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

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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).
Invasive Species Impacts

- Biodiversity
- Ecosystem Function
- Economies
- Aesthetics
- Human Health

Invasive Species

- Dutch elm disease
- Chestnut blight

Current Status

- Approximately 7,000 exotic species are established in US
- Less than 600 species actually causing some form of ecological harm

- Gypsy Moth
- Emerald Ash Borer
- Cogongrass
- Tree of Heaven
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)

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

Innocuous on all hemlock species except those found in Eastern US

Hemlock Woolly Adelgid

Native of Honshu, Japan

Occurs on Tsuga diversifola

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

Innocuous on all hemlock species except those found in Eastern US

HWA Life Cycle
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
Management

Foliar Sprays  Systemic Treatments  Predatory Beetles

Justification

Eastern hemlock is a common species in GSMNP

Foundation species

Shades streams and stabilizes temperatures
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
- Aspect
- Elevation
- Watershed size
- Solar radiation index
- Forest cover type
- Other parameters

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 (i.e., 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

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