



# Western Spruce Budworm

## About Western Spruce Budworm

Western spruce budworm (*Choristoneura freemani*) feeds upon and defoliates Douglas-fir, true fir (e.g., subalpine fir and white fir) and spruce trees. Damage is caused by larvae feeding on the buds and current year's foliage, causing a reddish-brown hue in the tips of branches and treetops. This native insect occurs over much of western North America, from southern Alberta and British Columbia south to California, Arizona and New Mexico, making it the most widespread and damaging defoliator of western forests. During outbreaks that can last for more than eight years, millions of acres of forest can suffer defoliation. Colorado has historically seen extensive outbreaks of western spruce budworm in most of its mixed-conifer forests with a Douglas-fir component.

## Life History

Western spruce budworm produces one new generation per year. In Colorado, adults typically are active in July and deposit approximately 150 eggs in masses usually containing 25 to 40 eggs on the underside of host tree needles. Individual eggs are oval, light green, and about the size of a pinhead, and overlap one another like shingles. They hatch in approximately 10 days.

The very young larvae, which are yellow-green with brown heads, do not feed but instead create a structure known as a *hibernaculum*, or self-made silken shelter, under bark crevices or lichen. They then spend the winter in this structure. The larvae again become active the following April or May as the buds of host trees begin to expand and provide a food source. The full-grown larvae are 1 to 1¼ inches (25-32 mm) long with a tan or light chestnut-brown head area, and olive or red-brown body with large ivory-colored areas. These caterpillars feed on the tree buds and flowers for a short period before boring into and destroying the expanding buds. As the larvae grow, they leave the buds to feed on the remaining foliage and shoots. Using silk, they web together the tips of branches and feed on needles within that webbing, providing them with protection from predators. Here they feed in high numbers until most or all of the new growth is destroyed. Feeding is usually completed by mid-summer.

Mature larvae tie the tips of twigs or foliage together with silk and pupate on the branch tips or elsewhere on the tree. Pupae are about ½-inch (13 mm) long and yellow-brown in color when first formed, later turning to red-brown. Pupation lasts about 10-15 days, followed by emergence of the adult moths.



**Figure 1.** Tree mortality from western spruce budworm in Grand County. *Photo: Matt Schiltz, CSFS*



**Figure 2.** Discoloration from larvae feeding on new foliage. *Photo: Dan West, CSFS*

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**Figure 3.** A caterpillar, or larva. Photo: Dan West, CSFS



**Figure 4.** A western spruce budworm pupa. Photo: Dan West, CSFS



**Figure 5.** An adult moth. Photo: William M. Ciesla



**Figure 6.** A larva ballooning on a strand of silk with associated severe defoliation. Photo: Dan West, CSFS

Adult moths are about ½-inch (13 mm) long, with a wingspan of approximately 1 inch (22-28 mm). Both sexes are similar in appearance, although females may be slightly larger. The wings are variable in color, ranging from gray to orange-brown; they also may be banded or streaked, and some individuals may have a conspicuous white dot on the wing margin.

## Signs and Symptoms of Infestation

Larvae feeding on the buds and new shoots of host trees cause discoloration of the foliage, progressing from the tops of trees downward. They often only partially feed on needles, which leaves them intact but causes them to dry out and turn red-brown in color. From a distance, this gives damaged trees and forests a thin, red-brown or grayish cast. Multiple successive years of infestation may cause nearly complete defoliation of infested trees.

## Natural Controls

Western spruce budworm populations are predominately regulated by natural enemies and adverse weather conditions. Pronounced fluctuations in temperature in late spring and early summer can cause populations to decline, by killing susceptible larvae or by freezing tree buds and causing them to starve. Larvae, pupae and adults also are all parasitized and preyed upon by several groups of insects and other arthropods, small mammals and various birds. More than 40 species of insects (namely wasps and flies) are known to parasitize western spruce budworm, and spiders, ants, snakeflies, true bugs (*Hemiptera* spp.) and the larvae of some beetles also feed on western spruce budworm life stages. Mammals including chipmunks and squirrels prey on western spruce budworms, as do birds including grosbeaks, warblers, thrushes, sparrows, fly-catchers, tanagers, siskins and waxwings. These natural enemies are responsible for significant mortality when western spruce budworm populations are low, but usually have a minimal effect during large outbreaks.

Weather conditions also may affect western spruce budworm populations in several ways. Small larvae can be blown from trees to the ground during high winds, where they die of starvation. Cool, wet conditions when larvae are active can slow the rates of feeding and development, and increase the length of time they are exposed to natural enemies. Warmer, drier conditions, on the other hand, can cause larvae to be more active and develop at a faster rate, potentially intensifying an outbreak.

During prolonged outbreaks, when tree stands are depleted of most foliage, the larvae may run out of food before they are ready to pupate and die en masse of starvation.

## Management/Prevention

When considering any treatment for western spruce budworm, 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 options for a specific area before taking action.



Mixed-conifer forests with a high proportion of Douglas-fir, true fir and/or spruce trees are susceptible to western spruce budworm outbreaks. Multi-storied stands, where regeneration of these tree species is abundant in the understory, are especially favorable for western spruce budworm outbreaks due to the ability of larvae to rappel out of large trees—a behavior known as “ballooning”—to land on younger trees and continue feeding.

### Forest Management Recommendations

Ongoing management of forests is the most effective long-term strategy for reducing tree losses from western spruce budworm. Approaches to managing the budworm focus on reducing the component of true firs and other host species in mixed-conifer forests, instead favoring non-host tree species such as pine and aspen. Other management recommendations include:

- Create wider spacing between trees to reduce the likelihood of larval dispersal to adjacent hosts.
- Remove young potential host trees growing under or directly adjacent to the canopy of older trees.

### Preventive Sprays

Western spruce budworm outbreaks over larger forested landscapes can be treated with aerial applications of the biological insecticide *Bacillus thuringiensis* (or Bt), which is often sold under the trade name “Foray.” Individual trees also can be treated from the ground using insecticidal sprays containing Bt (e.g., Dipel, Thuricide) or chemical treatments containing pyrethroids (Sevin), chlorpyrifos (Dusban), acephate (Orthene) or carbaryl (Sevin).

The CSFS recommends spraying only high-value trees, such as those near homes, businesses or recreation sites, and not using insecticides to treat more broadly 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. If planning to use preventive sprays, carefully read all label precautions before application. It is recommended that preventive sprays be applied only by a certified applicator.

## The Importance of Forest Management

It is important to remember that western spruce budworm 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 defoliator 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 7. Light defoliation. Photo: Matt Schiltz, CSFS

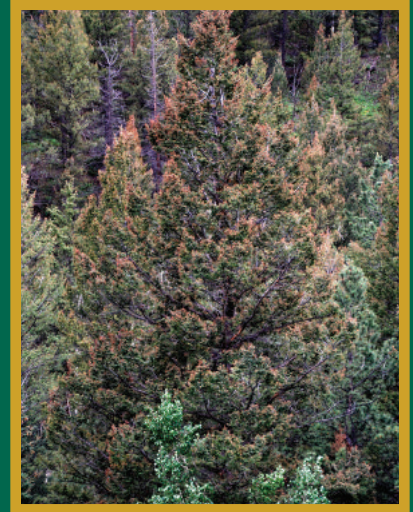


Figure 8. Moderate defoliation. Photo: Dan West, CSFS



Figure 9. Severe defoliation. Photo: Dan West, CSFS



**Figure 10.** Western spruce budworm defoliation in the Taylor River drainage, Gunnison County. *Photo: Dan West, CSFS*

## Impacts of Western Spruce Budworm on Colorado's Forests

Western spruce budworm is a native insect and an integral part of Colorado's forest ecosystems. Larger outbreaks, however, can cause extensive damage. Successive years of defoliation weakens trees and can cause reduced growth, top-kill, reduced cone crops and tree death over large areas. Western spruce budworm also is known to feed in and destroy cones of impacted trees. Additionally, trees weakened by defoliation may be attacked and killed by bark beetles such as Douglas-fir beetle (*Dendroctonus pseudotsugae*), spruce beetle (*Dendroctonus rufipennis*) or fir engraver beetle (*Scolytus ventralis*).

## For More Information

For more information on western spruce budworm and its management, contact a local Colorado State Forest Service district office or visit the CSFS website at [www.csfs.colostate.edu](http://www.csfs.colostate.edu).

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