

# Hemlock Woolly Adelgid in the Shenandoah National Park

Hemlock woolly adelgid (*Adelges tsugae*)(HWA) was introduced to America in 1924, but was first reported in the East in 1953. It is currently found in the mountainous regions of the Blue Ridge and Allegheny Mountains from New England to the Carolinas. Both *Tsuga canadensis* and *T. caroliniana* are impacted. The insect was first discovered in the Shenandoah National Park on January 1988, in the Thornton River hollow.

## HWA Biology

The adelgid (sometimes referred to as an aphid) feeds on the starch or fluid of hemlock trees. It resides where the needles attach to the underside of branchlets. They are present throughout the year but are most visible with their woolly sacks from January through April. HWA lays eggs in February-March. Egg hatch is the first part of March. Once attached to the branchlet beginning at the first instar, they stay at the feeding site all their lives. They can relocate, but it is not usual. They are black specks in September. They begin to form their wool in September-October, perhaps to protect themselves from the winter cold.

The HWA sap sucking robs the host hemlock of strength and causes the trees to lose needles. Once present, the adelgid and its progeny, stay on a given tree. After several years of this activity, the hemlock succumb due to lack of strength to refoliate. Once HWA becomes established in a tree, it is not assured that the tree can be saved. Conventional wisdom indicates that hemlock cannot survive beyond six years of infestation. Complete defoliation of hemlock is mortality producing. Foliation attempts are at the end of branchlets (unlike hardwoods which refoliate throughout the tree), making the tree quite odd looking.

## Control Methods

Several chemicals are effective on small tree plantations and for larger trees in specific, limited areas. For saplings or in whole-forest settings, large scale controls are not possible. Because the adelgid resides on the underside of the branchlets, aerial chemical spraying is ineffective. Spraying fine horticultural oil or insecticidal soap from beneath the tree is effective, however. Both the oil and soap act to clog the insect breathing, suffocating it. Trees must be liberally doused to ensure that none are missed. Other chemical treatments are also effective, but these too must be sprayed from underneath.

HWA suppression activities can be done from September until green up in April/May. The best intervention is early intervention. The best spray time is therefore in the fall because there is no wool, and the HWA have not yet laid their eggs. The later the spraying in the spring, the more the HWA will survive.

## Monitoring & Suppression Activity in the Park <sup>6</sup>

Hemlocks were initially weakened by a combination of undetected HWA populations and several years of drought from 1986 to 1988. These factors predisposed the hemlock to added stress. Hemlock borer (*Melanophila fulvoguttata*), a cambium feeding beetle, girdled and killed many of the hemlocks in Thornton Hollow. Armillaria rootrot (*Armillaria mellea*) also adds stress to many hemlock stands.

A primary detection survey was devised by an interagency monitoring workgroup and implemented in the Park in 1990 and 1991 to determine the extent of HWA presence. By 1991, 100% of the known hemlock stands in

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<sup>6</sup> USDA Forest Service. 1995. *Forest health evaluation of the hemlock woolly adelgid, Adelges tsugae annand, in the Shenandoah National Park, Virginia, 1994.* USDA-FS Southern Region Forest Health, Asheville Field Office.

SNP (n=94; acres=2,016) were infested with HWA. Additionally, Park staff initiated a random plot survey in all hemlock stands to assess hemlock crown health. That survey is a means of assessing HWA impacts.

Generally, crown health ratings are declining throughout the Park. For all plots combined, only 25.0% of the hemlocks in 1992 had a crown health rating of 1 (90-100% of foliage present). This number declined to 1.1% in 1994. In 1992, 56.0% of the hemlocks had a rating of 2 (50-89% of foliage present). By 1994, this number declined to 24.3%. Trees with a crown health rating of 3 (1-49% foliage present) rose from 18.3% in 1992 to 64.3% in 1994. HWA-related mortality had risen from 2.2% in 1992 to 9.2% in 1994. You will note what appears to be an improvement in the figures for 1995. We are analyzing the data and our methodology to determine if in fact there was an improvement that year or whether: (1) our field crews that year made differing interpretations of the categorical guidelines, or (2) whether there is now more total mortality which masks the percentages shown in live tree ratings 1-3, among other possibilities. Note the table of findings that follows.

**Table of Hemlock Crown Health Data for Shenandoah National Park, Virginia<sup>7</sup> \***

Year	Random Plots Crown Health Rating**					Permanent Plots Crown Health Rating					All Plots Crown Health Rating				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1990-91			***			77.4	12.9	2.1	2.2	5.4	77.4	12.9	2.1	2.1	5.4
1992	20.4	58.9	18.4	2.0	0.3	25.1	46.2	19.2	2.9	6.5	21.0	56.0	18.3	2.2	2.5
1993	12.9	39.5	43.4	3.7	0.4	18.3	34.3	33.5	7.8	6.0	13.3	39.2	42.7	4.0	0.8
1994	1.2	24.5	64.2	9.1	1.0	0.0	20.0	65.5	11.8	2.6	1.1	24.3	64.3	9.2	1.1
1995	5.1	27.8	54.3	7.1	5.7	1.4	29.0	55.7	13.2	0.7	4.8	27.9	54.4	7.6	5.3

\* Numbers are expressed as a percentage for that year.

\*\* Crown health ratings: 1=90-100% foliage in tact; 2=50-89%; 3=1-49%; 4=adelgid related mortality; and 5=baseline mortality.

\*\*\* No random surveys were conducted in 1990-91.

Suppression and evaluation activity took place in 1992. This was intended to prevent initial decline of trees and maintain crown health. Horticultural oil and insecticidal soap were applied in the recommended liquid drench method at Limberlost and Camp Hoover. AceCaps<sup>R</sup>, a systemic Acephate, were also applied to 24 trees in Camp Hoover. All three treatments were successful, but the evaluation was not published.

Extreme cold winter temperatures in 1993/94 resulted in heavy HWA mortality. Sampling at the Skyland and Headquarters areas in the Park indicated HWA mortality of 95-100%. Infested trees responded by producing a flush of new growth. Unfortunately, the surviving adelgids thrived and responded rapidly in the spring and summer to levels that again required treatment.

In the 1995/96 winter and spring season, the Limberlost and Camp Hoover areas were again designated for suppression treatment. Due to the 1995 Federal furlough and subsequent winterset, the fall operation was postponed. Resumption of the project took place May 1996. All together, 664 trees were treated; 372 received insecticidal soap and 292 trees received horticultural oil treatments. Each received approximately 2.7 gallons of mixed product or 0.04 gallons of pesticide. Effectiveness evaluations are being conducted through the summer.

<sup>7</sup> USDA Forest Service. 1995. *Forest health evaluation of the hemlock woolly adelgid, *Adelges tsugae annand*, in the Shenandoah National Park, Virginia, 1994*. USDA-FS Southern Region Forest Health, Asheville Field Office.