

Ecosystem Response to Hemlock Woolly Adelgid
(*Adelges tsugae*) Induced *Tsuga canadensis* Mortality



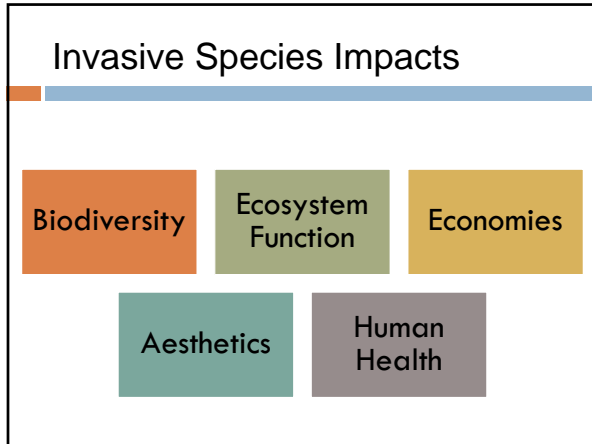
Misty Huddleston
Graduate Student Seminar

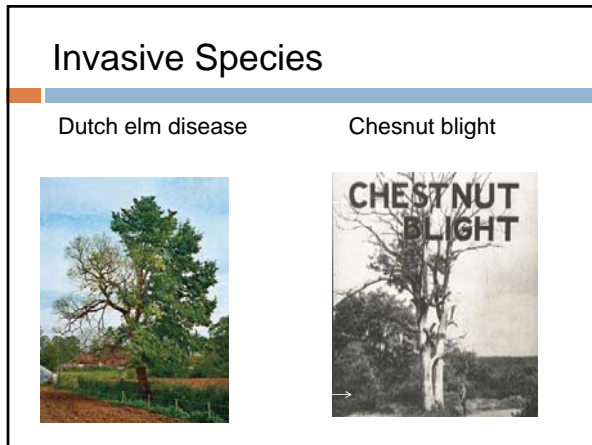
Invasive/ Exotic Species

Any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Invasive/ Exotic Species

Invasive species are now the second highest threat to the conservation and preservation of natural areas (ESA 2003).





Current Status

Approximately 7,000 exotic species are established in US

Less than 600 species actually causing some form of ecological harm

Three small images of invasive species: an Emerald Ash Borer caterpillar, Cogongrass, and a Tree of Heaven plant.

Emerald Ash Borer Cogongrass Tree of Heaven

Gypsy Moth

Current Status

Approximately **152** threats in Tennessee from invasive/exotic insects, diseases, and plants

GSMNP shares many of these threats including the hemlock woolly adelgid (HWA)

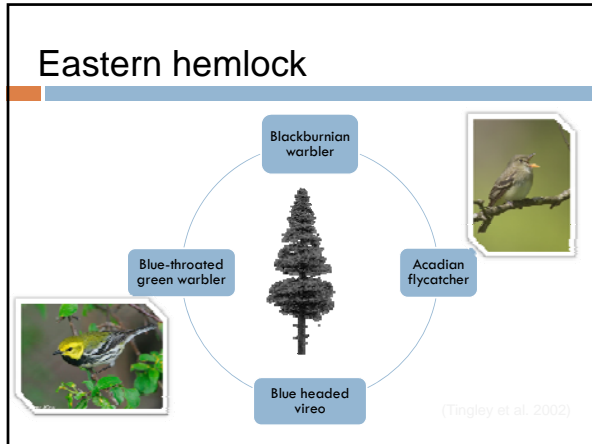
HWA was located in GSMNP in **2002**

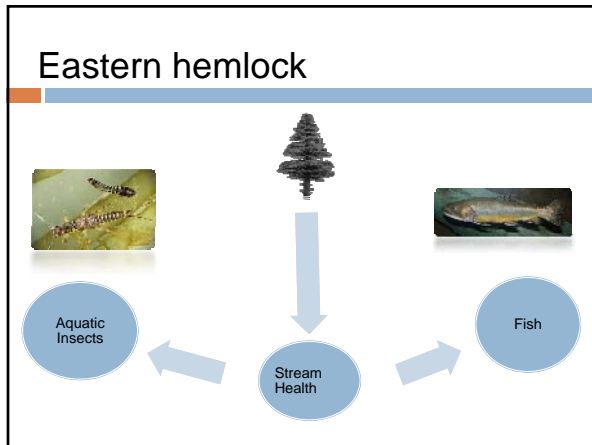
Eastern hemlock

slow growing
long lived (>800 years)
large species (>175 ft tall and 6 ft dbh)
shade tolerant
cool, moist habitat
elevations (3,000-5,000 ft)

Eastern hemlock

Uses include:	
boxes	general construction
crates	tannins
railway ties	poultice for wounds
pulpwood	liniments
timbers	ornamental plantings





Hemlock Woolly Adelgid


- First discovered in US in 1950's in Richmond, Virginia
Moved into GSMNP in 2002
- Decimated hemlocks in Delaware Water Gap National Recreation Area (80% mortality)
- Decimated hemlocks in Shenandoah National Park (90% mortality)

Hemlock Woolly Adelgid

Native of Honshu, Japan

Occurs on *Tsuga diversifolia*

Innocuous on all hemlock species except those found in Eastern US



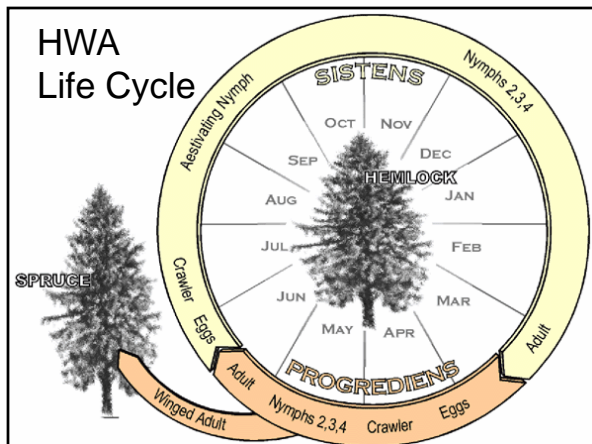
Hemlock Woolly Adelgid

Native of Honshu, Japan

Occurs on *Tsuga diversifolia*

Innocuous on all hemlock species except those found in Eastern US

Devastating *T. canadensis* and *T. caroliniana* throughout their native ranges



Sign of Infestation

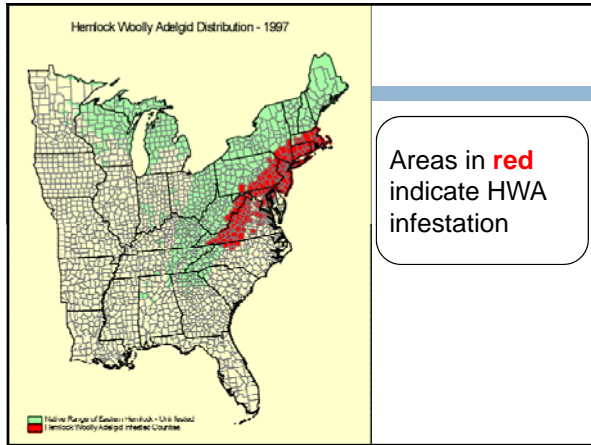


initial symptom is needle yellowing and drop
branch desiccation
thinning crown
limb dieback
tree mortality

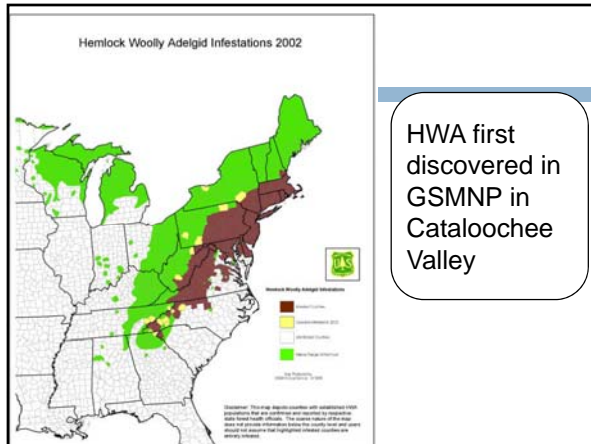


white, woolly masses at base of needles





Areas in **red** indicate HWA infestation

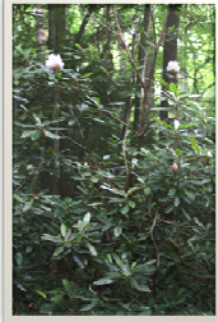


HWA first discovered in GSMNP in Cataloochee Valley

Justification

Terrestrial vegetative changes could lead to devastating effects on streams

Impacts of Rhododendron on replacement species composition is unknown



Justification

Alterations to terrestrial components of the watershed can be expected to have significant consequences to the abundance and distribution of both terrestrial vegetation and aquatic species.

Important for managers to have this information so that they can manage for or attempt to mitigate impacts created from this situation.

Research Objectives

Do measurable changes occur in aquatic biota as a result of hemlock mortality? And, if so, to what extent?

Research Objectives

What will be the vegetative response to the loss of the Eastern hemlock tree in the GSMNP? Will the presence of Rhododendron have an impact on this response?

Research Objectives

To what extent does HWA induced mortality in hemlock-dominated riparian forest influence water quality conditions?

Proposed Methods

Use GIS data to characterize watersheds within GSMNP based on certain parameters:

- | | |
|----------------|-----------------------|
| Slope | Solar radiation index |
| Aspect | Forest cover type |
| Elevation | Other parameters |
| Watershed size | |

Study sites located within watersheds that meet those parameters

Proposed Methods

- 3 sites where no HWA infestation is detectable
- 3 sites where HWA infestation is moderate
- 3 sites where HWA infestation is heavy and there is substantial tree mortality

Proposed Methods

- Forest Riparian Vegetative Community
 - ▣ Structure (vertical and horizontal arrangement)
 - ▣ Species composition

Proposed Methods

- Forested aquatic system process and biota
 - ▣ Processes:
 - Stream temperature
 - Water chemistry
 - pH, DO, acidity, etc.
 - Light penetration
 - ▣ Biota:
 - Species richness, diversity, and distribution
 - Fish
 - Aquatic macroinvertebrates



Proposed Methods

Other considerations:

- ▣ Should plots utilizing preventative measures (ie. Imidacloprid) be incorporated?

- ▣ What is impact of rhododendron and how to quantify this?

- ▣ Replicate prior study of Sams Creek and Indian Flats Prong, allowing for pre and post data comparisons in a case study format.

Summary

Eastern hemlock being devastated by HWA

The changing riparian conditions could potentially alter aquatic ecosystem function

Goal is to assess the aquatic ecosystem impacts from altered terrestrial vegetation due to hemlock mortality

Acknowledgements

Dr. Clatterbuck (Forestry, Wildlife and Fisheries)

Dr. Etnier (Ecology and Evolutionary Biology)

Dr. Lambdin (Entomology and Plant Pathology)

Kristine Johnson, National Park Service

Rusty Rhea, US Forest Service

