



# Balsam Woolly Adelgid

## Basic Fact Sheet



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### Quick Facts

- Balsam woolly adelgid (BWA) was first observed killing subalpine fir in northern Utah forests in 2017; it is now confirmed in eight counties.
- BWA was first detected in the U.S. in 1908; through multiple introductions and spread, it now infests true firs over most of the country.
- BWA presence is difficult to detect until a tree is heavily infested and displays advanced symptoms (canopy decline, branch and node swelling).
- Controlling BWA with insecticides on forested lands is limited by high cost and other factors. Restoration aimed at developing host tree resistance is the most viable management option.
- BWA on individual or small groups of trees can be managed with insecticides applied during the summer and fall when the crawler stage is active.



Figure 1. A subalpine fir stand infested with balsam woolly adelgid.

The balsam woolly adelgid, *Adelges piceae* (Ratzeburg) (Hemiptera: Adelgidae), is a tiny sucking insect that was introduced to North America from Europe. In the U.S., it is a serious pest of true firs in forests, landscapes, and in seed and Christmas tree production. In some areas of North America, BWA has completely removed true firs from forest stands. In Utah, subalpine fir (*Abies lasiocarpa*) is a highly susceptible host tree; white fir (*A. concolor*) is also a host but is more tolerant. Douglas-fir (*Pseudotsuga menziesii*) is not a true fir and is not affected by BWA. The USDA Forest Service Forest Health Protection (FHP) team in Ogden first detected and confirmed BWA in the mountains above Farmington Canyon (Fig. 1) and near Powder Mountain Resort. It is now confirmed in Box Elder, Cache, Rich, Weber, Davis, Morgan, Salt Lake and Summit counties. Subalpine fir typically grows at elevations above 7,500 ft, and until now, has been one of the few forest tree species that has resisted large-scale pest infestations.

### TREE INJURY AND SYMPTOMS

Subalpine fir is at high risk for attack by BWA in Utah. Vigorous, mature trees 4 inches (10 cm) or more in diameter seem to be most susceptible, but saplings may also be affected. In the West, stem (trunk) infestations are most abundant on sites with higher quality soils and conditions, including lower elevations, while crown attacks occur more often on sites with poorer soils and at higher elevations. Damage is most severe in the first decade of infestation in an area; however, BWA will remain in an affected area indefinitely.



The insect (adult, egg, first instar) is most visible in the fall in Utah. Common crown symptoms include:

- yellowing, then bronzing, of needles on the inner branches
- lower crown dieback leaving a green top and/or “top curl” (Fig. 4)
- abnormal swelling of branch nodes and buds called “gouting” in response to adelgid feeding (Fig. 3)
- woolly material may be evident on tree bole, near the base of tree, and on branches (Fig. 2)
- reduced cone production and poor stand regeneration
- reduced growth, stunted trees and branches (Fig. 6)
- dead leaders

Stem or bole infestations tend to be more serious than crown infestations, and can result in wide, irregular growth rings and reddish, brittle wood called “rotholz”. Host responses to BWA feeding eventually cause decreased water flow to the crown, leading to tree death. Tree mortality typically occurs within 2-10 years of infestation; heavy infestations can kill trees in 2-3 years.



**Figure 2. White woolly masses of balsam woolly adelgid on a fir trunk collar.**

## LIFE HISTORY AND IDENTIFICATION

In its native range, BWA alternates between spruce and fir; however, in North America, BWA remains on fir as its European spruce host is not present. BWA populations in



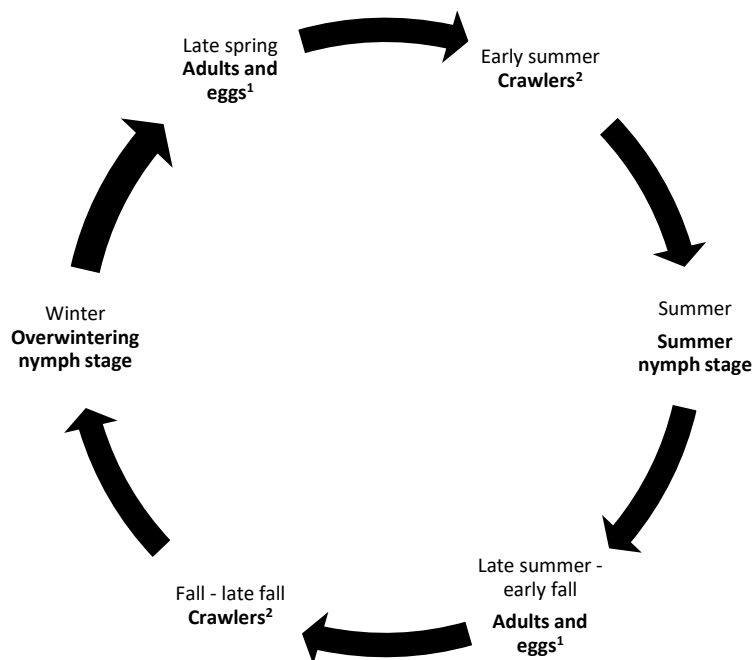
**Figure 3. Abnormal swelling, or gouting, of fir branches caused by feeding injury from the balsam woolly adelgid.**



**Figure 4. Subalpine fir tree canopy decline; note dying lower branches and green top leader.**

North America are composed of females reproducing without mating (parthenogenesis); sexual reproduction requires the European spruce host.

Two generations are most common in the mountainous regions of western North America (Fig. 5). In cold locations, a resting (immature) nymph stage, or neosistens, is the only stage that can survive winter temperatures.



**Figure 5. Balsam woolly adelgid life history in Utah.** <sup>1</sup>indicates the appropriate time for monitoring infestations of the insect. <sup>2</sup>indicates an appropriate time to consider management options, such as chemical treatments and movement restrictions.

## MONITORING

In forests, common monitoring methods include aerial surveys to detect tree stand decline, followed by ground-truthing to identify specific BWA symptoms. Turnquist and Harris (2015) describe a systematic sampling method for signs and symptoms of BWA to estimate the extent of infestation in an area.

In older stands:

1. Examine tree crowns, concentrating on the upper third, ideally using binoculars. Look for:
  - a. Thinning of foliage
  - b. Twig gouting
  - c. Stunted branch and leader growth
  - d. Dead leader
2. Examine recently windblown branches or slash for the above symptoms.
3. Examine the main stem for presence of white wool (sign of adelgid) up to a 10 m height.
4. Collect samples of all signs and symptoms for verification.

In young stands:

1. Sample and examine branch nodes from two 2-to-11-year-old branches per tree, from two trees per site.

## MANAGEMENT

### **Cultural Control**

Completely removing BWA from western ecosystems is unrealistic, as they are widespread and disperse by the wind. At the forest scale, the most effective tactics to reduce BWA damage include:

- selectively removing heavily infested trees
- cutting, removal and movement of infested trees in winter when crawlers are inactive
- consider prevailing winds when establishing cutting boundaries
- grow fir on short rotation cycles
- favor non-host tree species and genetically resistant strains or hybrids through selective harvest and planting
- stand management to promote stand vigor

### **Chemical Control**

Due to small size, protected feeding sites and the presence of wax around BWA second and third stage immatures and adults, aerial insecticide applications do not provide coverage adequate for insect control. A thorough insecticide application to high value trees (to bole and branches/entire trees) from the ground using a high-pressure system can provide control of BWA in areas such as ski resorts, cabin properties, campgrounds, tree





**Figure 6. Young subalpine fir infested with balsam woolly adelgid; note severely stunted growth.**

farms and in urban settings. Including other management techniques, such as planting non-host trees, can prove useful since chemical treatments would be indefinite, costly, and ongoing.

## IMPLICATIONS TO FOREST HEALTH

Widespread mortality of subalpine fir is already occurring at some locations in northern Utah. In many cases, there are few other tree species to occupy the growing site. This problem increases the potential for BWA to inflict great ecological damage through increased erosion, decline in watershed health, loss of wildlife and their habitat, and reduction in recreational value. Additionally, the potential of dying and dead fir adding to fuel loading in forest landscapes is a high concern. BWA-caused tree mortality occurs at a slow rate. True fir species are known for their capacity to retain dead green and dry needles in canopies over long periods of time, likely influencing fire severity and behavior.

A Utah partnership has been formed to implement survey, research, education and management efforts for BWA. Led by the Utah Department of Agriculture and Food, members represent concerned organizations including the United States Department of Agriculture (USDA) Forest Service; the Utah Division of Forestry, Fire and State Lands; Utah State University Extension; USDA Animal and Plant Health Inspection Service; and ski resorts (Fig. 7). This group is coordinating efforts to secure grant funding to study BWA and its impact in Utah, and to develop public educational resources.



**Figure 7. Utah partnership of interested agencies and stakeholders attended a tour of balsam woolly adelgid damaged sites in Farmington Canyon, September, 2017.**

## REFERENCES AND FURTHER READING

- Ragenovich, I. R., and R. G. Mitchell. 2006. Balsam woolly adelgid. Forest Insect and Disease Leaflet 118. USDA Forest Service. <https://www.na.fs.fed.us/pubs/fidls/bwa.pdf> (12 pages).
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