

# The Hemlock Crisis in Georgia (and the eastern U.S.)



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Thanks to the University of Georgia and the  
USDA Forest Service for review of this presentation.



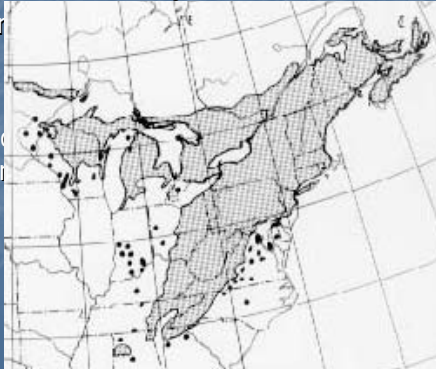
*This we know: the earth does not belong to man - man belongs to the earth. All things are connected like the blood that unites us all. Man did not weave the web of life; he is merely a strand in it. Whatever he does to this web, he does to himself.*

- Chief Seattle, 1858

# Eastern Hemlock – a Unique Tree!

(*Tsuga canadensis*)

- Range: Found from southern Canada to the great-lakes region southward to Georgia and Alabama
  - Carolina Hemlock (*Tsuga caroliniana*) is found from Virginia to Georgia
- In Georgia, it is found primarily from 1,500 ft – 5,000 ft elevations.
- Prefers north and west facing slopes (cooler and wetter)
- Long-lived tree – 500 year old trees not uncommon
  - Record is 988 years!
- Large tree – 150 + feet height
  - 6 meter / 120 feet
  - 3 meter / 58 feet
- Widely used as ornamental trees along streets and in parks in northern Georgia



Eastern Hemlock is found from southern Canada into the Great Lake States at the northern end of its range southward into the Appalachian Mountains which extend into northern Georgia and Alabama. It prefers elevations above 1,500 feet and can be found up to the upper elevations of where trees occur which is around 5,000 feet. It is a moisture loving tree and does better on lower slopes and on north and / or west facing slopes, and prefers annual rainfalls of 60 inches or more. It is considered a long lived tree and many trees in Georgia are several hundred years old with ages of 500 years being found.

It is a large tree throughout most of its range and the Georgia record Eastern is a little more than 6 feet in diameter and 120 feet tall (this specimen is found in Rabun County). The Carolina Hemlock is smaller and our state champion is located at Tallulah Gorge State Park in Habersham County. Both species of hemlocks can be found being used as ornamental trees (and as shrubs with continued pruning) throughout the range and slightly outside of where it is naturally found in the wild.

# Hemlocks in Georgia

- Hemlock occurs on 250,000 acres
- Shading for "marginal" Trout Streams
- Southern end of the Eastern and Carolina Hemlocks range
- Maintain & protect water quality



Chattooga River in Rabun County – Georgia is to the left, SC to the right

Georgia is at the southern end of the Appalachian Mountain Range and has about a quarter of a million acres where Hemlock occurs (based upon the latest FIA – forest inventory and analysis data). Hemlock is a moisture – loving species and generally occurs on lower slopes and along riparian areas. We have the Eastern Hemlock (*Tsuga canadensis*) and the rarer Carolina Hemlock (*Tsuga caroliniana*). Many of these areas where Hemlock occurs have steep slopes, soils with rocky outcrops and they provide many benefits including protecting water quality by anchoring the soil with their root systems, and shading these streams and water ways.

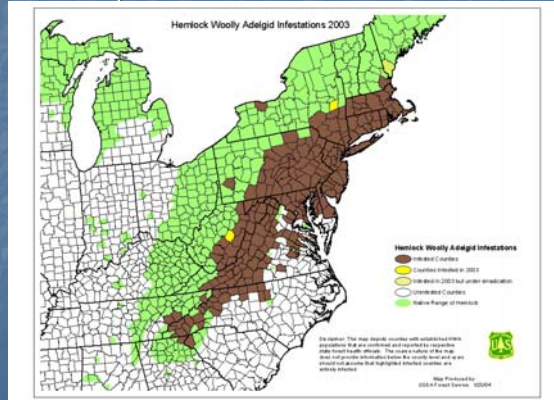
## Hemlock Benefits:

- 4,000 miles of trout streams in Georgia
  - Marginal – most are barely cold enough to maintain trout populations and must be stocked annually to support the 100,000+ fishermen who enjoy the sport
- Recreation – Hiking, fishing, camping, bird watching, mountain biking, photography, etc.
  - Hemlock adds to these environmental activities
  - \$1.1 Billion annually (Georgia Dept of Tourism)
  - \$1.7 Billion annually (Georgia Dept of Natural Resources)
- Ecosystem – Our hemlock is a naturally occurring species within our southern Appalachian hardwood forests. Every species plays an important role.
- Marginal commercial timber value

Hemlock provide shade and soil stabilization for many of our trout streams in Georgia. The loss of these species of hemlock (shading these waterways) could raise water temperatures a few degrees and these streams may not support trout. Hemlock is an important part of the forests in the mountains (the Chattahoochee National Forest is one of the most utilized national forests in the country).

# Hemlock Woolly Adelgid

- Exotic insect from Asia – 1920s
- Began in northwest – Western Hemlock (*Tsuga heterophylla*) initial host
- 1950 – HWA detected in Eastern U.S.
- Eastern & Carolina Hemlocks susceptible



The Hemlock Woolly Adelgid is an exotic insect from Asia that was introduced in the Pacific northwest in the 1920's (perhaps the Port at Seattle was the initial entry point). This insect did feed on Western Hemlock but wasn't a source of great concern since it doesn't normally kill this species. In the 1950's HWA was detected in the eastern U.S. feeding upon Eastern Hemlock and was found to kill this species. The map above shows the range of eastern hemlock in green and the occurrence of HWA in 2003. It now occupies 5 counties in the northeastern Georgia region. The photo above shows the dull green canopies of eastern hemlocks that are in decline and dying from repeated years of HWA.

## Hemlock Woolly Adelgid

- *Adelges tsugae*
- Sucking mouthparts – feed where the needles attach to the stem
- Woolly masses are present from late fall to early summer
- 2 years – numbers will build to twig/branch dieback
- 2-4 years – tree death (in Georgia)
- Eastern Hemlock in the northern end of the range can last for many years while being attacked
- HWA can attack and kill all ages and sizes of hemlock.



The hemlock woolly adelgid damages the tree by sucking sap from the twigs – thus removing food from the tree. The Adelgids attack where the needles attach to the stem of the tree and normally on the previous year's growth since this tends to be more succulent and nutrient rich. As the insect builds their population on trees, one of the first symptoms many trees exhibit is the lack of new growth and the presence of the cotton-like “woolly” covering which serves to protect adelgid and its eggs.

Once attacked for 2 or more years in Georgia, many trees exhibit branch dieback and eventually death. It appears that Hemlocks in the southern end of the range tend to go downhill and die much faster than trees in the more northern areas. This could be a combination of several factors including the Adelgids having a slightly warmer climate which extends the active period of the year and milder winters may not cause as much winter insect mortality in the south.

## *Visual Symptoms*

*Indicate Attacks*



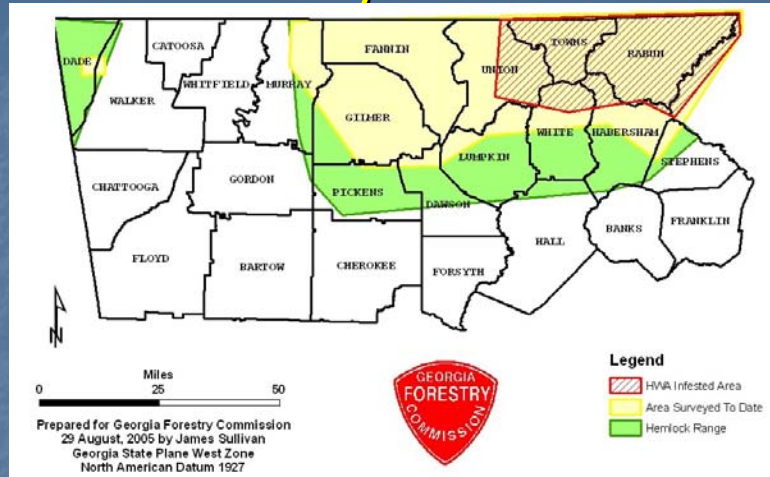
-Decline



Dieback-

Evidence of HWA attacks can be seen at a distance once the damage is severe. The lack of new growth (lighter needles are normally evident on the end of branches in healthy trees) is the first symptom. Trees will then fade from their normal green shade to a duller green or brownish-green when in decline (photo at left). Once branch dieback occurs (photo right), death will soon follow.

## 2005 Survey – GFC / USFS



### ***HWA is moving faster than projected!***

- Supposed to move about 15 miles/year (based upon surveys to the north)
- Moving at about 20-30 miles per year in Georgia
    - Inadvertent introductions, HWA finds our warmer climate more desirable, perhaps our hemlocks aren't as vigorous – many other theories...

Through a grant from the U.S.D.A. Forest Service, the Georgia Forestry Commission began surveying for the Hemlock Woolly Adelgid in 2003. The initial survey only found Hemlock Woolly Adelgid damage in northeastern Rabun County as it spread from South and North Carolina into the Peach State. Surveys have occurred in 2004 and 2005 and HWA damage can be found in 5 Georgia Counties now: Rabun, Habersham, Towns, Union and White. Other states have reported annual spread of HWA of about 15 miles per year, but we think it is moving faster in Georgia. Perhaps this is due to natural causes such as HWA finding our climate to its liking. There is also the possibility that humans or wildlife are moving the insects into uninfested areas (such as birds, insects, or man activities such as right of way mowing on roadsides).

It should be noted that although widespread damage has occurred in these 5 counties, all hemlocks are not dead within the shaded area on the map.

## What we're doing in Georgia

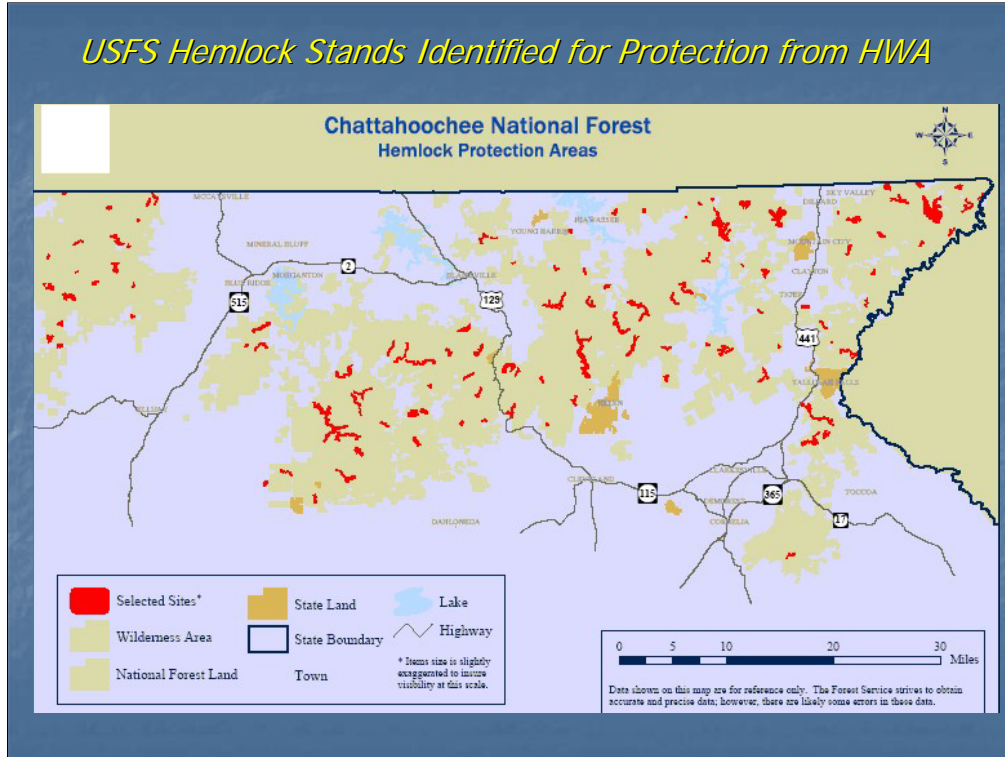
- Educating foresters, extension agents, cities, arborists, homeowner assoc
- Direct control on shade trees-homeowners and cities
  - Soil Drench/injection & direct tree injection - systemic insecticide
    - Imidacloprid ("Merit")
  - Direct sprays on infested foliage
    - Pyrethroids
    - Horticultural Oil
    - Insecticidal soap



is funded by the U.S.D.A. Forest Service Georgia Forestry Commission. The University of Georgia is currently in a trial phase with both HWA and biological release

The Georgia Forestry Commission, University of Georgia, USDA Forest Service and many concerned private groups have worked to educate and alert the public about the HWA problem. Educating natural resource managers such as foresters, extension agents, city and county officials, arborists, homeowner associations and individual homeowners about direct and indirect controls of HWA have been a high priority but there is a great deal of further work to do in this arena to get the message out to the general public. Insecticide treatments of high value shade trees and stands of significant hemlocks in the forest provide good protection in the short term, but this is impractical to protect the majority of our hemlocks (250,000 acres in Georgia!). The best long-term hope at minimizing the damage caused by the Hemlock Woolly Adelgid is by the rearing and release of several species of biological insects that feed solely on HWA (and don't impact any other species of insects).

## USFS Hemlock Stands Identified for Protection from HWA



The single largest landowner of Hemlocks in north Georgia is the U.S.D.A. Forest Service and a formal Hemlock protection plan has been developed and approved. They have identified significant stands of Hemlock throughout the Chattahoochee National Forest that will be protected from HWA. This protection will be done by using a combination of insecticides to treat individual trees and predator releases to protect more remote stands of Hemlock. Insecticides will also be used in high use areas that are easily accessible such as camp grounds, picnic areas, and some trail areas. More remote stands will be protected by a combination of chemical control as well as releasing the biological control insects. As you can see from the map, Hemlock throughout the Chattahoochee are scheduled for treatment.

## Biological Control Measures



- Rearing facilities:
  - Clemson University
  - Univ. of Tennessee
  - N.C. Dept of Ag
  - Virginia Tech University
  - University of Georgia?  
If funding is available.



Rearing cages for *Sasajiscymnus tsugae* beetles at Clemson University

Raising insects is a highly specialized, technically demanding and expensive discipline!

Four insect rearing labs currently are operating in the southeastern U.S.: Clemson University, University of Tennessee (Knoxville), N.C. Department of Agriculture, and Virginia Tech University. The best hope of controlling HWA on a regional scale is by the use of these biological species. Rearing these insects is technically demanding, highly specialized and quite expensive! Other labs have been funded through a combination of federal and state dollars combined with grants and private donations, and it will take a similar commitment for the Georgia Lab to become a reality.

## Insect Rearing

- Clemson University and University of Tennessee are rearing 2 species of predators at this time
  - *Sasajiscymnus tsugae* & *Laricobius nigrinus*

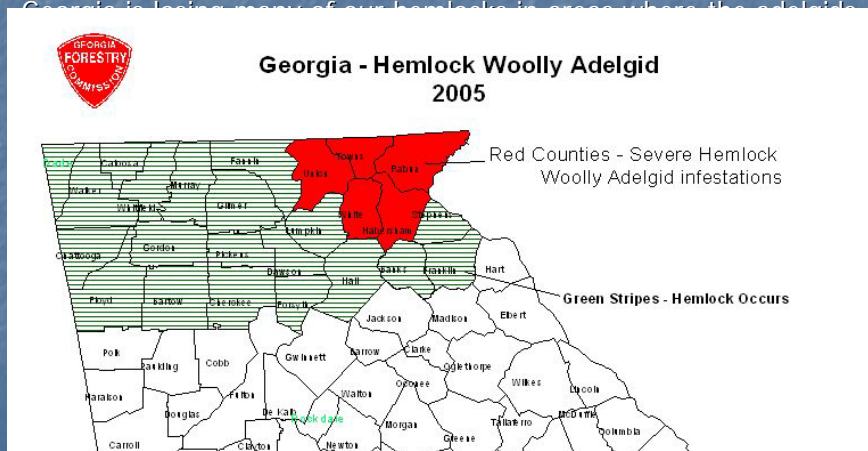
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Clemson and Tennessee are each raising 2 species of predators at this time and if the Georgia lab becomes a reality, it would begin rearing a 3<sup>rd</sup> species. These labs would cooperate and share insects so that all three species can be released in each state. This mixture of multiple species may be the best hope we have to control the spread of HWA and protect our hemlocks!

## Summary:

- Hemlock Woolly Adelgid has spread through most of the southern Appalachians and first entered Georgia in 2003
- Since entering Rabun County, it has spread into 4 other adjacent counties (5 Counties now have HWA damage)
- Georgia is losing many of our hemlocks in areas where the adelgid



The HWA was first detected in Georgia (Rabun County) in 2003 and has since spread into 4 other counties. Based upon the Georgia Forestry Commission surveys in 2003-2005, trees attacked for 2 or more years often are in severe decline or have died. It should be noted that ALL hemlocks in these counties (red on map) are not infested or dead. Many experts anticipate that a high percentage of both wild and urban trees will be lost if no action is taken.

High value shade trees in urban areas or groups of trees in the forest deemed to have significant importance should be treated with insecticides. Systemic insecticides provide 2+ years of control and resistance to HWA.

The USDA Forest Service has a very informative web site on all aspects of the HWA issue, and the Chattahoochee Ranger District has a management plan in place for both short term and long term protection of their Hemlocks from HWA.

## UGA Lab

- Biological Predator Insects being reared and released offer the best potential for long term control of HWA
  - Thus far with the releases in Georgia, the HWA is still advancing and causing damage (based upon observations in SC, NC and Georgia)
  - This is not unusual for many biological control agents – they often take years to build up population levels to make a difference
  - These biologicals (even though they don't provide the "quick fix") are the only long term solution science has to offer at this time
  - **NO GUARANTEES**
- University of Georgia has a building suitable (on the Athens campus) for the project that must be renovated as a first step
- A grant has been applied for that would match non-federal dollars 50-50 to get the lab going
- **Seeking state and private funding now**

Georgia has released some insects reared at the Clemson lab, but these have all occurred near the Chattooga River in extreme northeast Georgia. If we are to have biologicals released throughout our hemlock range, it will be necessary to have our own Georgia lab. These release sites have been studied (by Dr. Wayne Berisford, Professor of Entomology, UGA), and very little control has occurred based upon the release of 1 species. However, this is not unusual for most biological control agents – they tend to take years to build up adequate numbers to make a difference on the problem. There is no guarantee with any biological (or group of species) that they will absolutely be the effective answer to the problem, but they are the best science has to offer at this time. If the UGA becomes reality, it will raise a 3<sup>rd</sup> species (different from the species being raised at Clemson University and University of Tennessee), and these 3 institutions have met and agreed in principal to work cooperatively and share the insects being reared. Most experts believe that multiple predator species being released will give better control.

The Georgia lab will require funding from federal, state, and private sources to become a reality. The University of Georgia has identified a building (on the Athens campus) that would be suitable – once renovations are done.

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This presentation is available on-line at:  
<http://www.gainvasives.org/hwa/>