

be warranted on big trees with high larval population densities.

For the most recent information on insecticides available for control of this pest, call Agriculture and Agri-Food Canada's Plant Industry Directorate in Ottawa (toll-free) at 1-800-267-6315.

Insecticides are dangerous materials that may be toxic to humans, other mammals, birds, fish, and beneficial insects. Follow all instructions and precautions listed by the manufacturer when using toxic materials.

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## Bruce spanworm



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## Distribution and Hosts

The Bruce spanworm, *Operophtera bruceata* (Hulst), is native to North America. It is distributed from coastal British Columbia, through Alberta, and east to Newfoundland. In the United States it has been recovered from the Lake States to the New England states. It has also been reported from Greenland. The winter moth, *Operophtera brumata* (Hulst), which was accidentally introduced to the east and west coasts of Canada, is easily confused with the native Bruce spanworm, with which it seems to hybridize. At least 19 genera of woody plants have been listed as hosts of the Bruce spanworm. In the prairie provinces, the principal host is trembling aspen, but willows, balsam poplar, Manitoba maple, choke cherry, Saskatoon, currants, and wild roses are also hosts. Although sporadic outbreaks of the Bruce spanworm have occurred in various regions of Canada, fairly large outbreaks have occurred on trembling aspen in western Alberta in 1903 and 1913. More recently, outbreaks have been recorded toward the end of each of the last 4 decades. At its peak, an outbreak in 1958 covered 130 000 km<sup>2</sup> of aspen forest. This outbreak began with a buildup of populations in 1951, but had declined by 1960. In general, severe defoliation of aspen forests lasts 2–3 years.

## Symptoms and Damage

The Bruce spanworm begins feeding by mining developing aspen buds in the spring. When the leaves expand, this damage appears as holes in leaves. As the leaves expand, larvae feed openly on the leaves. In some cases, larvae roll or web leaves together while feeding. If they destroy the entire leaf crop, larvae often depart from the tree on silk strands. The trees then appear to be covered with a silken shroud. This silk is often found on understory vegetation as well.

Defoliation of trees during outbreaks results in reduced tree growth; however, outbreaks are short-lived and tree mortality is seldom of consequence. Bruce spanworm outbreaks can coincide with outbreaks of other aspen defoliators. Under these conditions, tree mortality can occur if severe defoliation is prolonged for several years.

## Causal Agent

The male moth has a light-brown body with brown and grey banded semitransparent wings. The body is 7–10 mm long and the wing span is 25–30 mm. By contrast, the female is flightless because its wings are reduced to small pads. The females are covered with large dull-brown scales, which give them a furry appearance.

Orange-colored eggs are laid individually in bark crevices and in lichens on trees in the fall. They overwinter and hatch in the spring when aspen buds begin to swell. The larvae spin down from branches on silk filaments and, if they do not encounter a suitable feeding site, may be carried off by the wind. This is the only means of dispersal because the female moth is flightless. Larvae have been recovered "ballooning" 800 m away from the nearest host trees.

The larval stage lasts for 5–7 weeks. Larvae molt 3 times before pupating. The hatched larva (first instar) is 2 mm long with a pale-yellow body. All instars have two pairs of abdominal prolegs. The larvae move by alternately arching the abdomen, moving the prolegs up to the thoracic legs, straightening the body by moving the thoracic legs forward, and repeating the process; hence the name spanworm. The second instar is one of two color phases, both of which can be found in a single population. This color difference becomes more and more pronounced as the larvae mature. At maturity, in the fourth

instar, one phase is light green with thin, white longitudinal lines on the body. The other phase is dark brown with the same striped pattern. At this stage the head capsule of the mature larva is 1.25–1.7 mm wide and the body is 18 mm long.

Pupation occurs in the latter half of June after larvae migrate to the ground and spin a light silken cocoon in the forest floor. On warm days in late fall, after frosts have occurred, adults emerge from these cocoons late in the afternoon or early evening. Females climb the trunks of trees and males are capable of flight at low temperatures. (*O. bruceata* and *O. brumata* are known as winter moths for this reason, although the specific common name of winter moth only applies to the latter.) The female moths release a scent (pheromone), which attracts males for mating. Eggs are laid shortly afterward to complete the 1-year life cycle.

## Prevention and Control

There are many natural enemies that affect Bruce spanworm populations. It is thought that parasites are important in controlling populations between outbreaks, though they seem ineffective in regulating populations once an outbreak has begun. A nuclear polyhedrosis virus (NPV), which was associated with collapsing Bruce spanworm populations, was discovered in Quebec. This NPV was unknown in the west. It has since been introduced with moderate success to a small population as an experimental control agent. The high cost of producing the virus, which is specific to the host, has precluded its development for commercial application.

Historically, outbreaks have not lasted more than 2 years, with little tree mortality. There does not seem much value in attempting to control this insect in forest situations. For ornamental trees, use of an insecticide might