may exude enough resin to successfully resist beetle attack. Once adults emerge from infested trees, the bark surface also will then be covered with tiny exit holes about the size of a pinhead.

Natural Controls

Natural enemies of fir engraver beetles include at least one species of parasitic wasp and two other species of beetles, all which prey on both fir engraver larvae and adults. A mite and a nematode species also account for commonly occurring parasites. Woodpeckers are fir engraver predators, by removing the outer bark of infested trees and feeding on the larvae. Unfortunately, none of these natural enemies are effective when conditions become favorable for the development of a considerable outbreak.

Management/Prevention

Preventative Sprays

Individual, high-value trees can be protected by spraying the trunk with a preventive pesticide prior to beetle attacks (by mid-May in many parts of Colorado). Be sure the pesticide is registered for use on bark beetles in fir trees, and apply only as directed on the label.

Permethrin (e.g. Astro, Onyx, Demand):

Permethrin and other synthetic pyrethroids (e.g. bifenthrin) attack the neurological systems of insects, paralyzing them on contact or through ingestion. Permethrin has a relatively low terrestrial environmental impact, as it breaks down quickly when exposed to UV light. Permethrin must be applied annually for effective treatment due to this UV sensitivity. Products containing Permethrin and other synthetic pyrethroids are highly toxic to bees, and extremely toxic to fish and aquatic invertebrates. Permethrin and other synthetic pyrethroids will impact a broad range of insects, and are not selective only for fir engraver beetle or other bark beetles.



Figure 8. Holes created by woodpeckers, which offer a natural control of fir engraver beetle populations. *Photo: Dan West, CSFS*



Figure 9. CSFS forest entomologist Dan West examines fir engraver larvae. *Photo: CSFS*

The Importance of Forest Management

It is important to remember that the fir engraver beetle is a native insect in Colorado's forest ecosystems, and part of an ever-changing forest. However, the potential negative impacts of natural disturbances, such as from this beetle and other insects and diseases, can be reduced through proactive forest management.

Colorado's forests provide clean air and water, wildlife habitat, world-class recreational opportunities, wood products and unparalleled scenery. These benefits contribute to quality of life and are vital to state and local economies. Without careful management of forest resources, these assets and community safety are at risk. It is critical to proactively manage forests and for landowners and communities to remain informed about threats to their forests, to ensure healthy, resilient forests for present and future generations.



Figure 10. A mixed-conifer forest with fir engraver beetle-killed trees. *Photo: Dan West, CSFS*

Carbaryl (e.g. Sevin, Sevinmol): Carbaryl is a neurotoxin that kills insects through ingestion or on contact. Carbaryl persists in the environment longer than permethrin, as it is less affected by UV light. It is extremely toxic to aquatic organisms and bees, therefore water sources and blooming plants must be protected when spraying this insecticide in a landscape setting. Products containing this active ingredient may leave a white residue on applied surfaces. A period of at least 24 hours with no precipitation is needed after application to allow the product to adhere to foliage and not run into surface water or drainage systems.

Mechanical Treatments

Mechanical treatments for fir engraver often can be effective, but also time-consuming and costly, and may not be practical or effective for all situations. It is important to research the best possible management option for a specific area before taking action.

Several options are effective for the treatment of existing fir engraver beetle infestations in individual trees. Infested trees can be:

- Felled, and the bark then burned in place, or the bark can be peeled and then burned. Chipping the wood, or removing the bark from the infested bole of the tree to expose and desiccate developing larvae also is effective. Cutting, splitting and stacking wood to dry out the growing conditions for developing larvae also will work if performed early enough in the developing stage of the larvae, well before they prepare to pupate.
- Felled, limbed, bucked into workable lengths and then left exposed to the sun on a south-facing slope or other area with ample sunlight. Logs must

be rolled every few days to expose all infested portions of the logs to direct sunlight. Timing also is important, to allow enough exposure to sunlight and heat to dry out the layers under the bark so developing larvae do not mature.

- Cut into logs and then submerged in water for at least six weeks. Log ponds at sawmill sites are an excellent place to practice this tactic.

Effective treatment of larger outbreaks is more complicated and may be constrained by lack of access, steep terrain or special land use designations, such as in wilderness areas.

Forest management efforts designed to maintain healthy forests offer the best long-term solution for dealing with fir engraver beetles, by creating conditions that inhibit outbreaks of this and other bark beetles. These include:

- Regular removal of diseased, injured and decadent trees from stands or management areas.
- Ongoing thinning of overly dense stands to reduce tree competition and increase stand vigor.
- Removal of windthrown and harvested trees within one year, before attacking beetles have sufficient time to produce new broods.

Impacts of Fir Engraver Beetle in Colorado's Forests

As is the case with all of Colorado's aggressive bark beetles, fir engraver is capable of killing trees over extensive areas. Yet fir engraver is a native insect – an integral part of Colorado's mixed conifer ecosystems – and plays a key role in the dynamics of these ecosystems. Outbreaks can, however, adversely affect the wide range of benefits that humans receive from forests.

Adverse effects of fir engraver outbreaks can include:

- Large numbers of bark beetle-killed trees increase the volume of dead fuels and, therefore, the potential intensity of wildfires.
- Dead trees pose a hazard of falling, to hikers, cross-country skiers and other outdoor recreationists.
- Large expanses of dead trees cannot intercept or absorb precipitation, or protect the soil from erosion, as well as live trees, which may affect timing of water yields and water quality.

Changes in forest structure and species composition resulting from bark beetle outbreaks can also affect wildlife behavior. Many migratory songbirds breed in mixed-conifer forests, where white fir is a component. A reduction in white fir in these mixed stands may negatively impact some songbird species.



Figure 11. Trees killed by fir engraver beetle are marked to be cut down on a homeowner's property. Photo: Dan West, CSFS

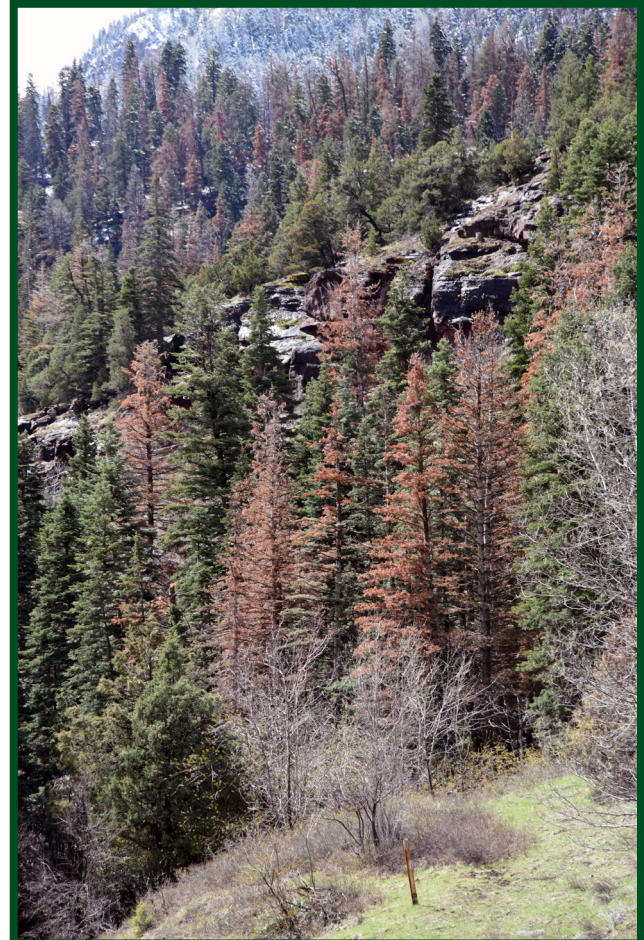


Figure 12. White fir trees, the fir engraver's only host in the state, in southern Colorado. Photo: Dan West, CSFS



Figure 13. A vista near Ouray, Colo.
Photo: Dan West, CSFS

Elk use mixed-conifer forests, particularly during calving season and in summer. Beetle-caused mortality of white fir may remove important thermal cover and alter elk and deer behavior in these impacted forests. However, tree mortality that opens up the forest canopy can increase forage for these species.

For More Information

For more information about fir engraver beetle and its management, contact a local Colorado State Forest Service district office or visit the CSFS website at www.csfs.colostate.edu

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