



Douglas-fir Beetle

About Douglas-fir Beetle

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is the most destructive bark beetle of mature Douglas-fir forests in western North America. It is a native insect found throughout the range of its only host tree, Douglas-fir, from southern Canada to northern Mexico. Douglas-fir beetle usually kills only small groups of trees, but during major outbreaks groups of 100 or more infested trees are not unusual. Infested trees may occur on a landscape-scale across multiple drainages during outbreaks.

Outbreaks tend to be associated with mature Douglas-fir forests, especially following extended periods of below-normal precipitation. Wind-thrown and downed trees often create suitable habitat for Douglas-fir beetle infestations, and subsequent generations later attack standing trees, in a pattern similar to that of its close relative, the spruce beetle (*Dendroctonus rufipennis*). Several factors can weaken and predispose trees to attacks by Douglas-fir beetle. These include: prior outbreaks of defoliating insects, such as western spruce budworm (*Choristoneura freemani*) and Douglas-fir tussock moth (*Orgyia pseudotsugata*); low-intensity wildfires; the presence of root disease, caused by several species of fungi; and heavy infestations of Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*).

In Colorado, outbreaks typically occur in the southern part of the state, especially in portions of the Rampart Range, Wet Mountains, Sangre de Cristo/Culebra ranges, La Garita Range, West Elk and Elk mountains, and the southern slopes of the San Juan Mountains.



Figure 1. A tree killed by Douglas-fir beetle. Photo: Dan West, CSFS



Figure 2. Douglas-fir tree cones are characterized by three-pronged "tails" jutting from between the scales. Photo: William M. Ciesla

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Figure 3. Douglas-fir beetle larvae underneath the bark. *Photo: Malcom Furniss, www.bugwood.org*



Figure 4. An adult Douglas-fir beetle. *Photo: William M. Ciesla*

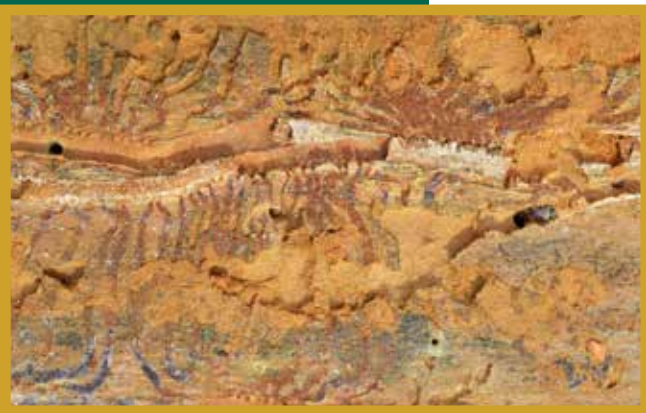


Figure 5. Galleries created by Douglas-fir beetle. *Photo: William M. Ciesla*

Life History

Douglas-fir beetles typically produce one new generation per year. Adults and some larvae survive the winter months under the bark of infested trees. The overwintering adults begin to emerge in April and May, when temperatures consistently exceed 60 degrees F, and continue to fly and attack new trees until early June, depending on local conditions. Adults that emerge early may make a second attack later in the summer, typically from late June through August. Individuals that spent the winter as larvae typically emerge as adults in July or August.

Adults are stout, cylindrical beetles less than ¼-inch (4-6 mm) long, or smaller than a grain of rice. The head and midsection are black and the elytra (wing covers) are typically reddish-brown. Adult females typically initiate an attack on new host trees, and mating then occurs near the entrance hole bored through the bark, by pairs that are monogamous. Males subsequently guard the hole after mating, while under the bark the female constructs a single egg gallery parallel to the grain of the wood, ranging in length from 8 to 10 inches and tightly packed with frass (boring dust). Females deposit eggs singly in small niches along one side of the gallery, then alternate sides and continue to deposit eggs, repeating the alternating pattern along the gallery. Eggs hatch within one to three weeks.

Larvae are white, C-shaped, legless grubs with an amber-colored head capsule. After hatching, they mine side galleries perpendicular to the egg gallery and parallel to one another. The larvae pass through three growth stages, also called “instars,” and when they finish feeding, they construct pupal cells at the end of their respective galleries. They then pupate, assuming a white to tan color and may have some adult features, like wings folded beneath the abdomen. By late summer, most have transformed into adults to overwinter.

Signs and Symptoms of Infestation

The most apparent indicators of Douglas-fir beetle infestation are small groups of dead and dying Douglas-fir trees. When a tree is dying from Douglas-fir beetle, its needles fade from green to red-brown before starting to drop off. Fading foliage occurs about one year after trees have been attacked, typically after adult beetles have emerged.

Other symptoms of Douglas-fir beetle infestation may include:

- The presence of reddish-brown boring dust around the base of trees and within the cracks and crevices of the bark.
- Streaming resin along the main trunk (not always present), usually white and/or clear in appearance.
- Vertically oriented galleries under the bark, with alternating larval side galleries.



Figure 6. Boring dust from beetles entering a tree. Photo: Dan West, CSFS



Figure 7. Resin streaming from a Douglas-fir tree. Photo: Sam Pankratz, CSFS

- Woodpecker damage, where the birds have stripped portions of the bark from infested trees in search of larvae, leaving accumulations of bark at the base of trees.
- Exit holes on the bark surface, after the adult beetles emerge from infested trees.

Douglas-fir beetle also may be associated with attacks by Douglas-fir pole beetle (*Pseudohylesinus nebulosus*). However, the Douglas-fir pole beetle often attacks smaller-diameter (less than 6 inches) Douglas-fir trees or the tops of trees.

Natural Controls

The natural resistance of healthy, vigorous Douglas-fir trees is the primary factor preventing the development of major Douglas-fir beetle outbreaks. As trees become stressed by drought, insects defoliating the tops of the trees, wildfire and/or the weakened resistance of advanced age, they become more susceptible to attack.

Natural enemies of Douglas-fir beetle include a variety of parasitic wasps, flies and predatory beetles. Some mites and nematodes also parasitize various life stages of the beetle, and woodpeckers will strip bark from infested trees in search of developing insects. However, natural enemies tend to have little or no real effect on beetle populations during major outbreaks.



Figure 8. Douglas-fir trees often grow on steep terrain, creating management challenges. Photo: CSFS

Management/ Prevention



Figure 9. Sam Pankratz, forester at the CSFS Gunnison Field Office, uses a hatchet to look for beetles underneath the bark. *Photo: Ryan Lockwood, CSFS*

Ongoing management of Douglas-fir forests is the most effective long-term strategy for reducing tree losses from Douglas-fir beetle. Thinning overly dense stands of trees, to reduce the competition between trees, is the most successful forest management strategy to promote tree vigor. Other harvesting strategies may include the removal of:

- infested trees and slash, by no later than May the year following an attack by Douglas-fir beetle
- wind-thrown trees susceptible to Douglas-fir beetle infestation
- trees already infested by other insects and diseases
- excess numbers of older trees, as the beetles most frequently attack the largest trees first

When possible, trees infested by Douglas-fir beetle should be considered for harvest and processing into wood products as soon as they are detected. This can help reduce management costs.

When considering any treatment for Douglas-fir beetle, choose an option that best meets your individual management objectives. Treatments often can be effective, but also time-consuming and costly, and may not be practical or effective for all situations. It is essential to research the best possible management option for a specific area before taking action.

Besides long-term forest management strategies, other more immediate management options include the use of pheromones, preventive sprays, solar treatments, trap trees, and mechanical treatments of infested wood.

Pheromones

Pheromones, which are chemicals used by beetles for communication between individuals, regulate the behavior of attacking Douglas-fir beetles. These chemicals have been synthetically reproduced for management use, demonstrating some success to deter attacks on individual trees and stands of Douglas-fir.

Packets containing the pheromone Methylcyclohexanone (MCH) disrupt the attraction of incoming beetles and can be used to reduce attacks on Douglas-fir trees. Packets are attached to un-infested trees and should be applied to trees before adult beetles begin to emerge, which in Colorado is typically April or May. These packets can be purchased through retail vendors, but it is recommended to work with a local forester to assist in designing the layout for pheromone application.



Figure 10. An MCH pheromone packet. *Photo: Dan West, CSFS*

Preventive Sprays

The use of insecticides has proven effective in preventing Douglas-fir beetle infestation. Certain formulations of carbaryl and pyrethroids that are registered and have been tested for effectiveness are the primary insecticide sprays used to help reduce the likelihood of attacks on individual trees. The Colorado State Forest Service (CSFS) recommends spraying only high-value trees, such as those near homes, businesses or recreation sites, and not using insecticides to treat at a stand level. Overuse of insecticide sprays may have negative environmental impacts on water supplies and wildlife; also, these sprays are not cost-effective on a landscape scale. Before using preventive chemical sprays, consider the following guidelines.

Insecticide sprays may be effective if applied to living, green trees:

- in the late spring, before adult emergence
- in the fall, if access to the site would be difficult in the early spring
- in the proper dosage and mixture
- annually
- consistently, to cover the entire tree

Insecticide sprays will NOT be effective if:

- applied to trees already infested with Douglas-fir beetles
- applied in improper dosages or mixtures
- significant rainfall or very high air temperatures occur immediately after application
- chemicals are not properly stored before use

If planning to use preventive sprays, carefully read all label precautions before application. The CSFS recommends that preventive sprays be applied only by a certified applicator.

Solar Treatments

Solar treatments can be used to reduce Douglas-fir beetle populations in infested stands. These treatments involve felling infested trees and stacking cut logs in an area with full sun before covering them with clear plastic. The solar treatment of infested trees creates conditions unsuitable for survival of Douglas-fir beetles, forcing them to either relocate or die. The temperature



Figure 11. Solar treatments are a possible management option for beetle-killed trees, in areas with ample sunlight. *Photo: Carolina Manriquez, CSFS*



Figure 12. Trees removed due to Douglas-fir beetle attacks often can be processed into wood products. *Photo: Carolina Manriquez, CSFS*



Figure 13. Douglas-fir beetle-killed trees at the Howelsen Hill Ski Area in Steamboat Springs. *Photo: Carolina Manriquez, CSFS*

under the bark must reach a minimum of 110 degrees F for this treatment to effectively reduce beetle populations, and turning the logs periodically is essential for all of the bark to reach this temperature. Solar treatments can be challenging, because forests with Douglas-fir often are cool, moist and shady, without ample sunlight. Talk to your local CSFS forester to determine if this is an appropriate treatment for your area.

Trap Trees

Trap trees are another management option that can prevent the spread of beetle populations. These trees serve as traps for recently emerged, adult beetles. Trap trees are suitable hosts intentionally baited with a Douglas-fir beetle attractant chemical. After the trap trees become infested with beetles, trees are removed and destroyed, usually during the fall or winter, while all of the Douglas-fir beetles are still inside. This strategy effectively reduces the population level of the next generation. The method is effective, but requires a significant amount of time and effort to plan, monitor and safely remove trees in a timely manner. Many variables must be considered, including the number of trap trees per acre, tree diameter and timing for tree cutting and removal. It is highly recommended that a local forester be contacted before using this treatment option.

Mechanical Treatments

Mechanical treatments, such as felling trees and subsequently chipping the wood and/or burning the resulting slash piles, are another management option; however, it is often difficult to utilize the proper equipment on steep, remote terrain. Debarking is another mechanical means to kill developing larvae under the tree bark. This is a labor-intensive method that involves peeling away the bark by hand or using machinery. Logs also can be

buried under at least 8 inches of soil to trap the beetles inside. However, debarking and burying logs often are not feasible options in forests with Douglas-fir, again because of the terrain.

Impacts of Douglas-fir Beetle on Colorado's Forests

Douglas-fir beetle is a native insect, playing an integral part in Colorado's mixed-conifer ecosystems. But the beetle is capable of killing many trees over large areas, and adverse effects may result:



Figure 14. Beetle-killed trees in the Black Canyon of the Gunnison. *Photo: Dan West, CSFS*

The Importance of Forest Management

It is important to remember that the Douglas-fir 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 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 related threats, to ensure healthy, resilient forests for present and future generations.



Figure 15. Beetle-killed trees can be hazardous, especially in recreation areas or places that people frequent, and often need to be removed. *Photo: Carolina, Manriquez, CSFS*

- Large numbers of beetle-killed trees can increase the volume of dead and dried fuels and, therefore, the intensity of wildfires, should an ignition occur.
- Standing dead trees pose a falling danger to hikers, campers, cross-country skiers and other recreationists.
- Large numbers of dead trees can affect water yields and quality, increase soil erosion, and reduce soil stability.
- Changes in habitat caused by Douglas-fir beetle outbreaks may adversely affect wildlife. For example, many migratory songbirds breed in mixed-conifer forests where Douglas-fir is a component, and elk use the forests extensively throughout the year, especially during calving season.
- Regeneration of Douglas-fir forests after an outbreak may be slow on some sites because of steep slopes, the lack of open mineral soil.



Figure 16. Douglas-fir trees are often a component of larger mixed-conifer forests. *Photo: CSFS*

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For More Information

For more information on Douglas-fir beetle, other forest insects and general forest management, contact a local Colorado State Forest Service district office or visit the CSFS website at www.csfs.colostate.edu.

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Figure 17. Among aspen stands are forested areas with Douglas-fir beetle-kill in the West Elk Mountains near the West Elk Wilderness. *Photo: Sam Pankratz, CSFS*



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