

# FOREST Pest LEAFLET

## Balsam Woolly Adelgid

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#### Introduction

The balsam woolly adelgid, *Adelges piceae* (Homoptera: Adelgidae), was accidentally introduced to North America from Europe and has become an important pest of true firs in the Maritime Provinces, the Northeastern and Northwestern States, and southern British Columbia. The adelgid can damage and sometimes even kill a significant proportion of the true fir in a stand after a few years of infestation. In B.C., its impact on local forest economies has depended upon the significance of *Abies* sp. in forest stands.

#### Distribution

In British Columbia, the adelgid occurs up to about 1000 m elevation in lower Fraser Valley drainages east to Agassiz and, in patches, up the mainland coast to West Thurlow Island, north of Powell River. Positive samples in young amabilis fir have also been collected from Lizzie Creek on the east side of Lillooet Lake, and at

Tikwalis Creek on the west side of the Fraser Canyon near Hells Gate. On Vancouver Island, infested trees are found in east coast drainages from Victoria to Qualicum Beach and just south of Port Alberni. Infested and damaged trees have also been found on Lasqueti and Hornby islands. Several of these locations were beyond known infestations and the 1976 regulation zone. As a result, on October 22, 1992, new boundaries were drawn up and a revised

quarantine zone established by provincial Order in Council. Some highlights of the regulations accompanying the revised zone are: annual permits are required to grow and sell *Abies* spp. in British Columbia; the movement of *Abies* spp. from within the zone to outside the zone is prohibited, only logs transported and stored in water and processed promptly are exempted; the selling or movement of cut trees or foliage of *Abies* spp. anywhere in

B.C. between January 31 and November 1 of a calendar year is prohibited. The revised quarantine zone, related to present distribution, lies mostly within the southern part of the Vancouver Forest Region (Fig. 1).

The insect does not appear to have spread rapidly to adjacent stands, which is, in part, attributable to the quarantine restricting the movement of host material within the Province. Presumably it is capable of spreading over much of the range of its hosts, as demonstrated in Idaho where the adelgid,

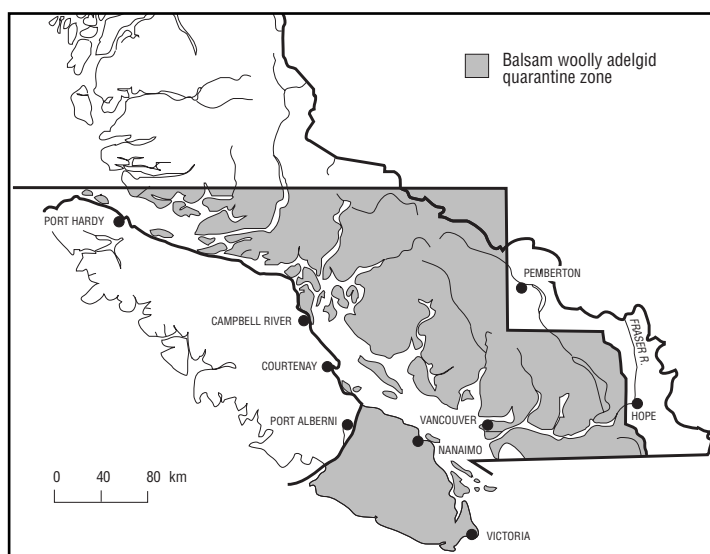


Figure 1. Quarantine zone (1992 Order in Council) for balsam woolly adelgid in British Columbia.



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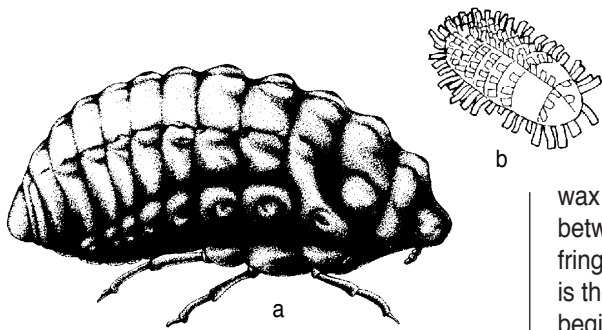


Figure 2. Balsam woolly adelgid: (a) Adult with waxy "wool" covering omitted from drawing, (b) first-stage resting or overwintering form.

first found in 1983, has spread throughout much of the state. It was recently detected in lower elevation grand fir and also in alpine fir stands up to 1800+m elevation. Although it is generally believed that the adelgid does not survive temperatures below -34°C, unless protected by snow at the lower parts of tree boles, the Idaho experience with high elevation grand fir mortality suggests the adelgid may be able to survive lower temperatures than previously suspected.

### Description and life history

Adult balsam woolly adelgids are aphid-like, wingless, oval, purplish-black insects (Fig. 2a), less than 2 mm long, covered with white, woolly, wax threads. The female (there are no males) may lay as many as 100 red-brown eggs in a cluster about her body. These hatch into tiny, red-brown first-stage nymphs or "crawlers," the only motile stage. After selecting a feeding location on thin bark, branch nodes, leaf or cone buds, the adelgid inserts its tube-like

mouthparts and remains at the chosen location for the remainder of its life. It becomes a black, flattened, resting form with a characteristic pattern of white

wax exudations along the midline, between the body segments, and in a fringe around its body (Fig. 2b). This is the overwintering form. Feeding begins after several weeks, or after overwintering, and the body becomes more rounded, resembling the adult. After three months, it becomes an adult and begins laying eggs. Eggs, young crawlers and adults are present from as early as February in coastal areas until October. There are two to four generations each year. At low population levels, detection is very difficult and requires microscopic examination of branch nodes.

### Damage

The insect inserts its mouthparts into the living cells of the bark, introducing substances that produce an

interaction with the tree. This results in a breakdown of normal translocation processes and eventually in abnormalities at the feeding sites. Twigs swell or "gout" at the nodes (Fig. 3) and the cambium produces wide, irregular annual growth rings consisting of reddish, highly lignified, brittle wood, similar to "compression wood," which reduces the quality of lumber and pulp. Heavy attacks on the bole or stem (Figs. 4,5), often results in tree death after 2 or 3 years, but it is not unusual for trees to recover. Gouted trees may survive for many years, but growth is curtailed. Crowns become distorted and thin as old needles are gradually shed and no new growth is added, while chronic attack can result in top-kill. Previous infestations in B.C. in the 1950s and '60s have caused extensive damage and mortality in *amabilis* and, to a lesser degree, grand fir. In Idaho, approximately 16 000+ ha of recent grand fir mortality were recorded during aerial surveys in 1989.

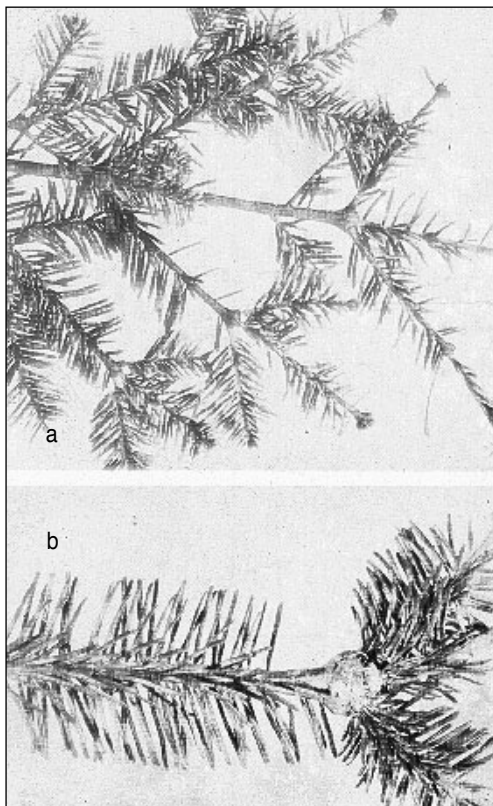


Figure 3. *Abies amabilis* foliage showing swellings or gout at nodes: (a) Branch with light gout, (b) close-up of twig showing heavy gout.

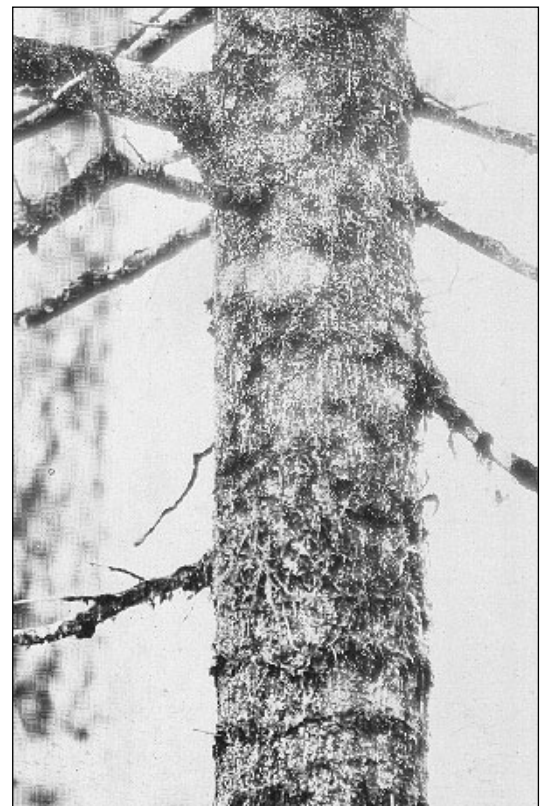


Figure 4. Medium stem attack on *Abies amabilis*.



## Host susceptibility

All species of true fir (*Abies* sp.) are susceptible, but some are less resistant to injury than others. Alpine fir (*A. lasiocarpa*) is the most readily damaged of the British Columbia species, but attacks on this host are not yet widespread in the province, although widespread damage and mortality has been found in high elevation stands in Idaho. Amabilis fir (*A. amabilis*) is the second most affected host and heavy mortality has occurred at certain sites on the B.C. mainland. Grand fir (*A. grandis*) is the least susceptible to damage of the major B.C. species, but can suffer appreciable deformation and mortality.

Trees of all ages and vigor, on all growing sites, may be attacked. Some trees are more resistant than others, but trees apparently free of attack for many years may suddenly develop a heavy population of adelgids and die.

## Detection

Balsam woolly adelgids may attack any part of the crown and bole but they are difficult to detect until symptoms of injury are well advanced.

Stems with as many as 100 adelgids per square cm of bark, although the most easily detected are infrequently found. The presence of live individuals may be confirmed by brushing the wool-covered bark and finding purplish streaks on the fingers. Stem attack occurs most frequently on smooth thin-barked trees, but is sometimes found in bark crevices of thicker-barked trees. It is most frequent on moderately exposed boles along roadsides, trails, edges of logged areas, natural stand openings and in parks. Small numbers of adelgids may be found in the summer by carefully searching the lower boles of trees for scattered wool spots.

Infestation in the crown is widespread in an infested area, but populations on individual trees vary a great deal. Swelling of the nodal

areas of infested branches may be more or less pronounced, and is usually greatest in the upper crown where growth is most rapid.

In summer, tufts of adelgid wool can be found by experienced searchers on the nodes and buds even when branches show no signs of injury. In winter, much less wool is present so the most practical method is to collect branch tips and have experienced examiners search for aphids under the bud scales with a microscope. Gouted seedlings and

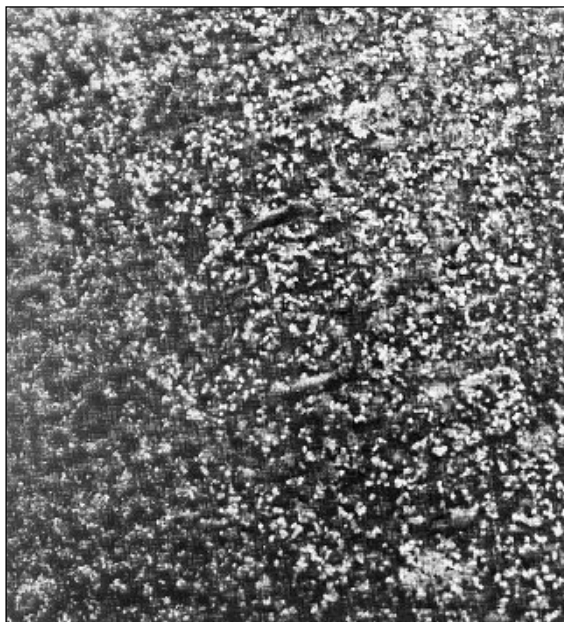


Figure 5. Close-up view of medium stem attack on bark. Each spot of white wool covers an aphid.

understory trees are an indication of infestation in the main stand above.

Persistent crown infestation results in visible thinning of the foliage, top-killing, broken tops and the eventual death of the tree (Fig. 6). Secondary enemies, such as bark-beetles, may hasten tree mortality. Trees experiencing damage may show thin crowns with strong growth on the extreme top, so infested crowns may exhibit a flat or bunched appearance. Trees that die within a year or two, from stem or twig attack compounded by secondary pests, have a red crown that is clearly visible from the air until the dead needles drop.

A related aphid (*Mindarus abietinus*) has been found on *Abies* in

British Columbia, and microscopic examination is necessary to positively distinguish it from *Adelges piceae*. This species does not cause significant damage to *Abies*. Lepidopteran borers also cause nodal swellings, but this damage can be identified by cutting through the node to expose the larval mine.

## Dispersal

Spread of the balsam woolly adelgid occurs during the egg and newly hatched nymph or crawler stages.

Experiments have shown crawlers to live over 8 days and to be capable of crawling more than 30 m. Eggs and crawlers fall or are blown from infested crowns during the spring, summer and fall and may be carried on clothing, vehicles, tents and other equipment. They have been found in traps 90 m from infested stands and are probably capable of being carried many kilometres by wind currents. They are also carried by birds and animals. Movement of infested logs, nursery stock and seedlings are other means of spread.

## Prevention of spread and control

Direct control of the balsam woolly adelgid in forest stands is impractical by methods known at

present. Because the adelgids are protected by their woolly covering and feed in protected sites, direct control (with pesticides, for example) is not practical.

Losses in forest stands can be minimized by selective and intensive cutting of *Abies* before serious tree mortality occurs and before dying trees become unsuitable for salvage. Preliminary results from studies in thinned stands in Newfoundland have shown increasing populations and damage, although little mortality, to date. Studies in these stands are continuing.

Natural enemies of the balsam woolly aphid, including parasites and predators, are not known to be



Figure 6. *Abies grandis* showing thin, deformed crowns which result from persistent attack.

effective in controlling populations.

Prevention of spread, via the quarantine regulation of 1992, offers the best possibility of minimizing impact of this pest. The regulation of tree and log movement also requires an intensive surveillance to ensure containment of the adelgid populations within its present limited distribution in B.C. Please follow the procedure for sampling (see below) should the presence of the balsam woolly adelgid be suspected in your area.

## Selected references

Balch, R.E. 1952. Studies of the balsam woolly aphid (*Adelges piceae* Ratz.) and its effects on balsam fir, *Abies balsamea* (L.) Mill. Canada Dept. Agric. Publ. No. 867, 76 p.

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Gast, S.; Beckman, D.P.; Livingston, R.L.; Gustin, J. January 1990. Distribution of the Balsam Woolly Adelgid in Idaho. U.S.D.A. Forest Service, Northern Region, Report 90-5.

McMullen, L.H.; Skovsgaard, J.P. 1972. Seasonal history of the balsam woolly aphid in coastal British Columbia. J. Entomol. Soc. B.C. 69: 33-40.

Mitchell, R.G. 1966. Infestation characteristics of the balsam woolly aphid in the Pacific Northwest. U.S. Forest Service PNW-35. 18 p.

Varty, I.W. 1956. Adelges insects of silver firs. Forestry Commission (Edinburgh) Bull. 26. 75 p.

## 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:

Natural Resources Canada  
Canadian Forest Service  
Pacific Forestry Centre  
506 West Burnside Road  
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## A Sampling Method for Balsam Woolly Adelgid (BWA)

A systematic sampling method for signs and symptoms of BWA can be used to estimate the level of infestation within infested areas and to determine spread outside a known infested zone. Trees can be examined and sampled at any time of the year.

### A. In Older Stands

1. Carefully examine trees crowns visually, using binoculars if necessary. Concentrate on the upper third of the crown, looking for symptoms such as:

- Thinning of foliage
- Twig gouting
- Stunted branch/leader growth
- Dead leader

2. Carefully examine recently windblown branches or slash for these symptoms.

3. Examine main stem for presence of white wool (sign of the adelgid), which

might be detected at heights to 10 m above ground.

4. Collect samples of all signs and symptoms possible. Record as much detail about the samples and the location as possible.

### B. In Young Stands and Advanced Regeneration

If BWA attack is suspected, collect branch samples and process as follows:

1. Using diagram below, collect branch nodes from two 2-to-11-year-old branches from the locations shown.

2. Repeat sample from a second tree, if possible.

3. Record and submit the following information:

- Collector's name
- Collector's address and phone number

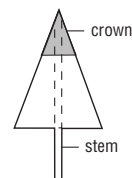
- location of the collection
- date of collection
- tree species
- Approximate elevation of the location (above sea level).

4. Submit specimens to address above, Attn: Insectary.

5. Please submit samples even if presence of BWA is uncertain; YOUR HELP IS APPRECIATED.

### Older stands

1. Check top 1/3 of crown carefully
2. Check main stem to 10 m from ground



### Branch

Collect and submit branch node samples from any two of these locations on two 2-to-11-year-old branches.

