Eastern Hemlock and Hemlock Woolly Adelgid

Tsuga canadensis (L.) Carr)

http://na.fs.fed.us/fhp/hwa
Ecological Significance of Eastern Hemlock

- Long lived, late successional climax trees
  - 250 to 300 years to reach maturity.
  - May live for 800 years or more.
- Provides critical wintering habitat
  - Moose
  - White tailed deer
  - Ruffed grouse
  - Turkey
  - Songbirds
Economic Significance of Hemlock

- Poor wood characteristics – ring shake
- Never had high economic demand
- Used in
  - Low grade products, such as pallets
  - Beams
  - Pulp
  - Bark used for landscaping mulch.
Ornamental Significance

- Good foliage color
- Adaptable to shearing
- Relative freedom from native insects and disease.
Eastern Hemlock Range

- Eastern Hemlock grows best in a cool humid climate that has adequate moisture in all seasons.
- Avg temps 10°F in winter to 60°F in summer
- Average precipitation around 29”
Soil

• The soils for eastern hemlock are not specific
  – Moist to very moist
  – Good drainage
  – Highly acidic
Management Objectives

- Component of naturally regenerated stands
- Ornamental plantings
Hemlock Woolly Adelgid (HWA)

- *Adelges tsugae*
- Family: Hemiptera
- Closely related to aphids
- Has asexual and sexual stages
- All *Adelges* species have spruce as a host for the sexual stage
- Native to Asia
HWA: Signs

• Adult is about the size of a period on a printed page

• Dry, white woolly substance on the twigs
  – Associated with masses of 50-300 eggs
  – Resembles the tip of a cotton swab, although somewhat smaller
  – Found at the base of the needles

Figure 5. Closeup of woolly ovisacs — the most obvious sign of HWA infestation.
Life Cycle

Life Cycle, Courtesy of Vince D’Amico and Mike Montom

Figure 5. Closeup of woolly ooze — the most obvious sign of HWA infestation.
Mechanism

- Inserts feeding stylet into stem at base of a needle
- The stylet follows vascular tissue to the parenchyma cells of the xylem rays
- Forms sheath – allows re-insertion after molting
- Absorbs nutrients that leak from parenchyma cells
Tree Symptoms

- Needles on infested branches desiccate
  - grayish-green
  - drop from the tree
- Most buds are also killed
  - little new growth.
- Dieback of major limbs occurs within two years
- Trees die in four years or persist in weakened state
Populations Rise and Fall

- On healthy tree, populations rapidly build.
- Stress results in decreased nutrients for insect – population declines.
- Tree recovers, nutrients in foliage increase, insect populations increase.
Predisposing Factors: Native of Asia

- Native to China and Japan
  - Harmless inhabitant
  - Common on forest and ornamental hemlock and spruce
- HWA occasionally attains high densities in Japan,
  - Only on ornamental trees grown on very poor sites.
  - Not significantly injured
  - Hemlocks have evolved resistance to the insect
  - Arthropods predators help minimize HWA populations
Predisposing Factors: HWA in North America

- Northwestern US – behaves as native insect
- Eastern US – invasive
  - Population originally from southern Japan
  - Only parthenogenetic reproduction
  - Can’t tolerate -20 to -30°C temperatures (0 to -20°F)
Cold Temperature Limitations

- Limits Balsam Woolly Adelgid to coastal areas
- HWA could be a cold hardy species.
  - Evolved at high elevations of Japan; as cold as -63°F.
- The mechanisms that influence cold hardiness are complex, and are not fully understood.

Figure 12. HWA mortality at minimum recorded temperature.


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• In the early 1950's, first observed in Virginia.
• 20-30 km per year
Now in 17 eastern states,
Predisposing Factors Related to Tree Species Adaptation

• HWA is an exotic.
• Eastern hemlock shows little natural resistance.
• Dry sites most vulnerable
  – On slope
  – Aspect: Not northern
  – Soils: Well drained or shallow
Inciting Factors

- High survival in mild winters?
- HWA nymphs are carried to new trees by:
  - the wind
  - carried by small mammals,
  - transportation by humans.
Contributing Factors

- HWA has the potential to kill the tree on its own.
- Weakened trees can succumb to
  - Wind
  - Armillaria
  - Scale insect
  - Borer
  - Drought
HWA and Drought

Figure 4. Cumulative tree mortality 1988 to 2001.

Preemptive Control Options

- Maximize Tree Vigor
  - Watering (1 inch/week)
  - Pruning
- Prevent Infestation
  - Sanitation – clean nursery stock
  - Quarantine - Maine
  - Education and Communication
Monitor and Survey

- Public education, professional training
- Investigate reports of infested planted hemlock
- Sample branches of hemlock in stands near infested areas
Reactive Control Options
Infested Plantings

• Chemical spraying
  – Diazinon
• Destroy trees
Reactive Control Options
Ornamental Trees in Infested Areas

- Imidacloprid
- Soil treatment
  - Injection
  - At least 50 ft from water body
- Inject tree
- Water as needed
Reactive Control Options: Natural Stands

- Harvest or Salvage
- No Action
- Biological control introductions
Sasajiscymnus tsugae
Japanese “lady beetles”

• Specific to adelgids
• Survive Maine winters?
Laricobius nigrinus

- Native to western North America
- Specific to adelgids
Conclusion: Hemlock woolly adelgid

- Threatens to substantially reduce eastern hemlock populations
- Vulnerable trees:
  - On dry sites
  - Warm winters
- Northern spread uncertain
- Quarantines
- Must survey and eradicate spot infestations
- Introduce biological controls