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FOREST Pest LEAFLET

Pacific Forestry Centre

# Spruce budworms

By L.S. Unger

## Introduction

Spruce budworms, *Choristoneura* species (Lepidoptera: Tortricidae), are destructive defoliators of conifers. The first recorded outbreak in British Columbia was in 1909, and since then infestations have occurred in all forest regions.

Severe defoliation results in reduced increment, deformity, dieback, mortality of regeneration, and some mortality of merchantable trees. Additional trees may be killed by secondary pests such as bark beetles during and following infestations due to the predisposition of defoliated trees.

Four species of *Choristoneura* are important in British Columbia: *C. occidentalis* Freeman (western spruce budworm, or western budworm), *C. biennis* Freeman (2-year-cycle budworm), *C. fumiferana* (Clemens) (spruce budworm), and *C. orae* Freeman.

## Hosts and distribution

The spruce budworms native to North America are found throughout most of Canada and the northern United States. In British Columbia, all age classes of Douglas-fir, true firs, and spruce in multilevel stands are preferred, but larch, hemlock and pine are occasionally attacked. *Choristoneura occidentalis* inhabits the coast, montane and Columbia forest types of southern British Columbia on Douglas-fir, amabilis fir and grand fir. *Choristoneura biennis* occurs in the subalpine and boreal forest types of the interior on alpine fir and the white spruce-Engelmann spruce complex, to the west of the Rocky Mountains. *Choristoneura fumiferana* occurs in the boreal forests of northern British Columbia, mainly on alpine fir and the white spruce-Engelmann spruce complex.

larva

*Choristoneura orae* is found in the rain shadow of the coastal mountains in northwestern British Columbia and the southern Yukon, particularly around Kitimat and Prince Rupert, mainly on spruce, true fir and low-elevation western hemlock.

Other minor species occur in British Columbia, although only *Choristoneura lambertiana*, which feeds on pine in southern British Columbia, has been named. Undescribed budworms have been noted in southwestern British Columbia, and in north-central British Columbia.

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## Description

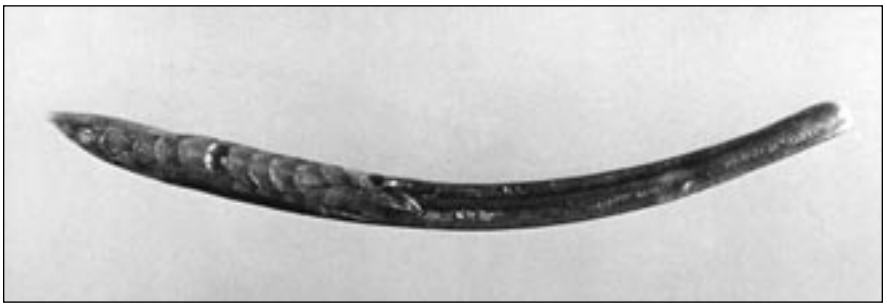
**Egg**: Eggs are pale yellow-green, oval, about 1.2 mm long, and are laid in masses consisting of two to several rows of overlapping eggs.

**Larva**: Larvae develop through five to six stages (instars), with body colors changing from yellow-green to orangy brown to dark brown. Mature larva are about 25 mm long, with a robust, pale to dark brown body, sometimes with a distinct greenish tinge; each body segment has four conspicuous light spots on the upper surface. Head coloring varies with species but is generally light to dark brown or black.

**Pupa**: Pupae are about 14 mm long, slightly curved, and tapered from head to tail. Coloration varies from brown to almost black, with blotches, bands and traces of larval spots.

**Adult**: Moths are about 13 mm long, with a 15-25 mm wingspan. Fore-wings are grey to brown and overlaid with similarly colored bands, spots and blotches. Hind-wings are buff or light to dark grey. Male and female moths are similar in appearance, but females are more robust than males. Both sexes fly.

adult



egg masses

## Life history and habits

*Choristoneura fumiferana* and *C. occidentalis* take one year to complete their life cycle, *C. biennis* takes two years, and *C. orae* develops in either one or two years.

### One-year cycle

Moths emerge from mid-July to early August, mate, oviposit and die within two weeks. Moths fly mainly at dusk. Females each deposit about 150 eggs in flattened shingle-like masses on the undersides of needles. The eggs hatch within 12 days. Newly hatched larvae do not feed, but seek shelter among lichens, under bark scales, and in flower and needle scars. They spin silken webs (hibernacula) and overwinter as second-instar larvae. Larvae become active in mid to late May, either mining needles until the buds begin to swell or mining expanding flower and foliage buds. As shoots elongate, larvae spin loose webs about the new foliage and shoots, which are used as feeding shelters. If the new foliage has been destroyed, larvae will feed on old foliage. Budworms pupate within webbed foliage from late June to mid-July and adults emerge 12-18 days later.

### Two-year cycle

Moths mate and lay eggs during July and August every second year. Newly emerged larvae construct a shelter where they overwinter during their second instar. Larvae reappear from late May to early June, mine needles and buds for 3-4 weeks, spin hibernacula and overwinter as fourth-instar larvae. Development is completed the following spring and summer. Most two-year-cycle budworms in British Columbia reach the adult stage in even-numbered years (1992, 1994), but in several areas in the province, such as in the Purcell Mountains, they reach the adult stage in odd-numbered years.

## Damage

Early-instar larvae mine and kill the buds and developing cones. Late-instar larvae are voracious and wasteful feeders, often consuming only parts of needles, chewing them off at their bases. Most new and old foliage as well as cone crops may be destroyed in severe infestations. Tree tops and branch tips are usually the most severely defoliated crown areas. If severe defoliation continues for several years, height and radial increment

larva

loss, tree deformity, top-kill and even tree mortality will occur. Weakened stands may become susceptible to bark beetle attack.

Budworm populations favor multi-storied, overstocked, older stands composed of more shade-tolerant tree species. In these stand types, even moderate budworm populations can cause severe damage, including mortality, to the intermediate and understory trees, i.e. the future crop trees. Larvae dropping down from the upper canopy are intercepted by the intermediate and understory trees, and the heavy-feeding, late-instar larvae quickly consume the limited amount of foliage on these trees.

## Detection

Large moth flights will often be evident during July and early August. Egg masses can be found on the underside of host tree needles from late July to mid-August. Empty whitish egg masses persist for several months or into the following year on the needles. The small larvae overwinter in silken hibernaculae in bark crevices, scars, and lichens. They can be found by a careful search in these areas, or they can be extracted from the substrate with a wash of weak NaOH solution.During late May and early June the small larvae can be found mining in needles and expanding buds. Mature larvae are readily found within webbed foliage from mid-June to early July. They are sensitive to disturbance and readily drop from their feeding sites. Pupae are formed in webbed foliage from late June into August and the empty cases remain evident on the branches for several months.

Defoliation, reddish-brown foliage and webbed branch tips may be noticeable from June through August. Severely defoliated crowns may appear reddish purple.

pupal case

## Natural control

The budworms have numerous parasites and predators, and a number of viral and fungal diseases in combination with climatic conditions usually regulate populations. If outbreaks persist for an extended period, starvation can become an important factor contributing to the decline of the population. During the early larval stage, budworms are vulnerable to windy conditions which can dislodge and disperse them, and to late spring frosts which can freeze them or destroy their food supply. Low winter temperatures have little impact on overwintering larvae.

## Management

Chemical insecticides can reduce budworm populations and provide short-term protection for individual trees or large stands. Application of the naturally occurring microbial insecticide *Bacillus thuringiensis*, a bacterial pathogen specific to lepidopterous insects, can provide protection for sensitive areas. Silvicultural practices that reduce the likelihood of major infestations and minimize the severity of infestations that do occur include (i) developing even-aged stands with a single crown stratum, (ii) maintaining a relatively open stand density, (iii) establishing tree species diversity including less susceptible species, (iv) maintaining a vigorous stand, and (v) harvesting prior to stand growth culmination.

## Selected references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severe defoliation


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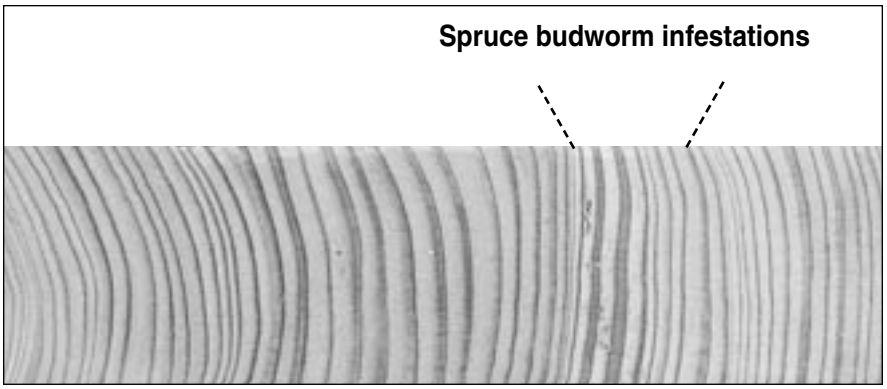


annual incremental impact

understory defoliation and mortality

## Additional Information

Additional copies of this and other leaflets in this Forest Pest Leaflets series, as well as additional scientific details and information about identification services, are available by writing to:


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