Massachusetts Department of Conservation and Recreation

THE CITIZEN FORESTER

Urban & Community Forestry Program

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dcr Massachusetts

The Moon Trees

Next Generation of Tree Seeds Fly on Artemis I

More than a half-century ago, on January 31st, 1971, Apollo 14 Launched from Cape Canaveral, Florida. On this flight, the third to reach the surface of the moon, was an unusual payload. Part of astronaut Stuart Roosa's personal travel kit contained about 450 tree seeds. They had ended up there because of a joint experiment between NASA and the U.S. Forest Service, to

NASA astronaut Stuart (Stu) Roosa, the command module pilot for the Apollo 14 mission and a former USDA Forest Service smoke jumper. *Photo: NASA*

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determine the effects of deep space on seeds, and to help raise awareness about the Forest Service and the wildland forest firefighters called smokejumpers. Roosa was born in 1933 and grew up in Oklahoma, where he attended high school and studied at Oklahoma State University. After High School in the early 1950's Stuart worked for the United States Forest Service as a smoke jumper in Oregon and California, dropping into at least 4 active fires. Roosa graduated from the University of Colorado Boulder with a degree in aeronautical engineering in 1960. He then joined the Air Force and was an experimental test pilot at Edwards Air Force Base in California before being selected for the astronaut class of 1966. With this ideal background, the Chief Forester for the Forest Service, Edward Cliff, asked Stuart if he would be willing to bring the seeds to space.

The Moon Tree Team involved Roosa, Cliff, and Stan Krugman a geneticist at the Forest Service. They first had to select which tree species to send to space. They decided on trees that were common to most of the United States, so that they could be planted across the country on their return. The trees selected were: Loblolly pine (*Pinus taeda*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), redwood (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziessii*). The seeds were wrapped in a plastic casing separated by species. The bags were then put into a tin and eventually into Stuarts personal

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travel kit. Every astronaut was allowed to bring a canvas bag full of mementos, normally it included items like family photos, not future trees. As part of the experiment, there were also a set of control seeds that were left on earth, since it was unknown how zero gravity and exposure to radiation would affect the seed growth. Stuart never actually touched the lunar surface since he piloted the command module "Kitty Hawk" that was orbiting the moon, while the other members of Apollo 14, Alan Shepard and Edgar Mitchell, spent time on the moon's surface. The seeds stayed with Stuart on the command module.

Apollo 14 returned to earth on February 9th, 1971, splashing down in the Pacific Ocean. Then disaster almost struck the seeds as they were unloaded. As part of the mission everything and everyone must be decontaminated. The seeds were taken out of the tin, but the seed bags burst inside a container and were exposed to a vacuum. People feared that the seeds would be unviable due to this. Krugman painstakingly removed all the seeds from the vacuum chamber. He then went through every seed, identifying them from what tree they came from, and organized them again. At the NASA facility in Houston, Krugman started to germinate some of these seeds. The seeds were feared to be dead, but surprisingly they germinated. Unfortunately, the seedlings he grew in Houston died since the Houston facility did not

An American Sycamore Moon Tree grown from a seed that flew aboard Apollo 14. Pisgah National Forest, North Carolina.

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have the proper equipment to maintain the seedlings. Fortunately, the remaining seeds were sent to other Forest Service offices for germination. The Loblolly pine, sycamore and sweetgum seeds were sent to a Forest Service facility in Gulfport Mississippi and the redwood and Douglas fir seeds were sent to a Forest Service facility in Placerville California. Many of the seeds were successful in germinating and grown into saplings. Some of these were planted at the Forest Service facilities next to their control trees, and after 50 years, there is no noticeable difference between the trees.

Soon, Moon Tree saplings were being gifted to schools, universities, parks, and government offices across the U.S. It was decided to use them as part of the Bicentennial celebrations of 1976. Not all States were given trees due to climate considerations. The first Moon Tree was planted in Washington Square, Philadelphia, Pennsylvania. Many were planted in historic locations for forestry and at many NASA facilities. Along with the tree a community received, they would also receive a telegram from President Gerald Ford:

> *I send warm greetings to those who attend this unique ceremony dedicating a small tree which was taken from earth to the moon on January 31, 1971 aboard Apollo 14. This tree which was carried by Astronauts Stuart Roosa, Alan Shepard and Edgar Mitchell on their mission to the moon, is a living symbol of our spectacular human and scientific achievements. It is a fitting tribute to our national space program which has brought out the best of American patriotism, dedication and determination to succeed.*
>
> *Planted in this community in our bicentennial year. May this young tree renew our deep-rooted faith in the ideals of our Founding Fathers and may it inspire us to strive for the kind of growth that benefits our own citizens and all mankind.*
>
> *Gerald R. Ford*

For a period, the final location of many of the Apollo Moon Tree seeds remained a mystery. Thanks to an inquiry from a third-grade teacher in 1996, NASA planetary scientist

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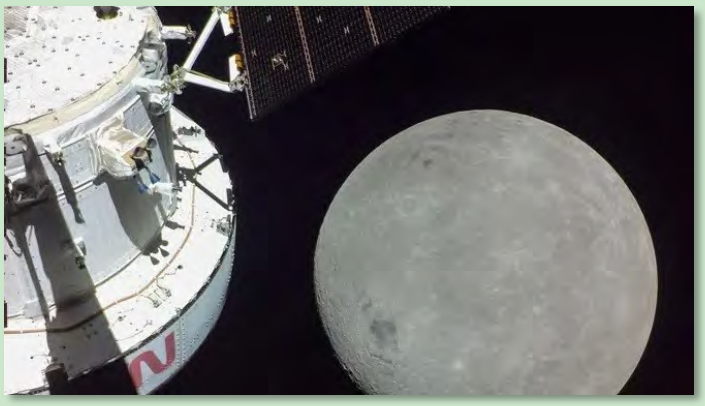
and lunar historian Dr. David Williams launched a campaign to locate the Apollo Moon Trees, leading to the most current Moon Tree database and historical archive describing Moon Tree milestones. Additionally, with only a handful of original trees still standing, Stuart Roosa's daughter, Rosemary, continues the legacy of the Moon Trees by planting or presenting descendants of these special trees via the Moon Tree Foundation. Second-generation trees, grown from Moon Tree seeds, are sometimes known as Half-Moon Trees and are also growing around the world.

In Massachusetts we believe there were two trees planted, one in Holliston and one in Pembroke. The Holliston tree is a sycamore that was planted at the police station. Much to the surprise of the recipients, they did not receive a seedling, but a root cutting which died in transit. A replacement was sent, which was then sent to Weston Nursery in Hopkinton to be taken care of until it grew to a bigger size. A "stand in" tree was planted instead, which was stolen six days later by "some unidentified teenagers." The real tree was planted six years later, and it is still there. Another sycamore was planted in Pembroke. It was planted at the Adah F. Hall house. Unfortunately, this tree died a few years after its planting.

Fortunately, there is now a new opportunity to plant Moon Trees on earth. In a nod to the legacy of Apollo 14, and a celebration of the future of space exploration, NASA's Office of STEM Engagement and the USDA Forest Service have partnered to fly a special payload aboard Artemis I, NASA's first flight test of the Space Launch System rocket and Orion spacecraft. Through a joint STEM education collaboration that



connects Artemis I programming to Earth science, data literacy and citizen science, a new generation of Moon Tree seeds have reached lunar orbit.

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One thousand tree seeds of five different species representing a range of climates across the continental United States were packed into pouches for their historic journey aboard the Orion spacecraft. Nestled alongside science payloads and mementos, the tree seeds traveled farther than any spacecraft designed for human exploration has ever flown, spending 25.5 days in space, and traveling more than 1.4 million miles. During the mission, Orion performed two lunar flybys, coming within 80 miles of the lunar surface. At its farthest distance during the mission, Orion traveled nearly 270,000 miles from our home planet, more than 1,000 times farther than where the International Space Station orbits Earth.

Back on Earth, the Forest Service will germinate the new Moon Tree seeds and grow them into seedlings. Public and education institutions across the U.S. will have the opportunity to submit a proposal to serve as a Moon Tree custodian. Thanks to the pioneering efforts of Stuart Roosa, we will be able to steward a new generation of Moon Trees to inspire future astronauts, and foresters, alike.

References:

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- https://www.moontreefoundation.com/
- https://nssdc.gsfc.nasa.gov/planetary/lunar/moon_tree.html
- https://www.nasa.gov/artemis-1
- https://www.nasa.gov/centers/marshall/history/moon-trees-stand-as-living-testaments-to-first-voyages-to-moon.html
- https://en.wikipedia.org/wiki/Apollo_14

DCR Forester Nathan Tobey stands with an American Sycamore Moon Tree at the police station in Holliston. *Photo: DCR*

Contributing Author: Nathan Tobey, DCR Urban Forestry

Photos: NASA

Forester Focus

A deeper look into today's Urban Forestry topics

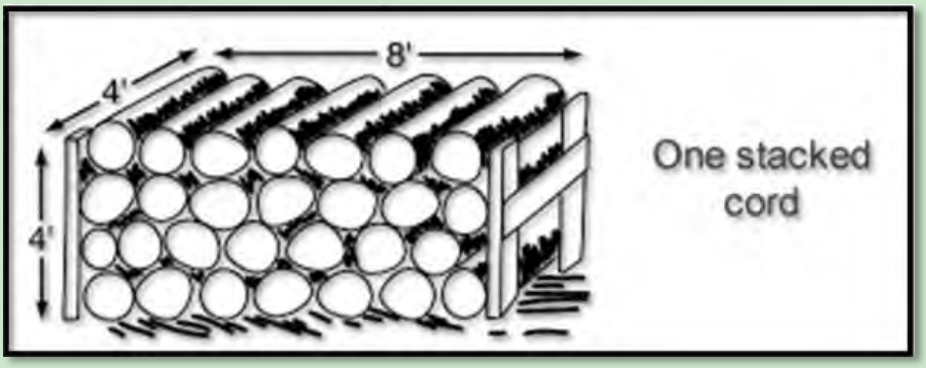
What is a Cord of Wood Anyway?

By Leon Caragulain , Forester, DCR

With lots of discussion around renewable resources, and rising prices of fossil fuels such as home heating oil, many people are turning to firewood as a source of both heating and enjoyment in their fireplaces. Most wood users are familiar with a common term used to describe a volume of firewood, the cord. It's a basic term ("yup, I've got six cords I'm all set") and some people have a general idea it has something to do with the number 128, but there's a little more to it. I've also heard people using truck load or face cord when buying or selling wood. So, let's investigate it a little bit.

The origin of the cord was a term used to measure pulpwood. Before mechanization, most pulpwood was cut by hand. The person cutting it was paid on production thus a unit of measurement was created the cord.

A standard cord consists of four-foot lengths of wood stacked four feet high and eight feet long, creating a total of 128 cubic feet. This measurement is for unsplit wood and includes bark and air space between the pieces.



Based on studies by the U.S. Forest service (and personal experience) if you cut and split this volume into 16-inch pieces and restack it, the wood reduces to between 85 and 110 cubic feet (or stacked cubic feet SCF). One hundred SCF is a good average measurement for a stacked cord of processed firewood. Processing the wood into typical usable lengths causes loss due to cutting and some bark and wood loss when splitting. Also, some variation in the size of the split wood and the effort in stacking

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Image: Courtesy of the USDA Forest Service-Idaho Panhandle National Forests – Forest Products Permits

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comes into play. Alternatively, when a cord of wood is cut to smaller lengths, and is loosely thrown in a box, (a truck bed for example) it would measure 150 cubic feet. As an example, a standard eight foot by four foot pick up bed piled with firewood until it just about falls off would be about 75 thrown cubic feet or a half cord. The best way to know what you have is to stack and measure it.

The purpose of this article is not to cause fights between the readers and their firewood suppliers. It is to provide an understanding of how fuelwood is measured, thus, giving one the ability to determine the amount of wood they have purchased. The goal is also to give enough information to buyers to ask the right questions such as "so what's the volume when I stack it?" or "how do you measure it and what do you consider a cord?" Now that you know a little more about a cord of wood, it's time to get stacking!

Leon Caragulian is a Licensed Massachusetts Forester with the DCR. He has over 30 years of experience in various aspects of forestry and can be reached at Leon.Caragulain@mass.gov

Umass Student Volunteers with Athol DPW staff stack wood for the Athol Wood Bank Photo: Sean Mahoney, DCR

DCR U&CF now has Challenge Grants to help provide funding for Community Wood Banks. These funds can help establish or expand existing community efforts to address household energy insecurity with local forests by recycling decommissioned trees into firewood and distributing this resource to residents in need of heating assistance.

For more information on U&CF Challenge Grants and Wood Banks visit:

https://www.mass.gov/guides/urban-and-community-forestry-challenge-grants

https://www.mass.gov/guides/community-wood-bank-program

State Laws on wood sales: https://www.mass.gov/firewood-sales

CLIMATE RESILIENCY

Resilient Lands Initiative Released for 2023 to Foster Land Conservation, Restoration, and Stewardship Initiatives

Boston – The Resilient Lands Initiative was drafted over the course of eighteen months, and benefits from the ideas and input of hundreds of people from the community, farm and forest, government and nonprofit areas. These ideas focused on how the forests, farms, parks, and other open spaces across Massachusetts can help improve the quality of life for residents, especially residents of Environmental Justice neighborhoods. The Resilient Lands Initiative will guide actions aimed at conserving, restoring and caring for the land – to help both nature and people. In this way, it is a powerful strategy to reduce the impacts of climate change on the most vulnerable populations.

The Resilient Lands Vision is to protect and improve the quality of life for residents of every Massachusetts community through land conservation, restoration, and stewardship initiatives that conserve and enhance the health of the forests, farms, and soils. These critical resources:

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- Protect human and natural communities;
- Provide drinking water and food supplies;
- Enable healthy outdoor recreation;
- Power a green economy;
- Support municipal fiscal stability;
- Protect wildlife habitat;
- Sequester and store carbon; and
- Reduce vulnerability to climate impacts such as urban heat islands, flooding, sea level rise, and drought.

The economy of Massachusetts, along with the health and welfare of its residents, depends on these "goods and services" that natural systems provide. Striving for an overall expansion of nature across the Commonwealth, particularly in areas with Environmental Justice populations and especially as climate impacts increase, is critical to the future quality of life for all Massachusetts residents.

The Resilient Lands Initiative is a broad-based effort to select the most effective land conservation, stewardship, and restoration policies and programs to 1) reduce the impacts of climate change on residents, particularly in EJ neighborhoods; 2) make more local, fresh food available, especially in food deserts; 3) provide new jobs greening EJ

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neighborhoods, 4) plant river and stream buffers to reduce flooding and improve water quality; 5) implement climate-smart farming and forestry practices; 6) enhance the resilience and carbon storage capacity of farms and forests; and 7) protect the Commonwealth's best remaining habitats, watersheds, and water supplies.

It strives to accomplish these things alongside other important objectives, including providing a sufficient and sustainable housing supply. The Initiative takes a "menu-based" approach, offering many potential actions to choose from as future capital budgets are developed, legislative agendas and regulatory updates considered, and decisions on policy and programmatic options contemplated.

For more information, visit:

https://www.mass.gov/info-details/resilient-lands

https://www.mass.gov/doc/the-resilient-lands-initiative-2023/download

LEFT PHOTO: Some of the more than 700 trees planted in Quincy's Snug Harbor public housing neighborhood (Photo credit: Mathew Cahill courtesy of the DCR Urban and Community Forestry Program)

RIGHT PHOTO: DCR tree planters in Fitchburg in 2022 (Photo credit: Mathew Cahill courtesy of the DCR Urban and Community Forestry Program)

Species Spotlight
Sweetgum, Liquidambar styraciflua

Sweetgum is in the witchazel family (Hamamelidaceae) and is found growing from the mid-Atlantic states, south to Florida, west to Texas, and north to southern Ohio and Indiana. It grows in USDA hardiness zones five to nine.

Despite a similar common name, sweetgum is not related to black gum (*Nyssa sylvatica*). Sweetgum thrives in moist soils and lower slopes of woodlands. In southern parts of its range, sweetgum is often one of the first trees to colonize clearings and floodplains. It can reach heights of 60 to 75 feet, with a spread that is two-thirds its height. Its form is pyramidal when young, and develops a rounded or oblong crown with maturity.

The leaves of sweetgum are alternate, glossy green above, and paler below. They are somewhat "star shaped" with five to seven serrated lobes, reminiscent of maple leaves. The fall color of sweetgum can range from yellow to red and can be striking.

The bark of sweetgum is gray and deeply furrowed. The twigs are gray to yellowish-brown, and young twigs often have corky wings. The buds are imbricate and diverge from the stem.

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Species Spotlight—Continued

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Flowers of sweetgum are monoecious. (Both male and female flowers appear on the same plants.) They are not showy and appear when the leaves are unfurling and expanding, usually in April or May in our area. Female flowers hang down on a slender stalk with a round head. Male flowers form upright racemes. The fruit is a syncarp (a fleshy aggregate fruit) that matures in autumn and persists on the tree through winter and even into spring. It hardens and turns brown as it dries.

Furniture, plywood, pulpwood, barrels, veneer, and boxes are all products that come from sweetgum. In the south, where sweetgum is abundant, deer feed on the seeds. Birds, squirrels, and chipmunks also eat the seeds. A resinous gum that sweetgum produces has been used medicinally in Mexico and Europe in the place of storax (which comes from the Turkish sweetgum, *Liquidambar orientalis*) to treat dysentery and diarrhea. The storax has also been used in adhesives, salves, and perfume.

Sweetgum prefers full sun and moist, acidic soils. 'Rotundiloba' is one variety with rounded lobes that does not set fruit. Sweetgum makes an ideal specimen tree, alone or in a grouping. The effect of a group of sweetgums in fall color can be stunning. For urban areas, sweetgums come in non-fruiting and low-fruiting varieties, making sweetgum an appropriate tree for streetsides, lawns, and parks.

Photos:

From DCR, Virginia Tech, and UConn Plant Database

dcr Massachusetts

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

New and Stories from the Northeast Region

The Forest Service Urban & Community Forestry Program provides

Urban Tree News in the Northeast, a collection of articles published in the media that have relevance to urban forestry in the Northeast.

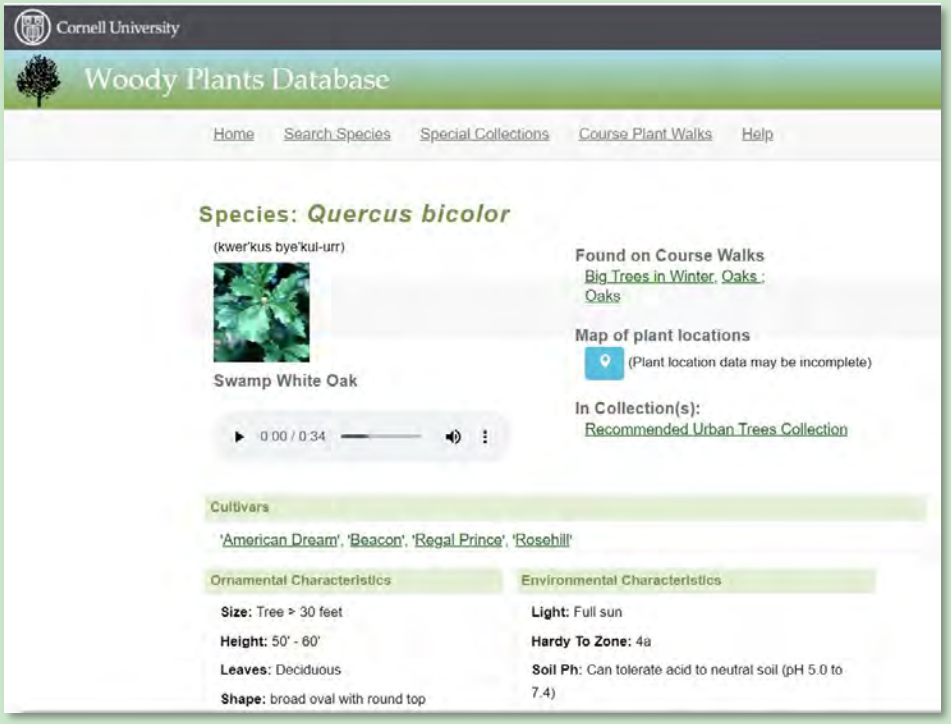
Implementation of the City's Urban Forestry Master Plan is improving Cambridge's tree canopy
The happiest, least stressful, most meaningful jobs in America
It's not the weather, it's the climate that worries biologists
MA Adds 3 Plants To List Of Banned Invasive Species
New Hampshire State Forest Nursery Now Selling Seedlings Online
Forests can help manage water amid development, climate change
Uprooted trees serve as physical record for extreme wind events, finds high-res forest mapping study
Cities Really Can Be Both Denser and Greener
This is your brain on nature: How to get '15 minutes of forest' daily to improve your health—even in the city

Cornell Woody Plant Database

The New England Botanic Garden at Tower Hill hosted the Urban Tree Symposium on February 3, 2023.

It was Co-sponsored by the Ecological Landscape Alliance, and in Partnership with Speak for the Trees.

The annual Urban Tree Symposium is dedicated to exploring the importance of urban forests and ways we can improve our green spaces. Each symposium brings together experts in the fields of forestry, horticulture, biology, technology and more.



Dr Nina Bassuk, Professor Emeritus, Urban Horticulture Institute, School of Integrative Plant Science, Cornell University gave a talk entitled: *Beyond the Native/Exotic Debate*.

Showcased in this presentation was the Woody Plant Database, an online tool to help choose the right tree, shrub or woody vine based on a site's conditions.

Included in the species information pages are both ornamental and environmental characteristics, pest and disease info, and native range maps. Be sure to check out this terrific resource for selecting the right trees for the right places!

For more info:

Cornell Urban Horticulture Institute

https://blogs.cornell.edu/urbanhort/

UMass Amherst News

Recently, a research team at UMass Amherst published a paper titled "A review of Dutch elm disease and new prospects for *Ulmus americana* in the urban environment." The team was composed of Christopher Copeland, Richard Harper, Nicholas Brazee and Forrest Bowlick, and results from ongoing evaluations of several American elm cultivars were detailed.

The team reviewed literature on the performance of these elm cultivars in the urban environment over time. They state that if resistant selections are to be successfully introduced and made available for planting in commercial and residential settings, they must also possess criteria that make them suitable for use as urban trees. This may include structural integrity, aesthetic appeal, and persistence under stressful urban conditions.

Though elm improvement programs show promise, critical knowledge gaps remain regarding specific factors that influence host plant resistance. Ongoing research to understand these factors and to continuously assess performance and ecological impacts of DED-resistant selections in urban landscapes will be critical.

Some notes on cultivar performance:

Less Promising for Urban Use	
'American Liberty'	Not considered resistant to modern strains of DED
'Valley Forge'	Requires extensive juvenile pruning
'Princeton'	Prone to storm damage due to narrow branch attachments

More Promising for Urban Use	
'New Harmony'	High DED tolerance, may retain central leader with moderate pruning
'Jefferson'	Wider branch unions, overall better structure than 'Princeton'
'Colonial Spirit'	Maintains a central leader

Christopher A. Copeland, Richard W. Harper, Nicholas J. Brazee & Forrest J. Bowlick (2022): A review of Dutch elm disease and new prospects for Ulmus americana in the urban environment, Arboricultural Journal, DOI: 10.1080/03071375.2022.2082177

On The Horizon

March 7	**Webinar:** The Tree Fund—Building Urban Tree Resiliency by Mitigating Below Ground Infrastructure Techniques https://treefund.org/webinars
March 16	**Webinar:** Urban Forestry Today— "They're Coming...the 2023 Pests of the Landscape" http://www.urbanforestrytoday.org/
March 25	**Conference:** Mass Land Conservation Conference — More info visit: https://massland.org/
March 30-31	**Event:** ArborEXPO This event offers tree care teams the opportunity to learn, network, demo gear and equipment, and invest in business essentials.
2023 Dates TBD	**Webinar:** UMass Extension — Invasive Insect Webinars, a series of FREE webinars focusing on the impact, monitoring, and management of invasive insects in Massachusetts. https://ag.umass.edu/landscape/education-events/invasive-insect-webinars
Spring 2023	**Webinar:** Urban Forest Connections Webinar Series: Climate Change Resilience and Adaptation https://www.fs.usda.gov/research/products/multimedia/webinars/urbanforestconnections
THIS OLD TREE PODCAST	**Podcast:** This Old Tree — *Heritage trees and the human stories behind them*. Old trees are awe inspiring links to the past that fire our historical imagination. Ever wonder what their stories are? Seasoned arborist and amateur historian Doug Still interviews local experts, historians, and regular folks to celebrate the myths and uncover the real tales. https://www.thisoldtree.show/

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Department of Conservation and Recreation – Bureau of Forestry
251 Causeway Street, Suite 600
Boston, MA 02114

Julie Coop, Urban and Community Forester
julie.coop@mass.gov | (617) 626-1468

Mathew Cahill, Community Action Forester
mathew.cahill@mass.gov | (617) 626-1464

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