

LANDSCAPE *culture*

Contents

About Us 1

Checking Up on Hemlock Health: Parks Treat Woolly Adelgid 1

Employee Spotlight: Adam Foldesi . . 4

Temporary Irrigation for Tree Establishment 5

Tool of the Moment: Wood Chipper . 7

Announcements & Publications. . . . 9

Upcoming Training Opportunities . . 9



Dan Bryson demonstrates stem injection tubes of imidacloprid at Old Sugarlands GRSM. (Bryson, NPS)

About Us

[Cultural landscapes in the National Park System](#)

[Park Cultural Landscapes Program](#)

[Park Cultural Landscapes Program Sharepoint](#)

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Checking Up on Hemlock Health: Parks Treat Woolly Adelgid

Eastern hemlock trees are an iconic part of many eastern national park cultural landscapes, from the towering forests of Great Smoky Mountains National Park (GRSM) in Tennessee and North Carolina to the heavy history of Flight 93 National Memorial (FLNI) in Pennsylvania. These trees are so threatened by pest infestation that until recently, some cultural landscape treatment plans called for their removal and replacement with other species. Significant progress with protocols for hemlock preservation and pest management now provide alternatives to removal.



Hemlock needles infected by woolly adelgid, with visible white wool. (Wheeler, NPS)

In the 70 years since hemlock woolly adelgid (HWA, *Adelges tsugae*), a non-native, invasive pest that feeds on sap of the eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*), was first observed in Virginia, land managers and researchers have been working on solutions. NPS staff have been active in this effort creating management initiatives to protect hemlock. One of these initiatives includes the NPS work in the historic hemlock forest at Rapidan Camp at Shenandoah National Park in Virginia, an effort highlighted in the [Spring 2018 edition](#) of this

newsletter. Preservation efforts have intensified over the past 20 years as HWA spreads. Chemical and biological treatment techniques continue to have a positive impact on historic hemlock forests and ecosystem health.

Chemical Control

At GRSM, dedicated forestry staff have been working on hemlock monitoring and treatment since 2002. The park's Forester, Jesse Webster, points out that correctly identifying the problem impacting a declining hemlock is the first step towards effective treatment. Hemlocks can be impacted by elongate hemlock scale (EHS), spider mite, pathogens, and abiotic stressors such as root compaction or drought, but woolly adelgid presents as white wax filaments at the base of needles. "There are highly effective NPS approved chemical treatments available for both it [HWA] and also EHS control that can be very cost effective in the long run when dealing with high value trees," Webster advises.

Dan Bryson, GRSM Forest Technician who has worked on HWA since 2006, implements chemical treatments at intervals of 5-8 years per tree. Reporting positive results, he shared, "we have been moving some of our sites to 7- or 8-year intervals based on good tree health and lower adelgid levels." Bryson uses imidacloprid, a systemic insecticide, in chemical treatment techniques including soil drench, slow-release tablets, and injection. Dosage depends on the diameter at breast height (DBH) of each tree, with larger trees receiving more ounces of imidacloprid solution.



Kate Fisher monitors crown density in trees impacted by HWA in GRSM. (Bryson, NPS)

Partnerships and Monitoring

In addition to work by NPS staff, contractors and partners have also implemented successful chemical treatments. The FLNI hemlock grove is located adjacent to the crash site. The grove was impacted by the fire and crash. Plane debris and human remains were found in the grove. As such, preservation of the hemlocks is particularly important to park management. Contractors have applied treatments to the hemlocks at FLNI since 2013. Brenda Wasler, Natural Resource Manager for the National Parks of Western Pennsylvania, shares that FLNI just finished its third and final year of a contract for hemlock chemical treatment, and the park is working on a future partnership with PA Bureau of Forestry. Partnerships are also a valuable tool to strengthen parks' capacity for monitoring, drawing on methodologies developed by other government agencies.

A monitoring standard developed by the US Forest Service are the [Forest Inventory and Analysis \(FIA\)](#) protocols, which can be applied to rate hemlock health. Bryson explains the value of monitoring random trees within both treatment and control areas to see a big-picture view of hemlock health in the area. A hemlock's health, growth, and pest damage is reflected in its the crown, and one component of monitoring is assessing crown density (pictured below).

Webster points out that there may be an acceptable level of pest in the landscape, saying, "a hemlock tree that is more open-grown or that has been treated can tolerate HWA in low populations on some lower branches and needles."

Biological Control

The aim of chemical control is to help trees through the first period of infestation, with long-term hopes for biological control and ecosystem balance. Both parks report success introducing predator beetles (*Laricobius nigrinus*) that feed exclusively on HWA. These natural predators are native to the US Pacific Northwest and to East Asia. Check out videos of predatory beetle release in action at [Flight 93](#) and [Great Smoky Mountains](#).

Brenda Wasler describes the overall preservation plan for the hemlock grove at FLNI, explaining that "we use a multi-faceted approach to management." The park's hemlock management plan is supported by a 2013 USFS Silvicultural Prescription, as well as recent work by Dr. Bill Elmendorf from Penn State University who is in the process of creating a Tree Operations Manual for the site. Wasler continues, "Our goal is to sustain the



Brenda Wasler and Colleen Curry release predatory beetles to control HWA. (Mealey, NPS)

hemlock health long enough to build viable biological control populations. We've released two species of HWA biocontrols at FLNI, which attack different life stages of HWA."

In collaboration with these current efforts, Olmsted Center for Landscape Preservation recently drafted a Landscape Character Area Report (forthcoming). The report connects the significance of the hemlock grove crash site, which is open only to family of those who died in the crash and management staff, to appropriate treatment recommendations to maintain the natural hemlock character despite high levels of HWA.

Future Health

In line with Wasler's outlook on biological control, Bryson shares hope that cyclic retreatment of trees paired with established beetle populations will promote balanced ecosystems and long-lived hemlocks. He reports, "We are seeing beetles remaining on the landscape in areas where they were released 5-10+ years ago, which is a good sign! The hope being that one day the beetles will do the heavy lifting to keep the HWA levels in check."

While HWA continues to spread, including [recent discoveries](#) of the pest at Acadia National Park in Maine, monitoring, planning, and treatment comprise an effective model for preservation of historic hemlocks on the landscape for generations to come. The work of Wasler, Bryson, Webster, and others is a valuable case study in management tactics and implementation.

Employee Spotlight: Adam Foldesi



Foldesi taking up residence in a hazardous sugar pine he removed in the Mariposa Grove of Giant Sequoias. (Foldesi, NPS)

Name: Adam Foldesi

Park: Andersonville National Historic Site

Position: Horticulturist

Time with NPS: 6 years

What is your background?

Private and municipal Arboriculture. I got my start in trees with the City and County of Denver, Department of Forestry. I really fell in love with urban forestry, and tree care as a whole. I worked as a subcontractor for private companies climbing trees and consulting for homeowners about tree maintenance. In 2019 I began working for Yosemite's Forestry Division, and just came on with Andersonville in March, 2023.

What is your favorite part of your job?

I just love trees and I love being in a space where we can think of creative solutions for complex problems. In the NPS we have so many things that we value; natural resources, wildlife, history, education. Trees, surprisingly, are an oftentimes neglected aspect of our parks, and nothing alive thrives on neglect. As

an arborist, I get to use what I know about trees to help parks connect the dots on a lot of different management goals.

What project are you working on?

Right now I'm working on the National Cemetery Investment Initiative here at Andersonville. We are rehabilitating various parts of the landscape, including our beautiful oaks and magnolias.

What was your favorite experience with NPS?

That has to be doing backcountry tree work in Yosemite's High Sierra Camps. We would have packing mules pack in all of our equipment and get to do tree work in these beautiful remote areas of the Sierra. Truly unique experiences.

Temporary Irrigation for Tree Establishment

After a tree or shrub is planted in the landscape, access to water is the primary factor that determines survival. While over-saturation can kill a tree, lack of sufficient water is usually a greater barrier to plant establishment. Many tree and shrub species do not require irrigation after establishment. For these trees, consider using a temporary irrigation method through establishment (3-5 years). Plan the temporary irrigation system at the same time you are developing your planting plan.

Temporary Irrigation Systems

There are two primary forms of temporary irrigation systems: watering bags and above ground irrigation.




Watering Bags

Watering bags are sturdy, soft-sided plastic containers that you can wrap around a tree trunk and fill with water. You can fill watering bags in locations without access to water from a watering truck or a standard spigot and hose. The bags have a small valve or pin holes at the bottom that allows water to slowly drip into the soil, preventing runoff and allowing the trees to be watered with 15-45 gallons over the period of several hours. The major downside of watering bags is the labor involved in refilling them on a weekly to monthly basis, depending upon their size. In addition, because the



Three watering bags attached to the wooden stakes increase a tree's water supply, reduce moisture around the trunk, and encourage root growth outwards. (*Garden Professors*)

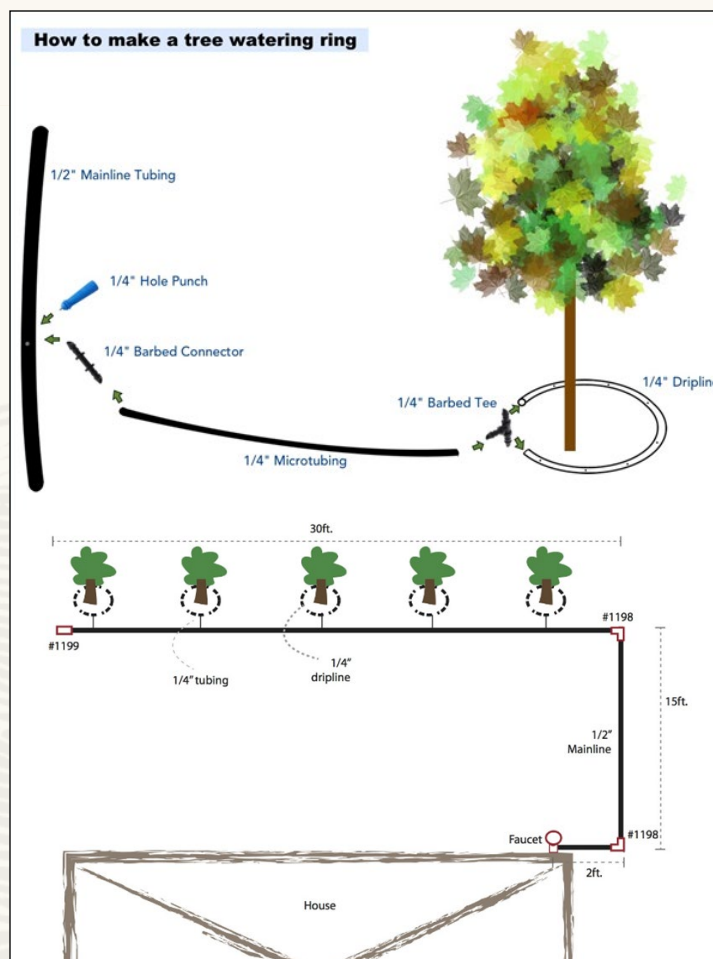
bags only deposit water around the base of the tree, the outer, newest roots will receive less water as roots grow. However, you can address this issue using multiple bags around the root zone, as shown in the photo above. Common types of watering bags include Tregators, Ooze tubes, and watering donuts. See the chart below to compare the three types of bags.

Watering Bag Pros and Cons				
Product Name	Appearance	Gallons	Pros	Cons
Tregator Original	 <i>Wandsworth Borough</i>	15	Capless design makes it easy to fill with hose.	Must remove in winter to avoid moisture build-up.
Ooze Tube	 <i>A.M. Leonard</i>	15, 25, 35, or 45	Larger size requires less frequent filling and reduces evaporation from the soil.	Larger size and label may make bag less attractive.
Donut Bag	 <i>City of Seattle</i>	15	Low profile, not visually obtrusive.	Cap can be difficult to open and they are more difficult to fill.

Above-Ground Irrigation

An above-ground irrigation system is attached to a water source that can be installed without digging holes in the ground. The advantage over a below-ground irrigation system is that you can install and remove it more quickly and attach it directly to a spigot. On the other hand, it is more visible and less durable. For trees, we recommend installing an above-ground system using flexible polyethylene tubing connecting to dripline or soaker tubing around each tree. (Soaker tubing should then be covered with mulch to prevent water loss to evaporation.) Attach a timer adjacent to the spigot and monitor output to determine effectiveness and frequency of watering needed. We do not generally recommend PVC pipe for above-ground systems because it is more visible than a polyethylene tube, costly, and time-consuming to install. You can use the above-ground irrigation system for 5 years through establishment, with the option to retain for periods of drought. In areas where freezing occurs, drain the line in the winter by attaching an air compressor to one end and blowing out the water.

Periods of increased temperature and drought are more frequent due to climate change. Once trees are established, be sure to provide supplemental watering weekly during periods of drought longer than what the trees species is adapted for.



Temporary poly tube irrigation system with driplines around individual trees. ([Drip Depot](#))

TEMPORARY IRRIGATION TIPS

WATER ACCESS

Water for temporary irrigation systems can come from an existing in-ground piped water source. If this is not available, a watering truck can be used to transport water to the site in a tank or bladder. A small water pump can pump the water from the truck to the plant.

PLANTING

Planting is recommended in the fall so that roots can establish through the winter when the soil is generally wetter. When planting a tree or shrub, water it thoroughly. Mulch the plant with 3 inches of woodchips or compost to reduce evaporation from the soil surface. Create a small 6-8 inch mulch berm 2-3 feet from the trunk to hold water.

HOW MUCH AND HOW OFTEN TO WATER

Soil properties, weather patterns (temperature and precipitation), plant size, and plant water requirements determine the amount of water and watering frequency a plant will need. Do not base watering frequency on plant condition, as you should water plants before they show signs of water stress like wilting.

After planting, water the plant daily for 1-2 weeks. After that, water the plant one to two times a week for the first 3-5 years. Water is not necessary in the dormant period, rainy season, or after heavy rains. Water approximately 10 gallons of water per inch of tree diameter at each watering.

Tool of the Moment: Wood Chipper

Wood chippers play an important role in the stewardship of cultural landscapes in national parks. Chippers can process woody debris into [mulch](#) that greatly reduces the bulk and volume of the debris to be disposed of or, better yet, used as mulch in the landscape around trees, shrubs, and garden beds.

Chipper Size

Chippers are categorized by the maximum diameter of material capable of being fed into the intake chute and processed by the blades inside the machine. Smaller farm chippers will accept material up to 3" diameter, cost around \$1,000, and may be small enough to maneuver around the landscape by hand. Larger commercial chippers can accept entire trees up to 21" in diameter and will cost upwards of \$150,000. Most parks that own chippers will likely be somewhere in the middle with diameter capacities between 6" and 12".

Most chippers are very portable and are usually attached to a truck-mounted hitch for transport to the job site. While bigger might seem better when it comes to processing large volumes of woody debris, there is a place for smaller stationary chippers when storage space is at a premium, or for applications such as processing small diameter material for composting operations.

Blade Design

Chippers have 3 types of cutting blade design, as follows:

Disc – A heavy steel disc with blades protruding from the flat face of the disc. Woody material meets the face of the spinning disc in a perpendicular fashion. This requires the wood to be actively (and safely) pushed into the blades by hydraulic infeed rollers.

Drum – Found on larger capacity chippers for high-volume applications such as clearing land, drum-style chippers have knives attached to a cylindrical drum that spins at a high rate of speed. Modern drum chippers will also have infeed rollers to control the material as it is consumed, a safety feature due to the fact that the spinning drum will grab and pull in material very quickly. Older drum chippers (a.k.a. the "chuck-'n-duck" style) may not have infeed rollers and should not be used since they lack modern safety features.

Screw – Cutting happens along a rotating spiral blade set parallel to the sides of the opening. The wood is

pulled in by the spiral action. This style is less common than either disc or drum chippers.

Chipper Safety

Although modern wood chippers are now designed with multiple safety features, they are still considered extremely dangerous and should only be used by properly trained park staff. The decision to buy a chipper of any size for park use must include consideration for the safety context within which it will be used. Standard Operation Procedures (SOPs) and Job Hazard Analyses (JHAs) should be a part of the required training prior to use.

Minimize the chance of brush snagging on clothing or other accessories by removing dangly keychains or gear from belts, and always remove chainsaw chaps before moving from pruning to chipping operations. Gloves are required for chipping operations and should be tight-fitting cuff style gloves (like Atlas or similar brands). Never use gauntlet-style gloves when chipping as the flared cuffs can easily get snagged by brush as it feeds into the machine. Eye and ear protection are mandatory, as are sturdy work shoes, preferably steel-toed boots. Two staff people should work together to operate larger chippers, one to feed debris and the other to stand by the safety shut-off valve. See [Chipper/Shredder Safety Manual](#) for more information.






What Chipper to Purchase

Consider how often your park plans to use a chipper, and purchase the size and style that best meets landscape maintenance needs. For occasional use, consider renting chippers by the day or week rather than committing to a costly purchase that will only take up space and require extra maintenance.

A larger and more robust chipper naturally makes sense for high volume applications such as forestry operations, while smaller operations such as orchard or ornamental garden may only require a small 3" farm chipper. Smaller chippers are also beneficial for composting operations when material needs to be broken down to decompose faster.

The chart on the following page describes the range of chippers and their best uses.

Comparison of Wood Chippers*

Chipper Type	Material Size	Pros and Cons	Price	Appearance
Small Farm	≤ 3"	Pros: Affordable for small sites with limited debris. Cons: Slow and not for processing large piles.	\$ (<\$5,000)	 <i>Bobvila.com</i>
Landscape Professional	≤ 6"	Pros: Good size for a small to medium sized park that has a regular shedding of branches or pruning. Easier to maneuver than larger chippers. Cons: Won't process large branches.	\$\$ (<\$10,000)	 <i>Carlton Professional Equipment</i>
Arborist Professional Disc	≤ 12"	Pros: Useful for most parks that handle small tree removals annually. Requires 2 or more sawyers and a place to deposit chips. Cons: Expensive and needs extra safety precautions.	\$\$\$ (>\$15,000)	 <i>Bandit Chippers</i>
Advanced Arborist Professional Drum	≤ 20"	Pros: For a park with a tree crews, a place to deposit the chips, and a need for a chipper much of the year. Can process trunk material efficiently. Cons: Expensive and needs extra safety precautions.	\$\$\$\$ (>\$20,000)	 <i>Global Machinery Sales</i>
Professional Tub Grinder	Variable	Pro: Can process a very larger amount of material in a short time. Cons: Would be better to rent for a specific project due to cost and size.	\$\$\$\$\$ (>\$30,000)	 <i>PAPE Machinery</i>

*The styles and brands of chippers shown represent a sampling of those available commercially as a starting point.

Announcements & Publications

» [July is Disability Pride Month](#) Disability Pride Month commemorates the anniversary of the signing of the ADA and serves as a reminder of the tremendous strides we have taken to ensure equal rights and opportunities for individuals with disabilities..

» [Tree Climbers' Guide Available Digitally](#). The International Society of Arboriculture has published a digital guide for tree climbers.

Preservation Horticulture Course at Gateway Arch last week of September

This three-day workshop provides participants with a foundation in maintaining trees and shrubs to perpetuate the historic character of a cultural landscape. [More Information](#).

Register here:

<https://forms.office.com/g/z6FsVqpN1x>



Upcoming Training Opportunities

Webinars/ Online Courses

[Wilderness Character Preservation and the NPS Wilderness Character Technical Monitoring Guide](#)

Tuesday, July 25 3:00-4:30 ET

Thursday, July 27 3:00-4:30 ET

[Perspectives on Tree Risk in Public Gardens](#)

July 26, 2:00 ET

[Tree Talk Tuesday - Healthy Urban Canopy/Tree Planting & After Planting Care](#)

Tuesday, August 8, 12:00 CT

[How do advanced decay detecting devices affect likelihood of failure ratings for trunks with decay?](#)

Tuesday, August 8, 2:00 CT

[Tribal Consultation Webinar Series](#)

Tuesday, August 22, 2023, 3:00 ET

[Identifying social barriers to equitable tree planting and quantifying potential benefits to overcoming them.](#)

Tuesday, September 12, 12:00 CT

[ISA Certified Arborist Exam Prep Course](#)

October 17-November 7

Tuesdays/Thursdays, 9:00 AM -12:00 PM ET

In-person Trainings

[Earthen Architecture Preservation and Repair](#)

October 16-20, Fort Davis NHS

[Western Hazard Tree Workshop](#)

October 17-19, Wenatchee, WA

[Tree Risk Assessment Qualification Workshop](#)

November 8-10, Redmond, WA

Video Corner

» This [playlist](#) developed by the Tree Care Industry Association provides the basics of brush chipper safety.

