



LEWIS F. ROGERS INSTITUTE FOR  
ENVIRONMENTAL AND SPATIAL ANALYSIS

**Environmental Education Workshop 2**  
UNG – Dahlonega Campus  
Hurricane Creek, Lumpkin County, Georgia  
May 04, 2019



Grant #  
00D882218

## Welcome to the Environmental Education Workshop.

We are thrilled that you have decided to attend this workshop! At the workshop, our goal is that you learn more about north Georgia's forests, soils, water, and environment. With this information we hope that our communities will become responsible stewards of the air, water, and soils in north Georgia. We hope the workshop is both enjoyable and educational. Finally, we encourage you to share the information learned today with your friends, family, and neighbors to have the largest positive impact on our communities to keep our air, soils, and water clean and safe. If you have any questions, please contact Dr. Allison Bailey or Dr. Jamie Mitchem. Enjoy the workshop!



## **Environmental Education Project**

The project objectives focus on comprehensive knowledge, application, technology, and environmental science skills on the environmental issues of invasive insect species, vegetation management, impairment of waterways due to sediment, soil and water quality issues affecting native forest ecosystems in urban, suburban, or rural communities, as all of these community types have native forest ecosystems in Georgia. One of the major issues in vegetation management is how to control invasive plant species without the excessive use of pesticides. Most citizens cannot identify native species in the Foothills landscape, nor proper methods for treatment; and therefore, are unable to act as good stewards of native forests/trees in Georgia rural, suburban, or urban landscapes. Learning activities on native/invasive plant identification and best treatment practices will mitigate this lack of knowledge.

### **About the Grant Team**



Dr. Allison Bailey (Left) & Dr. Jamie Mitchem (Right)

#### **Dr. Allison J. Bailey**

Associate Professor of Geography & Environmental Sustainability Studies, IESA

Dr. Bailey's teaching emphasizes environmental communication, human interaction with nature, and conducts research on forest health, tree canopy, wildlife habitat, and public green spaces.

#### **Dr. Jamie Mitchem**

Professor of Geography/GIS, IESA

Dr. Mitchem's teaching and research have been in the areas of hazards geography, Geographic Information Science (GIS), meteorology, storm chasing (tornadoes), climatology, climate change, social vulnerability, and emergency management.

#### **Jacob Lougee, Student GIS Technician**

##### **Student Workers:**

Natalie Crews, Biology Major

Aaron Carney, Environmental Spatial Analysis Major

Michelle Ortiz, Journalism Major

If you need this document in another format, please contact Dr. Allison Bailey at [allison.bailey@ung.edu](mailto:allison.bailey@ung.edu)

## Collaborating Partners

Sustaining Georgia's green legacy by partnering with individuals, organizations, and communities in raising awareness toward improving and maintaining Georgia's community forests.



Promote sustainable management that leads to naturally diverse and healthy forests and watersheds within the more than 867,510 acres of national forest lands in Georgia; to engage and educate the public to join in this effort; and to promote preservation of this legacy for future generations.

The Georgia Forestry Commission (GFC) is a dynamic state agency responsible for providing leadership, service and education in the protection and conservation of Georgia's forest resources



**GEORGIA FORESTRY COMMISSION** *protecting and conserving Georgia's forests*



Chattahoochee Riverkeeper is an environmental advocacy organization dedicated solely to protecting and restoring the Chattahoochee River Basin.

*Keeping Watch Over Our Waters Since 1994*

The Georgia Master Gardener Association, Inc. (GMGA) has as its primary purpose the support of and advocacy for master gardeners and master gardener organizations throughout the state. We work collaboratively with the University of Georgia (UGA) Extension to provide unbiased, research-based horticultural information to the public through our master gardener extension volunteers.



Lumpkin Coalition is a diverse group of wonderful folks -- young and not-so-young, working and retired, Georgia natives and transplants from all over the country -- united by a common commitment to preserving and enhancing the special quality of life here in north Georgia.

The Hall County Master Gardener Extension volunteers help the University of Georgia Cooperative Extension staff convey research-based information about gardening, horticulture and best practices to the public.



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## Today's Agenda

<u>Time</u>	<u>Speaker</u>	<u>Topic</u>	<u>Location</u>
<b>9:00</b>		Registration	inside
<b>9:30</b>	Bailey	Orientation/Welcome	inside
<b>10:00</b>	Mitchem	Weather & Climate	inside
<b>10:30</b>	Riddle	Georgia's Mountain Treasures	inside
<b>11:30</b>	MacAllister	Gardening & Pollinators	inside
<b><u>Noon</u></b>		Lunch	
<b>12:30</b>		Transport to Hurricane Creek	
<b>13:00</b>	Rogers	Soil Condition & Sampling for Hemlocks/Chestnuts	
<b>13:30</b>	Hawkins	Tree planting, watering, and mulching demo	Hurricane Creek
<b>14:00</b>	Bailey	Tree Identification & Assessment	Hurricane Creek
<b>14:30</b>	Student Guide	Trail Walk & Exploration	Hurricane Creek
<b>15:00</b>	James	Streambank Restoration at Hurricane Creek	Hurricane Creek
<b>15:30</b>		Transport to Campus	
<b>16:00</b>	James	Wooly Adelgid and Predator Beetles/ Ecological Protection Lab	Lab
<b>16:30</b>	Bailey	Closing Remarks	inside

## Weather and Climate



Trees affect our climate, and therefore our weather, in three primary ways: they lower temperatures, reduce energy usage and reduce or remove air pollutants. Each part of the tree contributes to climate control, from leaves to roots. The outdoor air conditioning provided by trees reduces the energy used inside your home or office. Shade provided by strategically planted

deciduous trees cools buildings during the warm months, allows the sun's warming rays to shine through its branches in the winter and also protects buildings from cold winds. With some planning, urban trees can help minimize the heat island effect that saddles many cities.

UNG has data collecting weather stations at each of the five campuses. The study of weather provides an excellent foundation for science, technology, engineering and math (STEM) education. The system provides an array of public safety features including lightning alerts, severe weather alerts, temperature forecasts, environmental cameras and agricultural monitoring. It also archives past weather and gives weather forecasts for the coming days. The data can be used to teach about atmospheric pressure, wind speed and direction, and cloud types. The system creates cloud movies, 24-hour time-lapse videos that show the sky conditions for an entire day, in less than a minute. The videos are linked with graphs of temperature, pressure, and dew point.



The UNG Weather STEM Station

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## Georgia's Mountain Treasures



An important part of Georgia Forest Watch's mission is to protect Georgia's last remaining wildlands – pockets of forested land that are wild and without roads, and home to some of the most remarkable biodiversity in the world. These wild places offer unspoiled scenic beauty and an escape from our fast-paced urban lives. For many of us, there is no greater joy than to hike deep

into the woods where the sights, smells and sounds are only those of the forest. Some of these wildlands in the Chattahoochee National Forest are permanently protected within the National Wilderness Preservation System (117,837 acres), and almost 65,000 acres are protected as Inventoried Roadless Areas. Unfortunately, many important wildland tracts in the Chattahoochee National Forest remain that are not adequately protected (approximately 300,000 acres).

One essential component of ForestWatch's preparation for the plan revision is to update the report, "Georgia's Mountain Treasures: The Unprotected Wildlands of the Chattahoochee National Forest," compiled by The Wilderness Society in 1995, with the help of allied organizations, including ForestWatch. The original publication was part of a Mountain Treasures series by The Wilderness Society in the 1990's that identified and described the unprotected wildlands in each of the six national forests in the Southern Appalachians. The Mountain Treasures series emerged at critical times in the forest planning processes for these national forests. The purpose was very specific: to give the public accurate, detailed information about wildlands in these forests so citizens may speak effectively on behalf of these special places.

## Gardening and Pollinators

Pollinators play important roles in biodiversity, crop production, and even the economy. A 2014 economic impact study by University of Georgia experts determined that the annual value of pollination to Georgia is over \$360 million. Even better? The services pollinators provide is totally free.

Pollination is key to seed production, and without pollinators like hummingbirds, bees, ants, butterflies, wasps, and many others, our favorite fruits and vegetables would never make it to our tables. Pollinators are also key to the survival of wild plant species, they help to control pests that destroy agricultural crops and they help in decomposition, which is extremely important in crop production because the process aerates the soil.

Although wasps, ants, and bees don't yield warm and fuzzy feelings for most people, that doesn't mean they should be ignored. Pollinator populations are decreasing. Not only in population, but also in diversity. Research from UGA is helping to identify not only the reasons behind the decline, but also what homeowners can do to help them. To help pollinators like bees and butterflies do their jobs of moving pollen, home gardeners can provide a habitat that provides water and shelter.



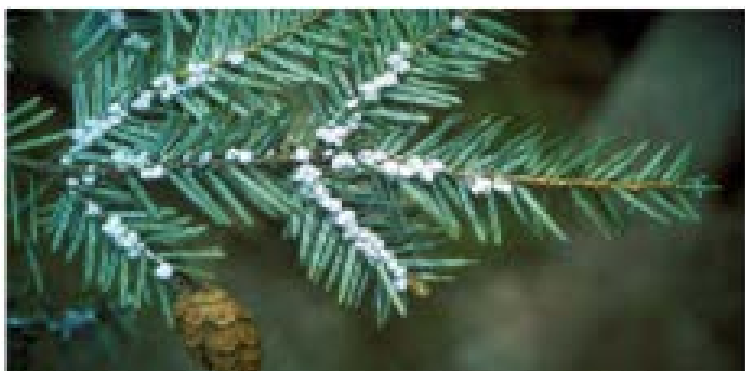
A pollinator-friendly garden can be created in the shade. For homeowners surrounded by shade, pollinator-friendly landscapes can seem unattainable, but they don't have to be. Landscapes graced with trees and an abundance of shade can be great resources for pollinators, too.

<http://extension.uga.edu/topic-areas/timely-topics/pollinators.html>



## Soil Condition and Sampling of Hemlocks

Similar to the blight that killed over 3 billion American Chestnut trees throughout eastern North America in the 1930's, another pest, the Hemlock woolly Adelgid (HWA), has been destroying our Hemlock forests since the 1950's. In Georgia, HWA infestations have reached Rabun, Habersham, Stephens, Towns, White, Union, Fannin, Gilmer, Pickens, Lumpkin, and Dawson Counties and are traveling fast. It is predicted that 90 % of our Hemlocks may die in the next few years. Brought into forests and neighborhoods by birds, squirrels, deer, wind, humans, and the planting of infested trees from other areas, the HWA, an aphid-like insect about 1/32



Woolly Adelgid infesting a Hemlock tree's needles

inch long, attaches itself to the base of the Hemlock's tiny green leaves and sinks its mouthpart into the tree's tissue, sucking out the sap and injecting a toxic saliva. Unless treated, the Hemlock sickens and dies, sometimes within only 2-4 years in the south. The fight is for the very survival of the Hemlock species. Unless stopped or significantly slowed, the spread of the Hemlock woolly Adelgid in Georgia will have enormous and lasting consequences:

- **For fish and other wildlife** – loss of the protection, habitat, and cooling effect of Hemlock canopy; permanently altered ecology or forest floor and hydrology of streams and rivers; decreased numbers of trout in particular as water temperatures rise.
- **For native plant species** – loss of a tremendous number of native plant species that depend on the deep shade and forest floor ecology maintained by hemlocks; resultant loss of food sources for wildlife; rampant increase of invasive, weedy plant species.
- **For homeowners** -- loss of aesthetics in their landscaping and possible decrease in property value.
- **For hunters, fishermen, and other outdoorsmen** – loss of recreational environment.
- **For tourism and related industries that depend directly or indirectly on the Hemlock tree** – huge loss of revenue that could reach into the millions of dollars as it already has in North Carolina.

## **Tree planting, watering, and mulching**



With proper care, trees can be valuable commodities around our homes, communities and urban landscapes. Providing care requires understanding tree biology, or how and why trees function. Trees constantly interact with the environment, including changes in soil, light, temperature, moisture, competitors and pests. Humans can produce additional stress by altering environments, but with proper care and maintenance trees can survive and thrive in your landscape. To best care for shade and street trees, it is important to learn to recognize

problems and understand how trees react to changes in their environment. Caring for trees when they are young can prevent many major defects as they mature and ensure good growth with long-term structural stability. Trees with structural weaknesses can be potentially dangerous to humans and property. These “hazard” trees need to be identified and immediately removed. Proper care can also correct life-threatening problems, ensure continued health and protect trees from environmental extremes and construction damage. Correctly diagnosing the real cause of problems rather than simply treating symptoms is important. For example, treating a symptom, such as yellow foliage, by applying fertilizer without first determining the true cause of the yellowing may cause undue stress for the tree. Timely treatments that are properly applied will keep trees in the best health possible.



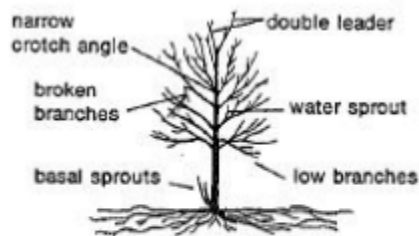
Young trees less than three to five years in the yard require special care to ensure establishment and rapid growth. Early care develops an adequate root system and a strong supportive branch structure. The time and expense invested to train a young tree is much less than treating problems as the tree matures. Young trees may require staking, wrapping and corrective pruning. Proper mulching and control of competition can speed growth. Trees require plenty of available water and essential elements for good growth. Young trees need protection from lawn mowers, weed eaters, vandals and construction activities.

## Tree Planting Concepts

1. Assess planting site characteristics prior to species selection
2. Determine the available soil volume for the site
3. Specify small caliper trees when possible
4. Prepare a large planting area
5. Ensure the root collar of the plant is flush with natural grade
6. Remove deformed roots and foreign materials from root balls
7. Do not wrap the trunk in most cases
8. Stake or guy the plant only if necessary
9. Prune judiciously
10. Implement a plant health care program



**Figure 3.** Dig the planting hole two times wider than the root ball. Make certain the top of the root ball is level with the soil surface.



**Figure 9.** Prune to a central leader. Remove all broken, weak and interfering branches. Prune to maintain the typical form. Remove problem branches as indicated.

## Native Trees of Georgia

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A list of native trees in Georgia.

## **Stream Bank Restoration**

River, stream, creek, brook, tributary, or branch these words all mean different things to different people. Throughout this publication, the word “stream” means any continuous or intermittent flowing water regardless of the channel size. It is the nature of a stream to change its course, constantly shift, and meander. Erosion of streambanks is a natural part of this process by which the stream adjusts to changing conditions within the channel and its watershed. If you try to interfere with this process, you will be in a long-term battle against the natural tendency of the stream to move and change. However, because of man’s development, especially in urban areas, this process may be accelerated. The shape of the stream channel is a result of the flow of the water, the sediment carried, and the composition of the streambed and streambank materials. A stream channel must simultaneously accommodate the flow and carry its sediment load within the streambanks. The stream forms a continuous system of pools, riffles, bars, and curves to absorb the energy of the flow.



Streams are rarely perfectly straight. What appears to be a “straight” stream is in reality made up of small curves not easily recognized. Flowing water has a natural tendency to meander from one side to the other of a channel, and soil, sand, and gravel are washed away from the areas where the current is fastest and deposited where the water moves more slowly.

Changes in streamflow, sediment load, and erosion or deposition on the streambanks will cause the stream to seek a new balance. Increasing paved areas or removing vegetative ground cover in the watershed will reduce the infiltration of rainfall and cause more runoff from the land. This leads to higher stream flows with an increased capacity to scour streambeds and undercut streambanks. Soil erosion from adjacent lands will cause increased sediment build up if the stream flow is insufficient to carry the load of soil (sediment) along the stream.



For those of you who live in urban or suburban areas, it is likely that your stream channel has or is in the process of adjusting to increased runoff by eroding deeper and/or wider. Many urban streams which have eroded their banks so that the channel can carry greater flows will have

lost the streamside vegetation that helps control bank erosion.

Streambank erosion is a natural process that occurs when the forces of flowing water exceed the ability of the soil and vegetation to hold the banks in place. Natural rates of streambank erosion vary with stream size, the amount of vegetative cover, and the type of soil in the streambank. Under well-vegetated conditions, the smallest streams (those without any tributaries) may show little evidence of erosion over periods of several decades unless subjected to extreme flood events. Large streams, on the other hand, often show evidence of noticeable erosion, especially on outside bends. The forces that cause erosion increase during flood events,

and most erosion occurs at these times. Human disturbances to watersheds that increase frequency and magnitude of runoff events also increase streambank erosion. Human disturbances include logging, mining, agriculture, and urbanization. Typical urban or suburban developments which may impact a stream include houses, garages, parking lots, and walkways, including areas cleared of forest and replaced by tailored lawns.

**TABLE 1**  
**EROSION TYPES AND CAUSES**

Type of Erosion	Causes
<b>General bank scour</b>	Increased discharge resulting from watershed changes; increased flow velocities caused by reduction in channel roughness or increased gradients; removal or loss of bank vegetation.
<b>Toe erosion and upper bank</b> especially along outside bends.	Removal of unconsolidated or loose lower bank materials, <b>failure</b> Widespread toe erosion may be associated with bed lowering
<b>Local streambank and streambed scour</b>	Scour of local lenses or deposits of unconsolidated material; erosion by secondary currents caused by flow obstructions and channel irregularities; loss of bank vegetation. Local bed scour may be caused by channel constrictions and flow obstructions. Some bed scour generally occurs below culverts.
<b>Overbank runoff</b>	Failure to provide adequate means of directing concentrated flows from overbank areas into the channel.

*Adapted from Nelson R. Nunnally*

Loss of streambank and streamside vegetation reduces the resisting forces and makes streambanks more susceptible to erosion. This is often the single greatest contributing factor to harmful or accelerated erosion on small and medium-size streams. Streambank vegetation may be removed intentionally for various reasons, or its loss may be inadvertent due to trampling by animals or humans.

**TABLE 3**  
**GENERAL GUIDANCE**  
**FOR ESTABLISHING SEVERITY OF EROSION**

Degree of Erosion	Characteristics
<b>Stable to Mild</b>	Little or no evidence of erosion; if eroding banks are present, they are small in extent (linear extent less than average bank height) and rates are modest (less than ½ foot per year); greater erosion may be tolerated at bends if it causes no associated problems.
<b>Moderate</b>	Extent of problem or rate of erosion exceeds criteria for stable class, but is less than severe.
<b>Severe</b>	Erosion covers large area of bank (linear extent greater than three times average bank height) and is occurring at a rate in excess of one foot per year or a rate that is unacceptable for safety, environmental, or economic reasons.

*From Robbin B. Sotir & Associates*

## **Ecological Protection Lab**

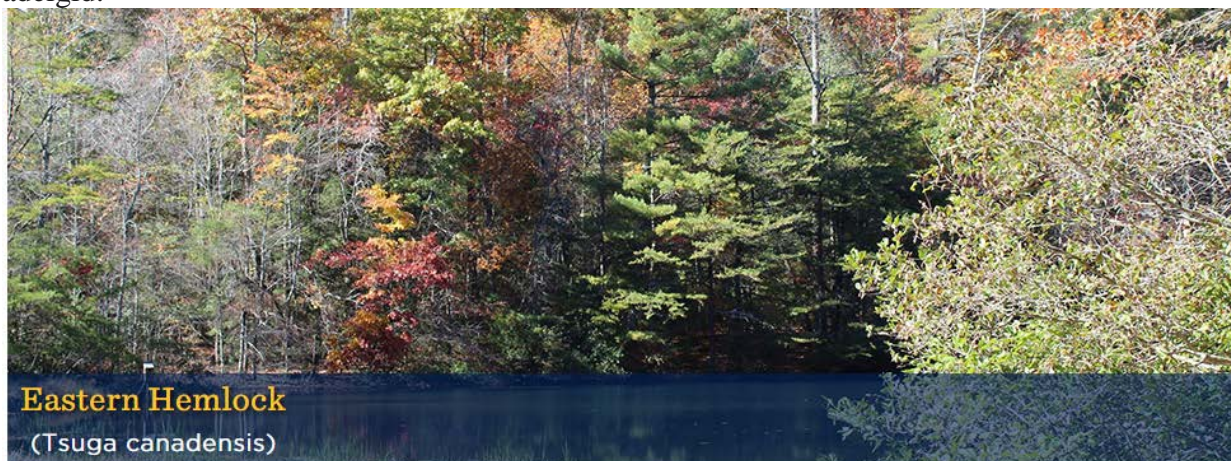
The UNG Ecological Protection Lab (formerly the Beetle Lab) has led in regional efforts to protect the Eastern Hemlock from the invasive Woolly Adelgid by initiating biological control efforts through the rearing and release of predatory beetles to reduce adelgid numbers and impacts.

During a field botany class a few years ago, a seed was planted in Dr. Robert Fuller's head (professor and Environmental Leadership Center director). The instructor of the class, Mark Warren, owner of the Medicine Bow outdoor school, was expressing the value of hemlock trees to the entire ecosystem and the grave risk they face from the hemlock woolly adelgid (HWA). The seed started germinating as he learned about the efforts to control this noxious pest locally by working with Young Harris College, Clemson University, and the University of Georgia (UGA).

These labs have been working with imported beetles that prey on the HWA. Dr. Fuller felt that it was time for the University of North Georgia (UNG) to help fight in this battle too. Fortunately, this notion was allowed to sprout. Two people stepped in to help nurture Dr. Fuller's idea. First, Dr. Mike Bodri, Dean of the School of Science and Health Professions, offered his support and bountiful expertise.

Secondly, Representative Amos Amerson was able to obtain ample funding to hire a full-time lab coordinator and support the lab in terms of materials and supplies to get the lab up and running. Soon members of the community stepped up and provided their support by volunteering and providing funding and donations. Three local nonprofit organizations, The Lumpkin Coalition, Upper Chattahoochee Riverkeepers, and Georgia Trout Unlimited, bestowed upon us the necessary monetary donations. Local residents even donated refrigerators, 5-gallon buckets, and their time to help support the cause.

The creation of this lab, the efforts from its workers and volunteers, and the increase of knowledge throughout the community will all aid in this battle against the hemlock woolly adelgid.



**Eastern Hemlock**

(*Tsuga canadensis*)

## The Woolly Adelgid and Predator Beetles

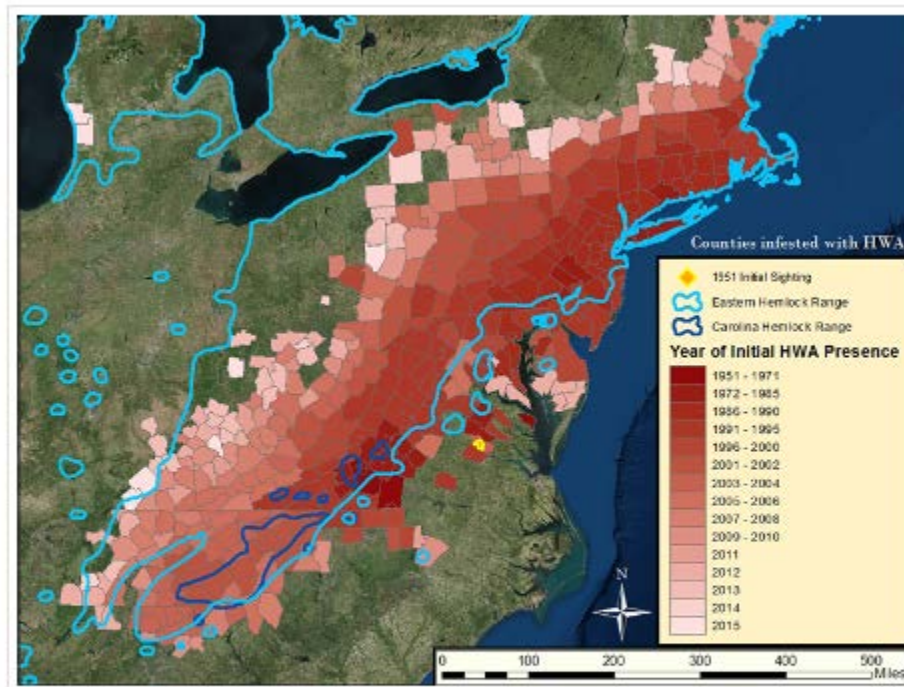
The Hemlock Woolly Adelgid (HWA) is an aphid-like insect that feeds mainly upon Hemlock tree species and was introduced into the eastern United States from Japan in 1951 by import of nursery stock. Since its introduction, HWA have spread to 17 states from Georgia to Maine where they cause large scale mortality of Native Eastern and Carolina hemlocks. This tiny parasite spreads across the forest by hitch-hiking on birds.

HWA use sucking mouthparts to pierce through the base of the hemlock needles into the parenchyma cells (nutrient transport cells). Large infestations can quickly deplete trees of their vital nutrients. Early impact to trees infested with HWA include loss of needles and stunts the growth of new needles and branches. If left untreated, HWA infestations can result in hemlock tree death within 3-5 years of infestation.

In their home environment of Japan, HWA experiences heavy predation, mostly from beetles, that they evolved an impressive bi-annual reproduction cycle. It is precisely these reproductive traits that allow HWA to have such rapid effects on hemlock trees in the U.S. where they have no natural predators.

During most of the summer they aestivate on the needles (basically a long sleep), once temperatures get colder they develop a white woolly egg mass. This generation is fully developed in the winter, will begin feeding, and reproduce in the spring. The second generation feeds and produces a new generation that will crawl to a needle to aestivate for the next summer, thus repeating the lifecycle. In the U.S. all HWA reproduction is asexual, a sexual generation does occur in its native range but targets a different tree species that is not present in the U.S.

When the U.S. realized how important it was to control HWA, several exploratory missions were sent to hemlock forest in Japan and the Pacific North West to identify natural predators of HWA. A handful of predatory beetles that coevolved specialized feeding on HWA were chosen as biological control agents. The UNG Ecological Protection Lab primarily breeds



Spread of HWA Since its Introduction  
1951 - 2015



two species of beetles: *Lacricobius nigrinus* (Ln) and *Sasajiscymnus tsugae* (St). Our lab, along with UGA and Young Harris, obtain a small amount of beetles each winter which we breed in the lab. These lab reared predators are then released into selected Hemlock Conservation Areas around North Georgia.

**Georgia has released nearly 1.4 million predatory beetles since 2004.**

### **The Problem: Hemlock Woolly Adelgid**



### **The Solution: Predator Beetles**

HWA is never going to be fully eliminated from the area, but the goal is to establish the predators to keep HWA populations at levels that no longer cause hemlock mortality. This is a complex process that involves understanding the lifecycle and environmental variables that influence both HWA and the predator beetles. The optimum time, locations, and species of beetles being released is a major area of future research. Lots of this research relies on conducting field surveys of predatory beetle establishment and hemlock health in order to learn what management techniques are working the best.

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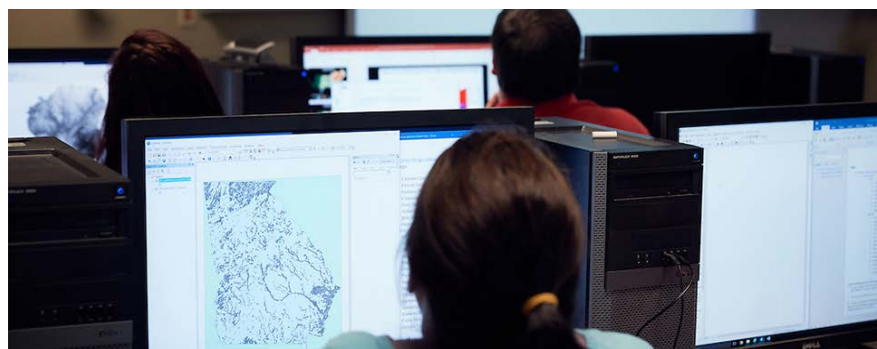
Established in 2001, the Lewis F. Rogers Institute for Environmental and Spatial Analysis (IESA) on UNG's Gainesville Campus promotes environmental education through the use of advanced technology, interdisciplinary instruction, collaborative learning, and community service. Graduates from our degree and certificate programs have found employment at impressive rates and many go on to reputable graduate schools throughout the United States. Our students follow a curriculum built around a solid core of geospatial science and technology and related courses in areas of their interest, such as environmental science, environmental studies, engineering, education, urban planning and community development, environmental health, and the geosciences. Students find the flexibility to follow their passions, while earning valuable, work-ready training in applied geospatial techniques.

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## Notes