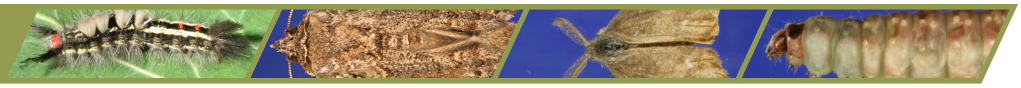
Natural Resources Canada | Ressources naturelles Canada

# Insect Production Services

http://www.nrcan.gc.ca/forests/research-centres/glfc/13467

version 2.1



## Biology of the Western Spruce Budworm (Choristoneura occidentalis)

### Introduction

The western spruce budworm, Choristoneura occidentalis, is a major defoliator of coniferous forests across western North America. Although western spruce budworm prefer Douglas-fir, they also readily attack white fir, blue spruce, Engleman spruce, western larch and western hemlock. Trees become weakened after four to five years of successive defoliation and may attract other insects and disease. Tree mortality occurs if trees undergo severe defoliation for six to eight years. The first recorded outbreak in Canada occurred on Vancouver Island, British Columbia in 1909. Epidemics of this species do not occur on a cyclic basis. Some outbreaks last only a few years and end naturally while others have persisted in the rocky mountains for up to 30 years in spite of all control tactics.

### Life Cycle

Western spruce budworm produce one generation a year (univoltine) and have four stages to their life cycle: egg, larva, pupa and moth. In July and early-August, females lay overlapping eggs in elongate rows on fir and spruce needles. These rows are two to three eggs wide and can contain up to 150 eggs per mass. The eggs are light green, oval and about 1mm long by 0.2mm wide. They hatch 7-14 days after oviposition. There are six larval stages (instars) before pupation. First-instar larvae are very small and light green in colour. Often times, the larvae will spin a thread of silk and get carried to other trees by the wind. This process of dispersal is termed "ballooning". These larvae do not feed, instead they immediately seek suitable shelter to overwinter, such as old flower bracts and cracks in bark. The tiny first-instar larvae spin silk shelters to wrap themselves in. Within this shelter, called a hibernacula, the larvae shed their skins and moult into yellow-orange coloured second-instars. During this overwintering stage, called diapause, they remain dormant until spring. In early May to June, before tree buds begin to expand, the second-instar larvae emerge from their hibernacula and move toward the tips of the tree branches. Early feeding occurs on staminate flower buds or old needles. Larvae will mine old needles until vegetative buds begin to expand. Once these buds swell, the larvae bore into them and begin feeding within the protection of the bud cap. Here, they moult into the third-instar and continue to feed until the buds expand. Fourth- and fifth-instars create feeding shelters and stay hidden by tying newly flushed needles together with silk until they have consumed the entire bud. Second-, third- and fourth-instar larvae are orange to cinnamon-brown in colour with black heads and black thoracic shields. Fifth-instar larvae are olive brown in color with 2 pairs of white spots on each body segment. They begin to have redidsh-brown heads but their thoracic shields remain black. Sixth-instar larvae have both red heads and red thoracic shields. They are 25 to 32 mm in lenth and their white spots are much

more distinctive. Once a bud is ingested, older instars will move to new shoots and then to other trees in search of food. It is at this stage that they are eating voraciously and are the most destructive. By late-June and July, larvae cease feeding and metamorphize into pupae, usually within old-year foliage. Around ten days later, adult moths emerge from late-June through to mid-July. They are small with characteristic "bell shaped" wings, reddish-brown to grey in colour with banded forewings and a white dot on each wing margin. Moths will mate and deposit their eggs preferably on a healthy tree. They are able to travel very long distances, especially if they are transported by wind or storms.

## Damage and Nuisance

The first sign of an infestation is the occurrence of silk webbing on branch tips. Also, bud caps will remain on infested shoots long after all others have been shed. In addition to foliage, larvae feed heavily on staminate flowers and developing cones. When an epidemic begins, most defoliation occurs in the top portion of the forest crown. Infested stands turn a reddish color because partially eaten needles on the tree start to die. Over time, these dead needles fall, tree tops turn grey and entire stands are eventually decimated when heavy defoliation persists over four or five successive years. Defoliation weakens trees and makes them more susceptible to other types of insect damage, diseases and harsh conditions such a drought. Commercially, spruce budworm outbreaks have the potential to seriously affect timber and non-timber boreal forest resources, reducing annual growth and timber volumes. Young trees in the understory often die after only three years of defoliation, greatly reducing future timber prospects and natural regeneration. In urban areas, large populations of western spruce budworm can greatly reduce aesthetic values of homes and recreational areas because they also attack ornamental firs and spruces.

## Natural Control

Natural factors such as disease, predators, parasites and adverse weather all play very important roles in controlling budworm. Natural preditors include spiders, beetle larvae, snakeflies and more than 40 species of insect parasites. Many bird species also feed on budworm including warblers, thrushes, sparrows, wax-wings and fly-catchers. Less than half of the larvae survive to adulthood, however, this amount could still lead to epidemics. Forest land owners have the option of integrating control tactics such as biological insecticides, silvicultural practices and chemicals. At the present time at least four natural viruses are endemic to North America including granulosis, entomopox, nucleopolyhedrosis and cyloplasmic polyhedrosis viruses. Use of these viruses as biological insecticides is considerably more expensive than chemicals and not always effective. However, the bacterial pathogen B.t. (Bacillus thuringiensis) is more cost effective and the most common biological insecticide used on crown land for budworm control today. Unfortunately, B.t. degrades in sunlight and washes away in rain easily so it offers a very narrow window for control. Climate conditions also greatly affect western spruce budworm survival. Cool summers reduce feeding and development, making larvae more vulnerable to parasites, predation and disease. Late freezing conditions in the spring will kill developing larvae and early freezes in the fall damage eggs before they have hatched.

## What can I do?

For private landowners, controlling budworm may prove difficult. The greatest problem is getting to the larvae because they stay hidden so well within needles, buds and feeding shelters. If there are small trees, few in number, manual removal is a possibility. If spraying is necessary, B.t. is available at most gardening centers and is much safer to use than chemicals. Spraying chemical insecticides might also greatly affect natural budworm predators and non-target species, so read the label carefully and follow instructions stringently before using such products.

## Contact

John Dedes, Insectarium Supervisor
Canadian Forest Service, Great Lakes Forestry Centre
1219 Queen Street East
Sault Ste. Marie, ON P6A 2E5
(705) 541-5673
john.dedes@nrcan.gc.ca