Will the hemlock woolly adelgid destroy our hemlock trees forever?

David A. Orwig
Hemlock woolly adelgid (*Adelges tsugae*)

<table>
<thead>
<tr>
<th>2 generations /year</th>
<th>Parthenogenetic</th>
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<tbody>
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<td>rapid dispersal</td>
<td>feed and kill all sizes and ages</td>
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<tr>
<td>hemlock resistance?</td>
<td>No effective native predators</td>
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HWA life cycle in E. North America (USDA)
*Adelges tsugae* documented on all 9 hemlocks worldwide

Recent genetics: from So. and low elevations in Japan

Serious pest only in Eastern U.S.
Study Sites

Harvard Forest HWA studies include:

1) Stand and community analyses

2) Landscape investigations of hemlock structure and HWA infestation patterns

3) Ecosystem analyses of HWA infestations including n cycling, decomp, throughfall chemistry

4) Comparisons of HWA vs. Hemlock Logging

5) Wildlife studies

6) Hydrological Investigations

7) HWA dispersal

Figure 1. HWA space-for-time study area, representing 7500 km². Hemlock represents >86,000 ha or 21% of the mapped area in MA (up to 36% in northern MA), and 16,500 ha or ~5% of the mapped area of CT.
Overstory mortality trends, high in many, but not all stands.
Crowns continue to deteriorate, with no sign of recovery
Rapid birch establishment
Occurs with canopy thinning
Invasives and ferns can also increase tremendously.
LANDSCAPE PATTERNS

CT: 114 stands
MA: 123 stands

HWA found within a few km of Vermont!

Latitudinal pattern present
But damage not as rapid

Only 2 stands > 50%
Overstory mortality in MA
Ecosystem Results

HWA leads to many indirect effects including dramatic structural and compositional changes, leading to: higher soil temperatures and subsurface soil moisture content, and reduced forest floor soil moisture content.

Resin bags incubated in soils captured higher amounts of ammonium and nitrate in infested versus control hemlock stands, indicating greater N availability.
HWA continues to migrate and cause decline and mortality in New England and elsewhere.

Salvage and pre-salvage is commonly associated with HWA infestations; more knowledge is needed to inform managers and landowners.
High Intensity cutting, but Little to no soil scarification, and no slash (public safety, aesthetics, erosion control)

Arnold Arboretum’s Hemlock Hill 1/05
Logging sites had higher seedlings and saplings than HWA infested trees or control sites.
Discussion

• HWA infestation and logging impact the structure in different ways due to inherent differences in the mode of disturbance

• Decline from HWA is gradual and exhibits variation within and among stands creating variable vegetation responses; more snags

• In contrast, logging leads to abrupt overstory removal and rapid vegetation recovery across the harvested area (more slash, scarification)
Imidacloprid (Merit) pesticide of choice:

Tree I.V.

Kioritz soil injection

Soil drench

Stem injection-important near streams

CoreTect time-release tablet

often provides 2 to 4+ years protection

So, what can be done?
Soil application widely used
Biological Controls

From Japan, over 1.5 million have been released in over 100 sites in 15 Eastern sites including MA

*Sasajiscymnus tsugae*

Native to British Columbia, over 7000 Adults have been released at 19 sites In 8 eastern states-recovery 2 years later

*Scymnus sinuanodulus*
*Tetraphleps galchanoides*

Others are on the way:
Pathogenic fungi
Uncertain success, impact
So what can students do to add to this body of work?

Can provide year by year assessments of HWA densities

Can evaluate year to year branch growth, related to HWA

Can provide important data at the northern extent of HWA range
A co-occurring pest on the rise! Students can also contribute here

**Elongate Hemlock Scale**
(EHS; *Fiorinia externa*)

Also from Japan, introduced in NYC in 1908

Now located in 14 eastern states, range overlaps with HWA

Often co-occur with HWA on same tree: uncertain consequences
Facilitation by HWA??

2007 survey – adelgid

2007 survey – scale

Mean EHS rating/stand
- 0 EHS/ m branch
- 1-10 EHS/ m branch
- 11-100 EHS/ m branch
- >100 EHS/ m branch

Facilitation by HWA??
Southern Appalachian forests dying rapidly!

W. Blozan