

The State of Hemlocks and the Hemlock Woolly Adelgid



An overview of the battle to save our hemlocks based on real-world experience

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How I got involved with hemlocks

- 1993: Forestry technician in **Great Smoky Mountains NP**
 - Map and inventory old-growth eastern hemlock forests
 - Prepare for arrival of HWA
- 1996: Co-founder of the **Eastern Native Tree Society**
 - Detailed study of eastern forests



My business background

- 1998: Co-founded **Appalachian Arborists, Inc.**
 - Specialize in hemlock management
- 2001: Found first infestation of HWA in SC
- Extensive community outreach re: HWA



Appalachian Arborists, Inc.

- Treating hemlock woolly adelgid since 2002
- Primary funding for the **Tsuga Search Project**
- Specialize in large scale contracts
 - 73,756 trees
 - 1,029,584 inches
 - <3,000 acres
- Key partner with **Eastern Native Tree Society**

My action background

- 2005: Initiated **Tsuga Search Project**
 - Create database of superlative eastern hemlock and site characteristics
 - Provide locations of potential forest preserves
- 2007-13: Consultant on **"The Vanishing Hemlock: a race against time"**



"The Vanishing Hemlock" A race against time

- Goals
 - Educate
 - Inspire
 - Protect



Filed on location in Great Smoky Mountains National Park, NC/TN

Release date: TBA

Eastern Native Tree Society

Hemlock documentation and preservation



- The ***Tsuga Search Project***
 - Document and preserve exemplary hemlocks and groves
 - Take an ecological "snapshot" for the future
 - Provided NPS/USFS with conservation sites
- Determine tree volume and height via climbing
 - First ever **accurate** assessment of eastern hemlock
 - Database for restoration efforts
 - Trees treated with systemic insecticides

And we have found some big ones!



Largest: 6.1 feet diameter, 1601 cubic feet of wood

Great Smoky Mountains National Park, NC

And some *really* tall ones

- Tallest known eastern hemlock 173.1' tall
 - Fourth largest eastern hemlock documented; 1533 cubic feet of wood volume
- Featured subject of documentary film



Great Smoky Mountains National Park, NC

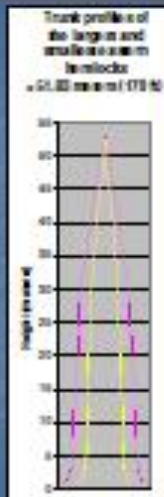
The "Holy Grail" hemlocks

"Noland Mtn" 171.5' "Yule" 171.6' "Survivor" 172.1' "Uels" 173.1'



They couldn't be much different in size...

- Even though only **17 inches** different in height, the four tallest hemlocks are nearly **4 times different in size!**
- Height has **nothing** to do with volume!



Search Results 10/2005-10/2007

- Several *thousand* trees measured
- Over **10,600 feet** of hemlock climbed
- Over sixty trees climbed and modeled in six states
- >60 *miles* of hemlock forest surveyed in southern Appalachians



**"Usis"-The new hemlock height record
173.1'**



"Usis" is the Cherokee word for antler



**This was the most complex
hemlock I have ever climbed**



**At 100' two large limbs fused into a
window of wood**



**The "Usis"
hemlock
contained
1,533 cubic
feet of
wood...**



**But it still was not the
largest!**

**A giant 1,564 cubic foot
tree discovered in
Highlands, NC dubbed
the "*Cheoah Hemlock*"
took the prize...**

...for the moment



How could another tree beat the huge *Cheoah Hemlock*?



A giant tree discovered in TN dubbed the "*Laurel Branch Leviathan*" soon snatched the title!



This giant scaled 1,585 cubic feet!



But **STILL** not the largest!



The "*Caldwell Giant*" took the title with a record of 1,601 cubic feet!



Unfortunately, the *Giant* and thousands of other hemlocks surrounding it were already dead from the hemlock woolly adelgid...



Including a possible new volume record discovered in 2009



It is already too late for vast areas of the southern Appalachians



It is already too late for vast areas of the southern Appalachians



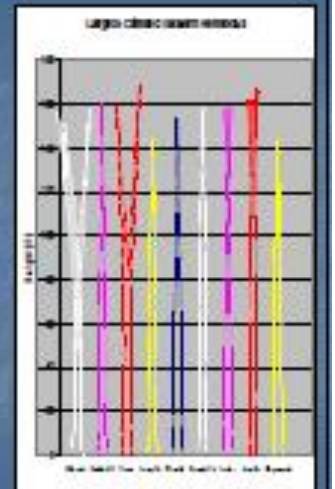
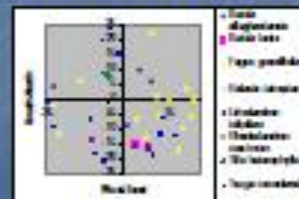
Time is quickly running out to document and save the remaining hemlock forests



Thus, the "Tsuga Search Project" was a race against time...



The trees and the surrounding forest were studied to learn what we could about these forests before they disappeared



When salvageable, the trees were treated with systemic insecticides



Digital legacy of dead giants

- 3-D crown mapping of the worlds tallest known eastern hemlock
- Preserve the structure of this superlative tree for future reference
- Characterize the distribution of wood, number of needles and living tissue

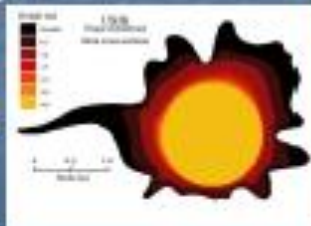


Crown mapping the "Ussie Hemlock",

GRSM-NC

3D Crown Measurements

- Enables undistorted, scale view of the tree and its structures
- Permanently document trees that may not survive HWA attack



What's going to happen?

- HWA is spreading very rapidly, mortality heavy
 - *Carolina hemlock extinction*
- HWA threatens to devastate hemlocks throughout their native range
 - Cold in north will slow spread
- *Now is the last and only opportunity to preserve the remaining hemlocks*



Timely and appropriate action is urgently needed

- Millions of trees are lost every year
- Natural heritage is being destroyed
- Time to make an impact is quickly running out



Of the 60+ superlative trees climbed, only one remained alive...

- The immense "Cheoah Hemlock" was thought to be in salvageable condition
 - Infested for five years
 - Heavily defoliated



2004



2007

Treatments commenced in 2006

- Imidacloprid high dose 3X ('06, '07, '08)
- Dinotefuran 8-12 grams inch 3X ('08, '09, '10)
- Top continued to decline...



Why?

- Extremely complex
- 690' of trunks!
- Dosage rate linear...
 - *Does this tree have 60X more mass than a 1" tree?*



Complex crown structure hindered uptake?

- Lower crown responded extremely well
- Top continued to thin but was hanging on



We decided to by-pass the vascular con-FUSION

- Bark paint at 120'
- Applied above reiterations
- Dosage for each of four stems



First ever aerial Safari application?



Seems like success!



Photo 5/30/2013



What is being done?

- **Federal**
 - USFS: Genetic conservation, hazard trees
 - NPS: Stand-level preservation, genetics
 - DNR: Ecologically significant sites
- **Private**
 - Forest
 - Residential: property value, privacy, hazards
- **Global**
 - CAMCORE: Seed banks, out-planting

Current projects

- Develop management plan for 1,250 acre preserve in the Catskills of NY
 - Near 100% dominance
 - World-class trout stream
 - Erosion management
 - Municipal watershed



South Carolina DNR

- Preservation of nearly all Carolina hemlock stands in the entire state



South Carolina DNR

- Coon Branch NA
- First Safari forest application (93%!)



Great Smoky Mountains NP

- Ecosystem-level preservation of old-growth eastern hemlock



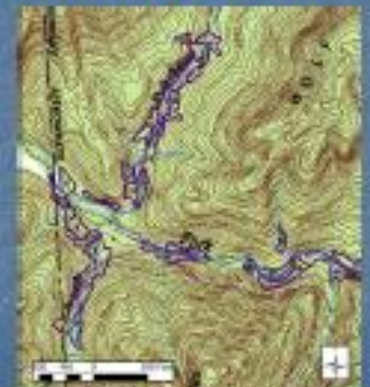
- To date (AA):
 - 11,579 trees
 - 236,291 inches



North Cumberland WMA, TN

- Water quality management for endangered fish and mussels

- To date:
 - 11,600 trees
 - 171,205 inches



Savage Gulf SNA, TN

- Old-growth and mature eastern hemlock
- To date:
 - 8,521 trees
 - 155,381 inches



Savage Gulf SNA

- Case study of extreme treatment areas
- Many believed it could not be done...



Savage Gulf SNA

- This project set the bar for what a small team can do
- Inspired other parks to take action



Savage Gulf SNA

- Expected to take 16 weeks...
- Did it in eight!
- Final cost:
~\$22 per tree (>12")



What is all this costing?

- Our pricing based on:
 - Time and materials
 - Diameter inch
 - Linear mile
 - Per acre



Appalachian Arborists pricing

- Imidacloprid soil only
 - \$.18 to \$1.22 per inch
- Dinotefuran soil only
 - Fixed \$2.00 inch
- Both \$2.10 inch
- 4,300-11,000" per day



Side benefit?

- Our meticulous data tracking is a surrogate for near 100% sample of hemlock forest
- Potential for setting restoration goals, carbon studies, water impacts

Year	Area	Volume	Value	Notes
2010	100	1000	10000	
2011	100	1000	10000	
2012	100	1000	10000	
2013	100	1000	10000	
2014	100	1000	10000	
2015	100	1000	10000	
2016	100	1000	10000	
2017	100	1000	10000	
2018	100	1000	10000	
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University of TN Study 2010-13

- Analyze foliar samples to refine treatments
 - Minimize chemical use
 - Extend Tx intervals
 - 6-8 years!



HWA management lessons

- The best tool*
 - 20/20 hindsight*
- The lessons
- The tools
- Implications



The lessons

- The greatest mistakes
 - Waiting too long
 - Not realizing the risk
 - Not being prepared
- Myths and misinformation!!!
 - "It's too expensive"
 - "You can't save forests"
 - Myriad of different and conflicting information on the internet



Urban/Municipal imposition (if you have hemlocks they *will* get HWA)

- Private**
 - No one is "Immune"
 - Hazard tree liability
 - Loss of property value
- Public**
 - Hazard tree management
 - Fire danger
 - Municipal management implications (water)



The fact of the matter is...

HWA KILLS!

- We must **act!**
- We have the **tools!**
- We have the **experience!**
- We know what **works!**

Thus...

- We currently have the **opportunity** to save trees and forests

Yet...

- This opportunity will **NEVER** come again!



Overview of management options

- Biological control



- Insecticides



Biological control

Sasajiscymnus beetle releases, North Carolina, May 2004



Are they working?

16,000 beetles released May, 2004



Photos taken:

September 2008

Then versus now...



2004



2006

Beetle release tree- 2000 beetles



2004



2006

HWA Management options

Biological control

- Expensive: ***\$2-\$10 per agent***
- No guaranteed results
- Reproductive rate very slow
- Field observations inconclusive

- ***Best long-term option but they are not saving forests***

=Losing irreplaceable resource



Extensive bio-control release site

Barner Blk, NC 2008

HWA Management options

Insecticidal intervention

- *Only proven method to save trees*
- "Guaranteed results"
- Cost effective management
 - Reduce liability on public lands
 - Tree removal *10 to 40 times* more \$\$\$!



Insecticidal Treatments

- *Soil application of systemic insecticides most effective*
- Soil treatment allows for large-scale treatments
 - Still on a tree-by-tree basis...
- Affordability and portability allows for the:
 - *Preservation of forest stands for the future*
 - *Preservation of remote or unique forests*



Remote or unique forests

Representative old-growth forests



Remote or unique forests

Threatened Carolina hemlock forests



Treatments can fail... *why?*

- Applied too late
- Inadequate dosages/rates not scaled to size
- Inappropriate product
- **Inadequate rainfall**
- Tree vigor too low for uptake
- Other stresses or diseases



Assumptions are made

- The tree will respond to treatments
- The tree has the capacity for uptake
- Environmental conditions will favor uptake
- The tree has a normal root zone
- The tree has no other serious pest/disease issue
- **This is not always the case...**

Which of the three trees was treated?

• ???



All three!

- With maximum dose of imidacloprid 6/2006

• Photo 9/2/2008



Systemic insecticide overview

- **Imidacloprid (Merit™)** is well known to be effective, but typically slow to achieve control (*18-24 months*)
 - Low solubility
 - Highly dependent on soil moisture
 - *Time/environment is not on the hemlock's side*
- **Dinotefuran (Safari™)** has proven to be very successful in urban and forest settings
 - Quick uptake and kill (*3-6 weeks*)
 - Relatively short environmental legacy
 - Reaches *low-vigor* branches
 - *Apparent disregard for drought conditions*

Dinotefuran- "miracle juice"

- "Salvage" treatments average 93% survival rate!
- Exceptional results on large, heavily declined trees
- Trees in excess of 85% defoliation can- and will- come back
- **Difference between life and death**

Dinotefuran- "miracle juice"

- Tree response greatly improves recovery
 - Needles up to 400% larger
 - Deep green free of mites
 - Latent bud expansion
 - Break bud earlier
- Short residence could be bio-control?



Which result would your clients want?



Valent study trees treated 20 months prior

Insecticides the only tool for stand-level hemlock *management*

- Allows for the preservation of:
 - Hemlock ecology and all associated environmental benefits
 - *Superlative specimens*
 - *Genetic diversity*
- Conservation of critically threatened *Carolina Hemlock*

Carolina hemlock: a moral responsibility

How can we let a species and its ecological dependents be eradicated from our woodlands when we have the tools to save them?



Questions?

www.appalachianarborists.com