A NON-INVASIVE GUIDE TO APPROXIMATING THE AGES OF HISTORICAL TREES IN THE NORTHEASTERN LANDSCAPE

A Project Paper

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ABSTRACT

Understanding the ages of trees and their historical significance has the potential to encourage the public to think critically about the resiliency of plants in the natural world. A common method for approximating the ages of trees used in public gardens is dendrochronology coring. The main issue with this technique is that it requires that the tree be cored to get this data, opening it up to diseases or pests. This process also requires professional equipment that is not accessible to the general public. As people begin to learn how to determine the age of a tree without cutting into it, they may become less likely to remove it from their home lawns. What if we could all learn how to approximate the ages of the trees around us in a simple, practical way? Children and adults could learn the same method and alter the way they think about historical trees. Trees can have their ages approximated using several different best practices including the examination of certain characteristics distinctive to old trees, as well as using a formula by the International Society of Arboriculture. By utilizing methodologies from highly respected public gardens, as well as best practices from other professionals in the field, a comprehensive public guide to aging significant trees when historical records are not present was created to promote the appreciation for legacy trees. We should all strive to gain a better perspective on the magnitude of our natural environment, but in a simple, digestible way. This guide will be shared with public gardens to try to impact the appreciation of historical trees by the public.

BIOGRAPHICAL SKETCH

Jenna Zier was born and raised on Long Island, New York. She grew up gardening, exploring nature preserves, and spending most of her free time outside with her mother, Maureen. She has a bachelor's of arts degree in Urban Planning and Geography from the University at Albany. Jenna found her passion for public gardens while working as a horticultural intern at Bayard Cutting Arboretum in Great River, New York. She then became a full time horticulturist and curator of two collections. Jenna has experience connecting people with plants both in her local community and abroad, volunteering on farms and school gardens in Nicaragua, Ecuador, and France. Jenna currently works as the Education Coordinator at the Polly Hill Arboretum on Martha's Vineyard, where she combines her love for horticulture and community building.

DEDICATION

For my family and friends who always supported my tree hugging lifestyle.

For all of my wonderful Cornell people who made me feel at home for the past year.

For my friends at Bayard who taught me to love public gardening.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to Don Rakow and Sonja Skelly for their guidance, support, and encouragement over this past year. I am so thankful to have had the opportunity to learn from two of the most passionate garden professionals. I would like to thank Cornell Botanic Garden for the opportunity to expand my professional skills as a Graduate Fellow in Public Garden Leadership.

Thank you to all of the public gardens that returned my countless emails and questions over the last year, including the Morton Arboretum, Arnold Arboretum, Morris Arboretum & Gardens, Desert Botanic Garden, and Cornell Botanic Garden.

A special thank you to everyone at Bayard Cutting Arboretum, where I discovered my love of horticulture and public gardens. Without the encouragement of Kevin Wiecks, I don't think I would be where I am today. Thank you for always believing in me and pushing me to be the best that I can be, both as a horticulturist and as a person. Thank you to Nelson Sterner, for taking a chance on me as a young college kid and letting me intern for you, when I didn't even know what the word horticulture was. Look at us now!

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INTRODUCTION

The Northeastern United States contains an extensive network of vast forests, wooded suburbia, and urban street trees. The trees around us hold historical and cultural significance with some dating back to long before colonialism and the creation of our present nation. To preserve the legacy of these trees, it is important to properly date them. Current methodologies to approximate the ages of trees include reviewing historical planting records, dendrochronology coring, comparing satellite imagery over time to assess changes in canopy growth, observing external characteristics of old trees, and utilizing a formula developed by the International Society of Arboriculture (ISA). The ISA's formula multiplies a tree's DBH (Diameter measured at breast height) by its growth factor to provide an approximate age for the tree (Nix, 2021). A tree's growth factor can be found using a growth factor chart (Purcell, 2018). When historical records are not available, the most common method used is dendrochronology coring. A metal instrument is inserted into the trunk of a tree in order to collect a core of its growth rings, which can then be counted to determine the tree's age. Each growth ring represents one year of growth in Northeastern environments. This method can be utilized by professionals and larger public gardens but is not necessarily accessible to the public or smaller organizations due to cost, lack of equipment and coring expertise. While coring can be helpful in gaining clearer information on a tree's age, it imposes some future risk to the tree's health. The process of coring is invasive, leaving behind a wound that can potentially lead to injury (Neo et al., 2017). When considering age approximation methods for historical trees, a guide to non-invasive aging can be helpful in determining whether coring is necessary, or if the age of a tree can be approximated in less invasive ways. Purdue University created a workshop for the public which utilizes non-invasive aging techniques including the ISA formula to encourage the public to engage with the trees

around them (Purcell, 2018). Purdue's workshop inspired the creation of this guide designed specifically for public gardens. This guide includes literature on visually assessing the age of trees, coring to determine age, and non-invasive tree aging techniques, methods to approximate the ages of trees utilized by five public gardens in North America and two educational programs on tree aging for adults and youth.

Benefits of cultural connections- awareness around cultural connections of trees

Preserving historical trees goes beyond the inherent landscape value. Many native trees have important cultural significance. Preserving trees with cultural significance can help to honor and respect the histories of communities for whom the tree has significance. An example of this can be found at Cornell Botanic Gardens which is located on the traditional homelands of the Gayogo̲hó꞉nǫ', also known as the Cayuga Nation. An important tree species to both the gardens and the Gayogo̲hó꞉nǫ' is *Pinus strobus*, or white pine. Known as the Great Tree of Peace, White Pines symbolize strength, protection, and longevity to the Gayogo̲hó꞉nǫ'. The five needles of the White Pine are thought to represent the five nations, the Mohawk, the Oneida, the Onondaga, the Gayogo̲hó꞉nǫ', and the Seneca that united into the Haudenosaunee Confederacy (Shade, 2022). Preserving significant trees like *Pinus strobus* can assist in the efforts of honoring biocultural diversity. It is recommended to research possible culturally significant tree species in your own community and to use this research together with non-invasive aging techniques to help convey the importance and significance of trees.

Project goals

The goal of this project was to develop a means by which public gardens could educate the public about the importance of historical trees in the landscape through experiential learning. By taking a non-invasive, hands-on approach to aging significant trees, the public can learn more about the trees in their landscape and their resilience throughout time. The ISA's tree aging formula was not previously used for educational purposes by any public gardens that were interviewed for this project. With this guide, smaller public gardens can begin to create their own public programming using non-invasive methods of approximating the ages of their trees. With the impending effects of climate change on our environment, it is critical that public gardens contribute to the preservation of historical trees. By utilizing a non-invasive method to approximate the ages of trees, there is less risk to the tree's overall health. Invasive methods like dendrochronology coring can open up the tree to potential pathogens (Norton, 1998). Public gardens can also contribute to honoring biocultural diversity by preserving culturally significant trees in their landscapes and not altering them through invasive methods. Educational programming focusing on non-invasive methods, like those developed for this project, can be used to connect the public with significant trees and their inherent biocultural and historical value.

This action project promotes the education and understanding of the importance of historical trees in the landscape. The resulting guide can be used with the public as well as smaller public gardens that may not have the resources to perform more in-depth methods of approximating the ages of their trees (such as dendrochronology coring). The process outlined in this guide and the materials included can be replicated by public gardens and utilized as a tool to promote educational programming around historical trees. This guide emphasizes the importance of

non-invasive methods on culturally significant trees to minimize potential damage and disease in a climate that is rapidly changing.

LITERATURE REVIEW

This section will outline the current literature discussing the different methods of approximating the ages of trees, broken down into three sections including visual assessment of trees, coring to determine age, and non-invasive tree aging.

Visual Assessment of Trees

When historical records are not available, the first step in approximating the age of a tree is to examine its external characteristics. By observing common physical properties, you can determine whether your tree shows signs of aging, and whether it warrants taking further steps to approximate its age.

N. Pederson outlined six major characteristics of old trees in *External Characteristics of Old Trees in the Eastern Deciduous Forest* (2010). These characteristics include:

1) Smooth bark: This is more clear on species with peeling or rough bark when young.

Illustration 1. *Cornus Kousa* with smooth bark. Photo: Jenna Zier.

2) Low stem taper: There is little to no difference in trunk diameter from the base to just beneath the crown.

Illustration 2. *Quercus coccinea* with low stem taper. Photo: Jenna Zier.

3) High stem sinuosity: A wavy or “snake” like appearance of the trunk.

Illustration 3. *Quercus bicolor* with a “snake” like trunk. Photo: Jenna Zier.

4) Crowns comprised of few, thick, twisting limbs

Illustration 4. *Quercus velutina* with a crown consisting of two, thick limbs. Photo: Jenna Zier.

5) Low crown volume: Few limbs in the crown, not branching very widely.

Illustration 5. *Quercus alba* with low crown volume consisting of one, thick limb. Photo: Jenna Zier.

6) Low ratio of leaf area to trunk volume

Illustration 6. *Quercus velutina* with few, thin branches containing leaves. More trunk area than leaf area.

Photo: Jenna Zier.

It is important to note that these characteristics are based on observations made of old trees in the Eastern deciduous forest (stretching from Maine down to Florida and as far west as Texas and Minnesota) (National Park Service, 2022) and may not apply to trees in other parts of the U.S. These characteristics can provide helpful hints of possible historical trees in the landscape. Every tree may not have all six characteristics, these are intended to be initial points of focus for observers. If one of the characteristics are spotted, further assessment can be done to identify whether the tree contains any of the other five characteristics. Observing these characteristics can guide you to decide whether you are interested in approximating the tree's age. In terms of educating the public, brochures or fact sheets can be made which outline these possible characteristics of old trees and encourage the public to search for them on the trees in their own landscapes.

Coring to Determine Age

Tsen, Sitzia, and Webber (2016) discussed the different views on whether coring is harmful to a tree. The main issue they cite with coring a live specimen is post-coring wound management. It is common for a tree to be cored and left to remediate its wounds naturally. When the wound is left to heal naturally, the tree is susceptible to pests and diseases. With a rapidly warming climate, threats may increase in severity and affect the tree's health. The act of coring directly injures a tree, leaving the specimen to heal itself through compartmentalization. The process of compartmentalization is used as a defense mechanism, allowing the tree to isolate damaged tissue and pathogens from new, healthy growth. It should be noted that some trees are able to compartmentalize better than others, and if a tree's compartmentalization process is disrupted, decay and disease can spread. In terms of North American trees, studies suggest that conifers

may be able to compartmentalize holes from coring at a faster rate than angiosperms (Norton, 1998). There is also research that suggests that time of year can impact the rate in which a tree is able to compartmentalize. Pathogens are more likely to enter a tree wound if it is created in the dormant season (winter), rather than the vegetative season (spring/summer) (Dujesiefken et al., 2005).

Post-coring wound management should also be considered when reviewing the impacts of invasive methods of tree aging. Common management practices include plugging the holes with dowels or dressing the wounds. In the past, these methods were thought to work towards preventing pathogens from entering into the tree, but there are increased concerns over their efficacy. Plugs and wound dressings may prevent the compartmentalization process, leading to larger areas of cambial (the part of the tree where growth occurs) damage that cannot remediate itself (Norton, 1998).

There are times at which dendrochronology coring is necessary. Dendrochronology coring can benefit research by identifying early, mid, and late successional species. In a forest setting, height-growth rate differences between species are reviewed to understand succession (Gutsell & Johnson, 2002). But, smaller public gardens may not have the means or need to perform this in-depth research.

Non-invasive Tree Aging

A formula credited to the International Society of Arboriculture has been previously used to create guides for the public on forestry blogs like The Treehugger (Nix, 2021). The formula was

derived from a multifactorial DBH model that uses the diameter of a tree (at breast height) and the species specific growth factor (a number derived from dividing a group of trees with known ages by their diameters) and multiplying them (insert formula here) to find the approximate age of the tree (Lukaszkiewicz & Kosmala, 2008). The formula will only provide a rough estimation of a tree's age, and environmental conditions are not easily taken into account, which can significantly impact the accuracy.

L. Purcell (2018) provides an example of an institution utilizing the ISA formula to approximate the ages of trees in an article for The Purdue Landscape Report, titled *How Old is My Tree?* By highlighting this non-invasive method, the public is encouraged to engage with the trees in their landscape and determine their ages in a simple, digestible way. This article also provides a growth factor chart which encompasses a number of species common in the Northeast. There is a more extensive growth factor chart included in the next section (Good Calculators, 2023).

Table 1. Growth Factor chart from the article *How Old is My Tree?* (Purcell, 2018)

Tree Species	Growth Factor	Tree Species	Growth Factor
Red Maple	4.5	White Oak	5.0
Silver Maple	3.0	Red Oak	4.0
Sugar Maple	5.0	Pin Oak	3.0
River Birch	3.5	Linden or Basswood	3.0
White Birch	5.0	American Elm	4.0
Shagbark Hickory	7.5	Ironwood	7.0
Green Ash	4.0	Cottonwood	2.0
Black Walnut	4.5	Dogwood	7.0
Black Cherry	5.0	Redbud	7.0

Historical records are a common way in which public gardens keep track of the ages of trees in their collections. Having a detailed records system that tracks genus, species, age, DBH, and

location can minimize the need for invasive methods to approximate age. Today, many records are kept in a digital database such as ArcGIS, IrisBG, or BGBase. Another non-invasive method to age trees is comparing satellite imagery over time. By comparing images over a specific time period, the canopies of trees can be analyzed to assess any changes in growth.

METHODOLOGY

Garden interviews

This section will review the current methodologies used by several public gardens to age significant trees in their collections. The following gardens were contacted as resources for this project; Morton Arboretum, Arnold Arboretum, Morris Arboretum & Gardens, Cornell Botanic Garden, and Desert Botanic Garden. Each organization is unique in its collections and practices.

Chuck Cannon, Director of the Center for Tree Science at the Morton Arboretum shared that the vast majority of their planted trees (spanning over 800 acres) do have historical planting records. The Morton Arboretum also does some coring on trees in their regenerative forest in order to gain information for research purposes. Michael Dosmann, Keeper of the Living Collection at the Arnold Arboretum conveyed that the pros and cons of coring is weighed and often the information gained from coring a tree is worth the potential risk to the tree's health. Non-invasive methods can be valuable, but in a research setting, it is important to be as accurate as possible. At the Arnold Arboretum, trees are not cored often, but when they are there is no post-coring wound management other than sanitizing tools to minimize the spread of potential pathogens.

At the Morris Arboretum & Gardens, Jason Lubar, Associate Director of Urban Forestry outlined other non-invasive methods to approximate the ages of trees. One method is to use aerial photography over time to compare tree size and canopy growth. Growth patterns can be determined if trees have failed nearby and their trunks were cut, revealing growth rings. There is also an invasive method that is used besides dendrochronology coring, and that is a resistance drill. Lubar explained that the resistance drill can be used to see and measure growth rings while minimally damaging the tree. Resistance drills are traditionally used to check for rotting wood inside of the trunk. After discussing the ISA formula, Lubar recommended that bark thickness be subtracted when using a growth rate formula. More research is needed to understand the possible differences in age approximation due to bark thickness.

According to Daniel Weitoish, Arborist for Cornell Botanic Gardens, historical planting records for some accessioned trees exist, but many trees in the Gardens' natural areas lack historical data. The trees on the Cornell University campus (not part of the Gardens' collections) also lacked historical planting records.

While this guide is specific to the northeastern landscape, more research is needed in understanding the growth rates of southern and desert trees. For example, at the Desert Botanic Garden in Arizona, the aging of trees in their collection are not currently being studied, as desert trees are unlike deciduous trees that can be dated. A staff member at the Desert Botanic Garden explained how desert trees have growth rings, but they are not reliable for determining age because they can grow anytime of the year when conditions are right.

EDUCATIONAL PROGRAM DEVELOPMENT

For this action project, an educational program was developed to illustrate the use of approximating tree ages with public audiences – one for adults and one for youth. Using a stepwise program planning guide developed by Kevin Moss (personal communication 2023), Student and Public Engagement Coordinator for Cornell Botanic Gardens, a program for non-invasive tree aging for Cornell Botanic Gardens was developed. It is presented here as an example.

Program Planning (Adult Audience)

1. **The Idea:** How to Approximate the Ages of Historical Trees
    - Educating the public on a non-invasive method of approximating the ages of trees, while emphasizing the biocultural value and histories of specific trees in the landscape.
    - Desired outcome: To connect people with their natural environment through hands-on learning and critical thinking about the historical and cultural values of specific trees.

2. **The Big Picture:**
    - Emphasizes the mission and vision of Cornell Botanic Gardens by connecting people with the cultural value of specific specimens, while conserving historical trees through the use of non-invasive methods.
    - Target audience: University affiliates, visitors, and supporters, as well as youth.

- Cost analysis: The main cost would be the purchase of DBH (define) tape that can be reused for each session. Number of DBH tapes depends on the number of workshop participants. Two attendees can pair up to use one DBH tape during the workshop so dividing the number of attendees by 2 would equal the number of DBH tapes to purchase. To counteract the cost of materials, a small fee can be charged for the workshop/ suggested donation amount. *This could be a one-time fee.
- Staff resources: staff assistance may be needed in scouting trees (arborist), a knowledgeable tour guide will need to run the workshop, and assistance with marketing the event.
- Partners for collaboration: could include local schools and/or university classes, local garden clubs, extension groups, tree-support groups that would like to incorporate this workshop into their curriculum. (STEM classes, outdoor education, environmental studies).
- Other: Can be "sold" as a possible alumni reunion event, where specific trees from graduation years can be scouted and included. Add historical references from approximated years, as well as the cultural significance of the tree.
- Ideal date: Arbor Day Tour- Historic trees of Cornell
- Proposed Workshop Date: Spring/Summer 2023

3. Type/Scope of Program:

- Format- In person, directed workshop or tour.

Goal

Participants will develop a better understanding of the trees on Cornell's campus and their resilience in the landscape over time.

Objectives

1. Almost all of the audience will understand the importance of historic trees within the landscape and their historic significance and be able to name one historic tree within the landscape and its historic significance.
2. Most of the audience will feel inspired to visit the trees around the Cornell campus.
3. Some of the audience will perform the ISA formula on trees in their own landscapes and be able to approximate the age of at least one tree.

Logistical Planning- Pre-Event:

- Scouting trees and taking measurements and approximations in advance for reference. Labeling trees that will be included in the workshop. Researching cultural and historical significance of the chosen trees.
- Arbor Day- Historic Trees of Cornell Tour, collaboration between Cornell Botanic Gardens, the University Landscape Architect and the University Grounds Department.
- Budgeting will determine the price of materials and expected cost. DBH tape can range from $15-$50 per tape measure. Possibly purchase around 10. (Depends on the size of the workshop).

Example Storyline for Tour:

Stop A-

Acer sacchurum, Sugar Maple: **Family**- *Sapindaceae*. **Native Range**- Eastern North America. **Height**- Up to 80ft tall. **Characteristics**- spectacular fall color, fruit is the two-winged samara, long lived tree, relatively slow growing. **Fun Fact**- Native Americans taught colonists how to tap these trees to get maple syrup, which is now a multi-billion dollar industry in America and Canada (Missouri Botanical Garden). **DBH**- 24. **Approximate Age**- 120 years old. **Cornell History of 1903**- Typhoid epidemic ripped through Ithaca and Cornell University, 1 in 10 people were infected that year due to bad sanitation of water treatment. At least 82 people in Ithaca died due to the disease, including 29 Cornell University students (Seely, 2011). Liberty Hyde Bailey became the first Dean of the New York State College of Agriculture (Division of Rare & Manuscript Collections, 2004).

Stop B-

Tilia cordata, Littleleaf Linden: **Family**- *Malvaceae*. **Native Range**- Europe & Southwestern Asia. **Height**- Up to 70ft tall. **Characteristics**- fragrant pale yellow flowers in Spring, attractive foliage, tolerant of urban conditions often used as a street tree. **Fun Fact**- When flowers are in bloom, large numbers of bees can be seen visiting the tree and it's said that the humming can be heard from several feet away (Missouri Botanical Garden). **DBH**- 38. **Approximate Age**- 114 years old. **Cornell History of 1909**- President Shurman announced efforts to completely turn over the university to the State of New York for funding and support (Cornell Alumni News Vol.

12, No. 10 (December 1, 1909). New greenhouses were constructed where the Plant Science building and Bradfield Hall now stand (Cornell University, 2023).

Stop C-

Tilia tomentosa, Silver Linden: **Family**- Malvaceae. **Native Range**- Southeast Europe to Asia Minor. **Height**- Up to 70 ft. tall. **Characteristics**- Glossy green foliage above with silver below. Flowers in late spring followed by small nutlets. **Fun Fact**- Linden trees are usually called limes in Great Britain and the UK. In Sweden Linden trees are the origin of the name Linnaeus (Missouri Botanical Garden). **DBH**- 24. **Approximate Age**- 72 years old. **Cornell History of 1951-** The Cornell University Archives was officially established through the funding from a Rockefeller grant after the mass destruction of records during World War II. The archives began as a regional history of everyday life in Ithaca, and grew to hold information and work from past university presidents, faculty, and students (Cornell University Library, 2023).

Stop D-

Gymnocladus dioicus, Kentucky Coffee Tree: **Family**- Fabaceae. **Native Range**- Central and eastern US to Ontario and Quebec, Canada. **Height**- Up to 80 ft. tall. **Characteristics**- Large bipinnate compound leaves. The species is dioecious, meaning separate male and female trees. Fertilized female flowers will make way for brown, flattened pods about 10 inches long. **Fun Fact**- Native Americans and early American settlers in the Kentucky territory roasted and ground the seeds into a coffee like beverage. Keep in mind the seeds are extremely toxic to ingest prior to roasting so do not eat the seeds raw. This tree is bare most months out of the year, being one of the last trees to develop its leaves in the Spring and one of the first trees to drop its

leaves in the Fall (Missouri Botanical Garden). **DBH**- 18. **Approximate Age**- 54 years old. **Cornell History of 1969-** Student takeover and protest by the Cornell University Afro-American Society over institutional racism, a biased judicial system, and slow progress in establishing a Black Studies Program. The students occupied Willard Straight Hall for 36 hours before the University agreed to meet their requests (Lowery, 2009).

Stop E-

Quercus rubra, Red Oak: **Family**- Fagaceae. **Native Range**- Eastern North America. **Height**- Up to 75 ft. tall. **Characteristics**- Typically grows at a fairly fast rate with dark green leaves containing 7-11 toothed lobes which are sharply pointed at the tips. Their fruits are the classic acorn. **Fun Fact**- An abundant number of acorns may not appear before the tree reaches age 40 ((Missouri Botanical Garden). **DBH**- 36.5. **Approximate Age**- 146 years old. **Cornell History of 1877**- On July 7, 1877 the first of what will become Cornell University's Summer Sessions began by Professor J.H. Comstock, offering an "Aquatic Summer School" which took students by steamboat through the Great Lakes to study Geology, Zoology, and Botany of the local region. This program cost $125 for 30 days of study (Cornell SCE, 2023).

Stop F-

Quercus rubra, Red Oak: **Fun Fact**- The species name rubra means red in Latin. **DBH**- 52.5. **Approximate Age**- 210 years old. **Cornell History of 1813**- Cornell University was not founded until 1865, and in 1813 founder Ezra Cornell was only 6 years old. State Cornell University's land acknowledgement.

Stop G-

Quercus rubra, Red Oak: **Fun Fact**- The oldest red oaks can live up to 500 years old in their native habitats (DeAngelis, 2021). **DBH**- 43. **Approximate Age**- 172 years old. **Cornell History of 1851**- As we know Cornell University was not founded until 1865 and this site was the traditional lands of the Cayuga nation. But, in 1851 founder A.D. White was actually a student at one of our ivy league rivals, Yale University (Wikipedia, 2023).

Stop H-

Quercus rubra, red oak: **Fun Fact**- The leaf stalk is slightly red in color, another reason why it is named the red oak, aside from its vibrant red color in fall. **DBH**- 38.5. **Approximate Age**- 154 years old. **Cornell History of 1869**- The Class of 1869 was Cornell University's first graduating class. The university officially began instruction in October of 1868 with the largest class at any American university at the time with 412 students. 9 of those students came to Cornell with significant educational experience which placed them as undergraduate seniors, and 8 of those students were eligible to graduate on July 1, 1869 as the very first Cornell University Alumni. All 8 graduates of the class of 1869 received Bachelor of Arts degrees (Division of Rare & Manuscript Collections, 2018).

Stop I-

Cornus florida, flowering dogwood: **Family**- Cornaceae. **Native Range**- Eastern North America. **Height**- Up to 30 ft. tall. **Characteristics**- Blooms in early spring, usually April. The traditional showy, white flowers are actually composed of clusters of small insignificant green flowers surrounded by 4 white, petal-like bracts that give the appearance of a single, large 4 petaled

white flower. **Fun fact**- The common name dogwood is a reference to an old-time use of the hard, slender stems of this tree which were used as skewers to cook with, and these skewers were called dogs (Missouri Botanical Garden). **DBH**- 7. **Approximate Age**- 49 years old. **Cornell History of 1974**- On April 4th 1974 a $1.35 million pedestrian shopping mall for downtown Ithaca was approved, later known as the Ithaca Commons. On May 1, 1974 the Cornell Daily Sun produced an article titled, "Electronic Calculator: Friend or Foe? Discussing the advantages of battery powered calculators, quote "Assignments that used to take entire evenings can now be done in an hour or two." Fall of 1974 dormitories went co-ed. Formerly the men's dorms were on West campus and the women's dorms were on North campus. Women students freshman to juniors were also allowed to live off campus for the first time that year (Cornell University Class of '77, 2023).

Another Notable Tree on Campus-

The oldest known tree on the Cornell campus is located on the slope. This tree is a *Quercus alba,* White Oak. **Family-** Fagaceae. **Native Range**- Eastern United States. **Height**- Up to 80 ft. tall. **Characteristics**- Leaves with 7-9 deeply rounded lobes, emerging slightly pinkish in the Spring then maturing into a dark green color. **Fun Fact**- The name White Oak comes from the light ash colored bark, and it is a very important hardwood timber tree. It has a slow growth rate and a very large size, sometimes growing up to 100 ft tall in the wild (Missouri Botanical Garden). **Approximate Age** of the oldest known tree on campus is between 350- 400 years old. I encourage everyone to visit this massive white oak and you can learn more through the many articles that have been written about this historic tree which long predates Cornell University and its founders Ezra Cornell and A.D. White (Wilensky, 2022).

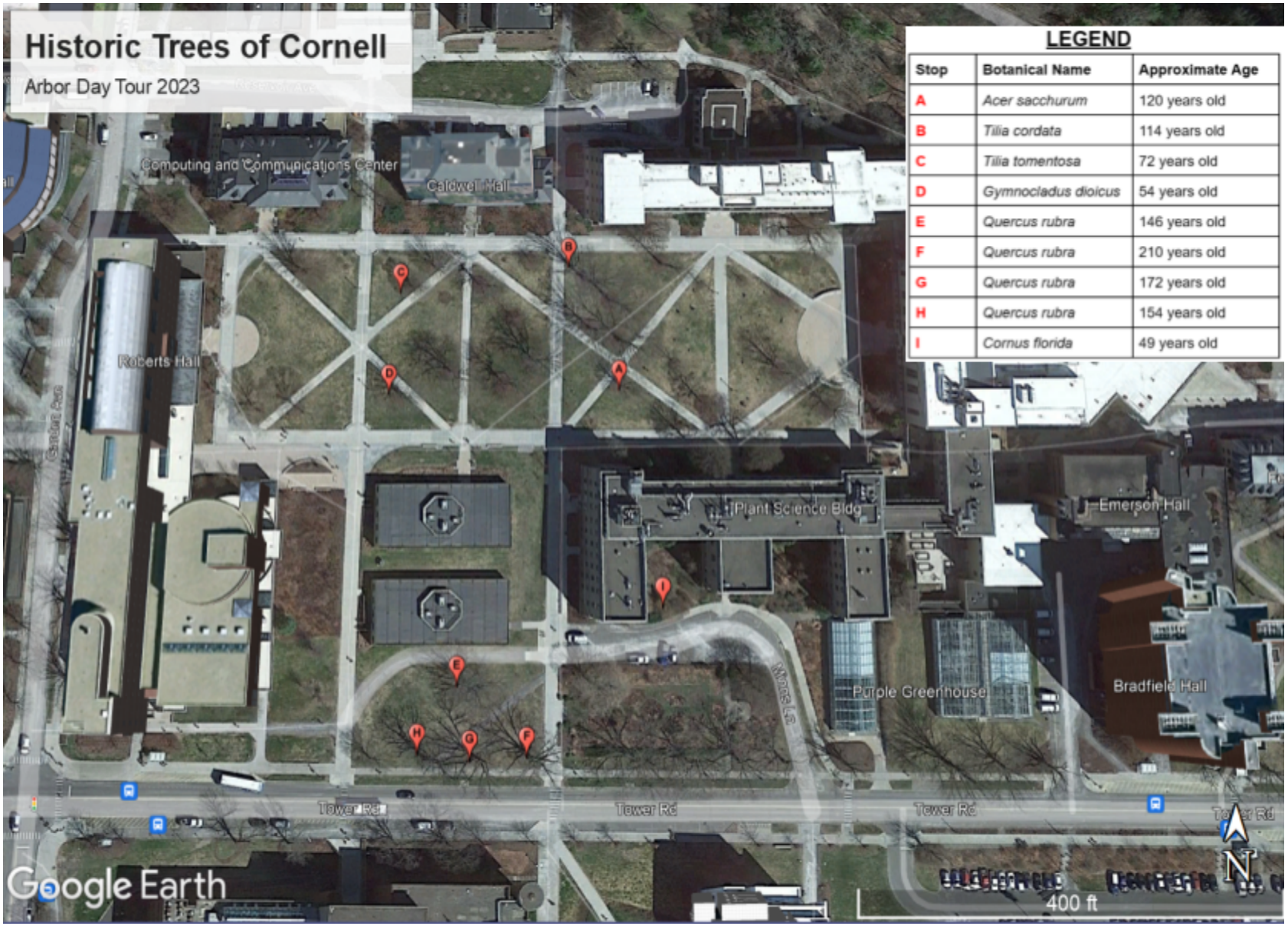

Illustration 7. *Historic Trees of Cornell* Map. Created by Jenna Zier.

DBH x Growth Factor = Approximate Age

Table 2. Tree Growth Factor chart. (Good Calculators, 2023)

Tree Species	Growth Factor	Tree Species	Growth Factor
American beech	6.0	Pin oak	3.0
American elm	4.0	Redbud	7.0
Black cherry	5.0	Red maple	4.5
Basswood	3.0	Red oak	4.0
Black walnut	4.5	River birch	3.5
Colorado blue spruce	4.5	Scarlet oak	4.0
Cottonwood	2.0	Scotch pine	3.5
Dogwood	7.0	Shagbark hickory	7.5
Douglas fir	5.0	Shingle oak	6.0
European beech	4.0	Silver maple	3.0
Horse chestnut	8.0	Sugar maple	5.0
Ironwood	7.0	Sweet gum	4.0
Kentucky coffee tree	3.0	Tulip tree	3.0
Linden	3.0	White oak	5.0
Norway spruce	5.0	White pine	5.0

Example of Programming Marketing:

Celebrate Arbor Day with a Historic Trees of Cornell Tour

Come join us in celebrating Arbor Day at Cornell on April 28, 2023! Focused around the Ag Quad, this tour will emphasize significant trees as they relate to Cornell history. Each tree will take us back in time, reflecting on the past of our institution. There will also be a hands on demonstration of a non-invasive method to approximate the ages of trees. Get outside and enjoy the Spring weather before the end of the semester, while reflecting on the role that historical trees play in our landscape.

This tour is free and open to the Cornell community, no registration required. Please meet in front of Mann Library at 4pm on Friday April 28, 2023- rain or shine. Dress accordingly, this tour will be fully outdoors

Program Planning (Youth Audience)

1. **The Idea:** How to Approximate the Ages of Trees
    - Educating youth on a non-invasive method of approximating the ages of trees and basic identification methods for common trees in our area through experiential learning.
    - Desired outcome: To connect children with their environment through hands-on learning and to spark curiosity about the natural world.

2. The Big Picture:

- Emphasizes experiential learning for youth and self-directed activities.
- Target audience: Youth grades 7-12th.
- Cost analysis: The main cost would be the purchase of DBH (define) tape that can be reused for each session. Number of DBH tapes depends on the number of workshop participants. Two attendees can pair up to use one DBH tape during the workshop so dividing the number of attendees by 2 would equal the number of DBH tapes to purchase. To counteract the cost of materials, a small fee can be charged for the workshop/ suggested donation amount. *This could be a one-time fee.
- Staff resources: staff assistance may be needed in scouting trees (arborist), a knowledgeable tour guide will need to run the workshop, and assistance with marketing the event.

- Partners for collaboration: could include local schools and/or university classes, local garden clubs, extension groups, tree-support groups that would like to incorporate this workshop into their curriculum. (STEM classes, outdoor education, environmental studies).
- Other: Starting the workshop off with tree identification tips can help the students feel empowered to self-direct. Make plant ID cards using cuttings from trees in the area.
- Ideal date: Late Spring, Summer, or early Fall when leaves are prominent.
- Proposed Workshop Date: April 2023

3. Type/Scope of Program:

- Format- In person, directed workshop.

4. Logistical Planning- Pre-Event:

- Scouting trees and taking measurements and approximations in advance for reference. Labeling trees that will be included in the workshop. Collecting cuttings for Plant ID cards.
- Collaborating with local schools and STEM teachers to align curriculum.
- Budgeting will determine the price of materials and expected cost. DBH tape can range from $15-$50 per tape measure. Possibly purchase around 10. (Depends on the size of the workshop).

How Old is that Tree?

Come join us for a hands-on workshop where you will learn how to measure the ages of some common trees in our area! We are so lucky to be surrounded by beautiful historic trees, and you could learn how to approximate how old they are with a few fun steps. This activity will take place outside, and is meant to introduce students to a simple method that they can repeat at home. There will be many opportunities for students to be curious, engaged, and connect with the trees around them.

Goal- To learn how to approximate the ages of some common Northeastern trees through basic identification tips, taking measurements, following a growth chart, and doing a simple multiplication problem.

Outcome- Students should feel excited to take what they learn at our workshop and repeat the method on trees in their own backyards.

Class Capacity- This workshop will be the most productive with a maximum of 20 participants.

Instructions for Youth Workshop:

1. **Scout Trees:**
    - Take cuttings from trees located within the area that the workshop will be taking place. The more trees that are identified and included will result in more freedom for the students to explore and learn.

2. **Create Identification Cards:**
    - It will be helpful to start the lesson off with a tree identification exercise. Utilizing the cuttings taken from the trees in your area, have students create their own ID cards to get familiar with the different species they may see during the workshop. Include an example with genus, species, common name, and a cutting with a distinct feature (leaf, flower, fruit).
    - Materials: Cardstock paper, packing tape, markers, scissors, napkins.

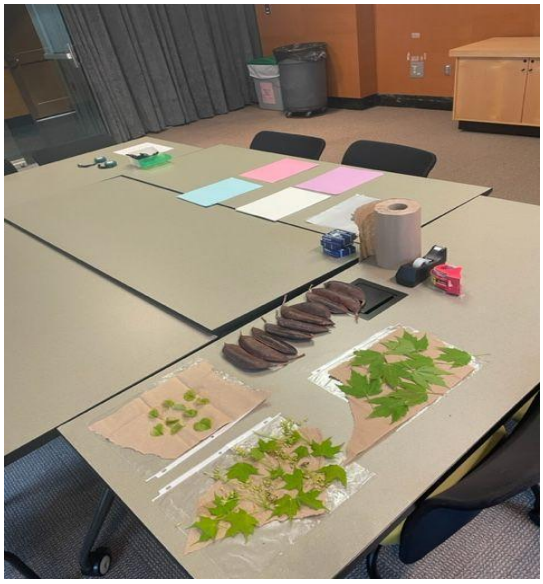

Illustration 8. Plant ID exercise including *Tilia cordata* (top left), *Acer saccharum* (bottom left), *Acer rubrum* (bottom right), *and Gymnocladus dioicus* (top right). Photo: Jenna Zier.

Illustration 9. Example Plant ID card of *Ailanthus altissima.* Photo: Jenna Zier.

3. **How Old is that Tree? Worksheet:**
    - Encourage students to use their new plant ID cards to assist in calculating the approximate ages of some trees in the area. Students should be allowed to work in pairs to identify trees that match their ID cards, measure the DBH of the trees, and find the specific growth factor of that tree from the growth factor chart on their worksheet. The formula, DBH x Growth Factor = Approximate Age, can be solved for each tree that is identified and measured.
    - Materials: DBH tape, calculator, How Old is that Tree? worksheet, Plant ID cards, pencils.

Example Worksheet used in the Youth Program:

<u>How Old is That Tree</u>?

1. Tree name- _____

DBH _____ x Growth Factor _____ = Approximate Age _____

2. Tree name- _____

DBH _____ x Growth Factor _____ = Approximate Age _____

3. Tree name- _____

DBH _____ x Growth Factor _____ = Approximate Age _____

4. Tree name- _____

DBH _____ x Growth Factor _____ = Approximate Age _____

DBH x Growth Factor = Approximate Age

Table 2. Tree Growth Factor chart. (Good Calculators, 2023)

Tree Species	Growth Factor	Tree Species	Growth Factor
American beech	6.0	Pin oak	3.0
American elm	4.0	Redbud	7.0
Black cherry	5.0	Red maple	4.5
Basswood	3.0	Red oak	4.0
Black walnut	4.5	River birch	3.5
Colorado blue spruce	4.5	Scarlet oak	4.0
Cottonwood	2.0	Scotch pine	3.5
Dogwood	7.0	Shagbark hickory	7.5
Douglas fir	5.0	Shingle oak	6.0
European beech	4.0	Silver maple	3.0
Horse chestnut	8.0	Sugar maple	5.0
Ironwood	7.0	Sweet gum	4.0
Kentucky coffee tree	3.0	Tulip tree	3.0
Linden	3.0	White oak	5.0
Norway spruce	5.0	White pine	5.0

LIMITATIONS & FURTHER RESEARCH

A major limitation in utilizing the ISA formula is that it is merely an approximation. Dendrochronology coring will produce a more accurate tree age. Non-invasive methods should not completely replace dendrochronology coring, rather they can be substituted by smaller gardens who lack the professional equipment and time to perform coring on their trees. Non-invasive methods can also be utilized as educational programming for the public. In terms of using growth factors that are species specific, the growth factors that are currently publicly available from institutions like Purdue University, only include species in the Northeast. Further research is needed to determine growth rates of trees in southern and desert regions, when rings are formed at a different rate than in the Northeast. Further research is also needed to determine how environmental conditions and climate change are affecting ring formation in trees in the Northeast and beyond.

CONCLUSION

The goal of this guide is to assist in educating the public on the importance of historical trees in the landscape through experiential learning, with an emphasis on the benefits of non-invasive methods for approximating tree ages. By bringing the ISA formula into the context of public gardens, more research can be done to understand the accuracy of this formula, and whether it should be used solely for educational purposes, rather than scientific research. This guide creates an overview of the different methods of approximating the ages of trees, including visual assessment of trees, coring to determine tree age, and non-invasive methods. Public garden professionals were interviewed in order to gain different institutional perspectives on how trees are currently being aged.

As we look to the future, it is crucial to investigate alternative methods that can help to preserve biocultural and historically significant trees in our landscapes. Non-invasive methods to approximate the ages of trees should be utilized by public gardens to help strengthen their educational programming through hands-on, experiential learning. The purpose of this guide is to promote a deeper consideration about whether historical trees need to have their ages approximated invasively, or if they can be honored in different ways.

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