



2019

Lean on Me: Recommendations for Heritage Tree Support at the Morris Arboretum

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An independent study project report by The Walter W. Root Memorial Endowed Arborist Intern (2018-2019)

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Lean on Me: Recommendations for Heritage Tree Support at the Morris Arboretum

Abstract

The history of the Morris Arboretum can be told through its eldest trees. Every scar and abnormality present on these immense specimens inspire awe, enrich visitor experience, and provide a glimpse into the past of the gardens. They also act as living representatives of a fundamental truth: our natural world, when tended to with care, can persist through even the most brutal and unpredictable of circumstances. Longevity does have its limits, however, and the past decade has brought the Morris Arboretum to face this tragic fact. Irreparable damage to two of the Arboretum's most treasured accessions –*Fagus engleriana* and *Quercus x benderii* – has served as a reminder that even trees that have stood for centuries are not invincible. In response to these recent losses, the upkeep and protection of heritage trees has risen to paramount importance for the Morris Arboretum. My project has strived to make manifest the Arboretum's goal of improving its process of historic tree cataloguing, inspection, and protection. This report details my efforts of the past year: amassing data concerning previously treated or at-risk trees, organizing Morris Arboretum's first Arborist's Round Table consultation event, and creating management plans for a suite of highest priority specimens.

Disciplines

Horticulture

Comments

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at the Morris Arboretum**

Author: **Daniel Sax**
 Walter W. Root Endowed Arborist Intern

Date: **April 2018**

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INTRODUCTION

The history of the Morris Arboretum can be told through its eldest trees. Every scar and abnormality present on these immense specimens inspire awe, enrich visitor experience, and allow us a glimpse into the past of the gardens. They also act as living representatives of a fundamental truth: our natural world, when tended to with care, can persist through even the most brutal and unpredictable of circumstances. Longevity does have its limits, however, and the past decade has brought the Morris Arboretum to face this tragic fact. Irreparable damage to two of Morris Arboretum's most treasured accessions –*Fagus engleriana* and *Quercus x benderii* – have served as reminders that even trees that have stood for centuries are not invincible. In response to these recent losses, the upkeep and protection of heritage trees¹ has risen to paramount importance for the Morris Arboretum. My project has strived to make manifest the Arboretum's goal of improving its process of historic tree cataloguing, inspection, and protection. This report will serve as the culmination of myriad initiatives; each completed in pursuit of an arboretum further committed to the preservation of its most long-lived trees.

To best marry the eclectic elements of my project, I have divided this report into two subsections; each focusing on a particular facet of heritage tree care and its place at Morris Arboretum. In the first section –‘Theory and Practice’ –I will explore the ecological and social benefits of heritage trees in order to reinforce the need for codified and consistent practices in tree management. For the next section –‘Heritage Tree Management at the Morris Arboretum’ – I will review the tangible elements of my project and discuss their efficacy and replicability for future arborist interns. I will begin with a report on my work cataloguing and classifying Morris Arboretum's heritage trees. Then I will discuss the organization and execution of the 2019 *Arborist's Round Table* as well as the management initiatives that developed as a result of the event. Finally, I will posit suggestions for ways that Morris Arboretum might continue to expand its net of heritage tree protection.

¹ There are numerous terms employed to refer to long-lived trees within arboriculture literature. Some –‘heritage trees;’ ‘champion trees;’ – refer to the pedigree and immensity of the specimen. Others –‘large old trees;’ ‘ancient trees’ -are used interchangeably to denote specimens which boast extreme age and ecological importance for the landscape (Zapponi et al. 2017). Another term often seen is ‘veteran tree.’ This refers to specimens in the final stages of life: “The crown dies back and branches may be lost [...] the leaf area declines [...]” (Reed et al. 2000, 29). It is important to recognize the nuance which distinguishes each of these terms to best comprehend the role played by trees that fall under each moniker. For the purposes of this report, the term ‘heritage tree’ will be used as the default as it best encompasses the specimens reviewed at the Morris Arboretum.

THEORY AND PRACTICE

The Morris Arboretum holds a unique position as a controlled environment within which tree care can take a leading role among institutional priorities. For this reason, it is essential that contemporary research in arboriculture be reflected in any proposal concerning the application of advanced tree support techniques. In acting as a paradigm of tree support and protection, Morris Arboretum can provide inspiration to surrounding townships and gardens that may face similar issues in heritage tree care. To facilitate the Arboretum's movement towards model tree management, this section will begin by summarizing the heritage tree's role as a champion of healthy forest ecology and an emblem of history. Then, it will turn its focus to the public garden to consider how modern arboriculture techniques –e.g. cabling, bracing, propping, installation of lightning protection, revitalization tactics –can enhance and assist the ecological impacts already discussed, and preserve trees as specimens of historical interest.

The Impact of Heritage Trees

By the time they are approaching the latest stages of their life cycleⁱ, most heritage trees have developed a multitude of defects that are attractive to wildlife (Read et al. 2000). Loss of major limbs and the emergence of significant decay serve to create essential biological niches for wildlifeⁱⁱ. In fact, each permutation of aged tree decline serves a unique function in the scheme of habitat creation: e.g. trees with pockets of internal decay are long-lasting and ideal for territorial mammals while snags and logs resting on the ground are temporary and support nomadic invertebrates (Bull et al. 1999). In addition, heritage trees act as a consistent source of food for an array of creatures (Read et al. 2000). Apart from benefits for macroclimate, heritage trees also support complex colonies of microorganisms that are central to a larger scheme of decomposition and nutrient cycling (Van der Wal et al. 2013).

As heritage trees traverse their life cycle, they facilitate the transportation and distribution of nutrients essential to the ecological health of their respective environments (Van der Wal et al. 2013; Mestre et al. 2018). This function has been a major focus among contemporary scholars interested in quantifying the benefits of heritage trees. There has long been consensus that aged tree specimens contribute to vibrant soil microbiomes through the expulsion of organic matter – e.g. leaf litter –and processes of wood decay and decomposition (Gessner et al. 2010); however, more recent studies concerning carbon sequestration in old-growth forest ecosystems have illuminated the extent to which heritage trees serve as long-term biological carbon stores (Dickie et al. 2014; Luyssaert et al. 2008). These findings reveal that a given heritage specimen will continue to support a vibrant soil ecology long after its time as a 'living component' of an ecosystem (Bull et al. 1999). Furthermore, it reinforces the idea that heritage trees should be managed as long-term fixtures of an environment.

Although the majority of research concerning the benefits of heritage trees tends to focus on the ecological services that they provide, a contemporary school of thought is striving to merge that perspective with one that values trees for their contributions to the strictly human environment and social world (Blicharska et al. 2014). This shift is reflected in recent environmental legislation: "Many conservation policies already highlight the necessity to include people, their needs, and values in conservation decisions [...] The concept frames the ecosystem as something that provides benefits to people and is seen as a tool to convince decision makers of the need to protect the biodiversity that underlies these benefits" (Blicharska et al. 2014, p. 1563). Beyond functioning as a legislative bargaining chip, the change in perspective also adds

validity to efforts that strive to push the boundaries of how people record and experience history (Blicharska et al. 2014). Although many services within this subset are not strictly quantifiable, considering heritage trees as socially significant entities has widened the audience base who prioritize heritage tree protection and has, therefore elevated heritage tree care as a topic of import for the development of landscape conservation protocols (Read et al. 2000; Blicharska et al. 2014). Public gardens are in a position to act as strong proponents of this form of public support for the abstract values of heritage specimens.

Heritage Tree Management and the Public Garden

Heritage trees seamlessly integrate context and texture into an arboretum visit; beyond displaying unique and engaging horticultural forms, they also give the garden a chance to interpret their historical narrative. These benefits do not come without complications, however, and there are major risks associated with the preservation of aged tree specimens. Therefore, it is essential that public gardens –beyond understanding what heritage trees contribute to their landscape –recognize the responsibilities mandated by the display of heritage specimens and plan accordingly. Adopting a hands-off approach to heritage tree care is not an option for public gardens. Although it may sound counter-intuitive, trees cannot experience a ‘natural’ life cycle within garden grounds. Instead, they must be tended to in a fashion that mitigates risk to visitors while simultaneously respecting the tree’s stature and grandeur. While this former requirement can be achieved through the successful application of tree support strategies –e.g. targeted pruning, cabling, bracing, propping –the latter demands active management. Any garden hoping to protect their heritage specimens must maintain active records of past damage and future concerns. Planning with an eye to the distant future ensures a balance between safety to visitors and tree care.

An often overlooked element of tree management is determining when intervention should be prescribed and when heritage specimens are past the point of preservation. Although the primary concern must be ensuring visitor safety, non-intervention cannot be the operative strategy (Read et al. 2000) for a public garden. Some emphasis should be placed on acting with intention to increase the longevity of heritage specimens. Arborists tend to operate on a spectrum that fluctuates between minor intervention and removal; however, there is a middle ground within which heritage trees are permitted to decay in place. In other words, if a tree has failed beyond a point of maintaining its structure, a garden should consider how it might facilitate a productive decomposition and nutrient cycling process. Appreciation of the role that heritage trees play in the landscape and greater environment can sometimes require an arborist to facilitate processes of decay as opposed to fight against them (Zapponi et al. 2017).

Even if, over time, ancient trees tend to accumulate decayed wood, it is important to stress that they “are not necessarily moribund [at the point of death].” As time passes, their anatomy tends to change to accommodate these structural alterations [...] (Zapponi et al. 2017, p. 232).

This passage highlights the capacity of heritage trees to manage themselves even as they enter the late stages of their life cycle. Furthermore, it suggests that our perspective on the arborist’s role in caring for heritage trees in public spaces needs updating. Although an arborist working in a public garden may have an inclination towards removing a tree at a late stage of decay, there are many other options that can be considered to facilitate the controlled decline of the tree. Such

action takes into account the tree's capacity to survive immense damage and decay, and, simultaneously acknowledges the myriad benefits a heritage tree offers the arboreta landscape as it transitions through its decline.

HERITAGE TREE MANAGEMENT AT THE MORRIS ARBORETUM

It is essential that the theory of heritage tree care be understood if an institution hopes to design a comprehensive management plan. It is of equal import, though, that the resultant plan is a reasonable undertaking based on the scale and staff size of the target site. Thus, for the Morris Arboretum—a public garden with a small in-house arborist presence—this means that the proposed plan will need to be phased in over time and have a focused scope. Furthermore, long term planning and record keeping should be heavily featured. Slow adoption and selective tree choice will be the key to a successful result. In an effort to meet both of these needs, I first corroborated and updated the information the Arboretum had recorded about its protected trees. Second, I helped to prepare for and host the Morris Arboretum's first *Arboriculture Round Table* event; during which tree assessment professionals were led on a tour of twelve heritage trees and asked to provide recommendations for their continued care. This section will review both of the aforementioned projects as well as provide a management plan designed in response to the initiatives.

Cataloguing Morris's Protected and Vulnerable Trees

In its nascent stages, this project sought to consolidate the Morris Arboretum's data concerning its trees with artificial support: cabling; bracing; lightning protection; and propping. Beginning from a list of trees that hosted such systems, I surveyed the Arboretum to both update and corroborate the Arboretum's records. The first step in this process was the creation of an Excel workbook within which pertinent data could be entered and easily accessed². Each tree was logged based on its accession and location alongside information regarding the presence of artificial tree support systems, as well as system specifics and notes, and its current size (if previously recorded). As the reach of my survey spread further into the gardens, I subdivided the document to account for the myriad cases that I had come across. In its final permutation, the workbook contains four sections—'Trees with existing supports,' 'Trees to be assessed,' 'Trees to assess in-house,' 'Arborist Round Table Candidates,' which categorize trees based on their value to the Arboretum, the state of their decline, and how they are to be assessed in the future.

My work illuminated a concerning pattern in Morris Arboretum's tree management; although trees were receiving attention and appropriate maintenance, there was a lack of structured long-term maintenance planning. Most specimens had been assessed in the past, treated for structural defects and other concerns, and then left alone without the formalization of management goals. In other words, Morris Arboretum had taken the first steps to commit itself to the health of its heritage trees, but had yet to institute a system through which their continued maintenance could be ensured. As was discussed earlier (see *Heritage Tree Management and the Public Garden*), proactive and continual management is essential to ensure a safe and controlled decline of heritage specimens. It was at this point that I realized that the core of what was missing in Morris Arboretum's heritage tree care

² This file is accessible through the Morris Arboretum S-Drive using the following path: *Morris > Horticulture > NoBackups > Arborists > Sax – Intern Project 2018-19 > Final Intern Project > Working List of Red Flag Trees*

regimen was not rooted in how it recorded information about its aged trees, but how that information informed long-term management strategies. A remedy to this concern came in the form of the Arborist's Round Table

*The Arborist's Round Table: January 10, 2019*³

Hosting the Arborist's Roundtable was a first for the Morris Arboretum, and displayed a renewed enthusiasm for heritage tree management. The event brought a group of local consulting arborists, half in-house Morris Arboretum staff, and half for-profit arborists active in the greater Philadelphia area and botanical garden community, to Morris Arboretum for a day dedicated to the analysis and discussion of twelve high priority heritage trees. The breadth of knowledge and expertise provided by each of the consulting arborists present was instrumental in the formulation of a comprehensive list of potential tree protection recommendations. The round table was comprised of an introductory presentation showcasing each of the specimens to be examined, a tree assessment tour, and a round table discussion. This format was useful for myriad reasons. First, it allowed the arborists to acquaint themselves with each heritage specimen, and Morris Arboretum's particular concerns with each specimen, before they viewed the trees in the garden. Second, by splitting the arborists into two groups and providing them with an organizational document in which they could take personal notes (see *Appendix B*), it minimized the duration spent at each tree site in the field. This led to a more fruitful dialogue once all parties were reunited at the final discussion. Lastly, the format encouraged the sharing of ideas without the pressure of coming to consensus on a management plan for each tree. In amassing recommendations from an array of arborists, Arboretum staff was left with a firm grasp on potential action steps and, moreover, with the autonomy to act within their own timeframe.

*Management Plan and Schedule for Heritage Trees at the Morris Arboretum*⁴

Once the Arborist's Round Table had passed, representatives from the Morris Arboretum met to come to a final consensus about how each assessed tree would be managed. Drawing on the recommendations collected during the round table, a refined list of care strategies was compiled for each tree. The management plans produced were guided by three primary tenets:

1. Treat the cause of decline, not just the symptoms.
 - a. It is essential to have a holistic understanding of a tree's health before prescribing treatment to ensure that the tree is receiving optimal care.
2. Establish long-term goals and aspirations and plan in accordance with them.
 - a. Manage the tree in a fashion that reflects expectations for its longevity.
3. Plan for the late-stage life cycles and future generations of specimen.

³ Refer to *Appendix B* for further information on the 'Tree Profile and Assessment' forms. These documents were distributed to each participating arborist of the 2019 Arborist's Round Table. They were intended to provide essential context for all tree specimens and to act as a simple format through which thoughts and recommendations could be communicated.

⁴ Refer to *Appendix C* for further information on the 'Priority Tree Management' forms. These documents were created to keep record of the arboretum's management strategy for twelve high priority trees.

- a. Consider how the tree will be treated in its latest stages of decay –e.g. removal versus decay in place –and the potential for propagation.

In following these guidelines, it was ensured that the management schemas would be both equipped to adapt to specimen decline and ensure a higher level of care throughout that process. The plans codified immediate remedial action steps, scheduled habitual treatments, and set expectations and goals concerning the longevity and health of each specimen. This final facet is particularly important since it highlights the transition away from Morris Arboretum's previous form of reactionary heritage tree care and adopts a strategy that incorporates advanced planning.

Once finalized, the framework of each plan was formatted into a compact 'Tree Management Plan' (see *Appendix C*) that includes an overview of past damages, a synopsis of the determined management strategy, a management schedule, and a management log. The standalone nature of each document allows for a seamless transition between a digital form, wherein arborists can update and amend the schedule or log, and a printed version that can be distributed and used in the field. *Appendix C* shows the management plan for *Prunus x yedoensis*, an example that is representative of the eleven other documents created in conjunction with this project.

Planning for and Improving future Arborist's Round Tables

The future success of the Arborist's Round Table hinges on more than the immediate outcomes of its first installment; in fact, the true impact of the event may not be visible for years or decades. Ensuring the effectiveness of the event will require two distinct action steps. First, there must be strict adherence to the management plans created through the round table, and second, Morris Arboretum needs to build its dossier of actively managed heritage trees through future Arborist's Round Tables. The former requirement is addressed by the creation of management plans and schedules (as discussed in the previous section). The latter calls for an analysis of the round table to best ascertain the ways in which it might be improved and recreated. A list of recommendations has been compiled based on participant and organizer feedback as well as the expressed need of the Morris Arboretum:

1. Create a vision for the Arborist's Round Table's future installments.
 - a. To most effectively grow its catalogue of appropriately protected and monitored heritage trees, Morris Arboretum should hold Arborist Round Table events annually up until it is satisfied with the trees under active management. After a comprehensive catalogue has been created, Morris Arboretum should decide upon a new rate of occurrence –e.g. triennial –for the round table that will ensure the continual update of existing management schema.
2. Increase the depth of information provided about each tree in advance of the garden tour.
 - a. Visiting arborists entering the field should be equipped with a greater suite of information about each of the selected trees: e.g. in-depth analysis (resistograph, sonic tomographic imaging) of structural defects, rates of growth, canopy coverage, and wound healing.
 - b. One invited arborist summarized this need as follows: "A comprehensive physiological and structural assessment of each tree should be done in advance,

along with soil fertility and structural condition. When attending to old trees every impact has import, and no tasks should be prescribed outside of the known ability of the tree to respond positively” (recorded as exit survey response).

Further consideration should also be given to the trees of Bloomfield Farm as visitation increases following the construction of the visitors and events center. Beyond making changes to the Arborist’s Round Table format, it is essential that the Arboretum continue to expand its dossier of actively managed trees to include those within the Bloomfield Farm’s boundaries. This is especially true when one considers the multitude of field-grown specimen present on the Bloomfield Farm property, and the tendency of the Arboretum to prioritize trees in the garden above those on the farm. Although the assessment and treatment of Bloomfield Farm’s heritage trees is a large undertaking, the Arborist’s Round Table model could prove effective in simplifying and expediting the process.

CONCLUSION

Public gardens are singular in their capacity to invest resources into trees at the limits of their longevity. This gives visitors the opportunity to view specimens in rare conditions; stages of life that are typically observable in old growth forest ecologies can be replicated and shared with arboretum guests. The fact that arboreta are in a position to provide specialized care and attention to their eldest trees does not mean that it is common practice to do so. The Morris Arboretum, after suffering a year of disheartening tree failures, has recommitted itself to the task of heritage tree upkeep and protection. This project report, and all of its various, tangible components, mark a point of transition away from passive stewardship towards a future of focused arboricultural attention and care. The recommendations, and subsequent management plans, born as a result of the Arborist’s Round Table represent this concerted effort to protect and sustain its most valuable and vulnerable trees. Regardless of how successful the most immediate action steps are at increasing the longevity of specimens, the act of developing a comprehensive management schema has already moved Morris Arboretum into a new era of heritage tree care.

ACKNOWLEDGEMENTS

I would like to recognize the past arboriculture interns whose research served to lay the groundwork for my project: Micah Barrett (‘94) and Daniel Church (’10). It was an honor to build upon their work and apply their findings to the development of practical reforms within the Morris Arboretum’s arboriculture program.

APPENDIX A: MODEL TREE PROFILE AND ASSESSMENT FORMS

The attached *Tree Profile and Assessment Form* was selected as a representative of the style and format of the twelve profiles created for the Arborist's Round Table assessment and discussion. In addition to this singular document, the complete pamphlet provided to each participating arborist can be found within the Morris Arboretum S-drive (*Morris > Horticulture > NoBackups > Arborists > Sax – Intern Project 2018-19 > Arborist Round Table Resources > Tree Profiles and Inspection Forms*).

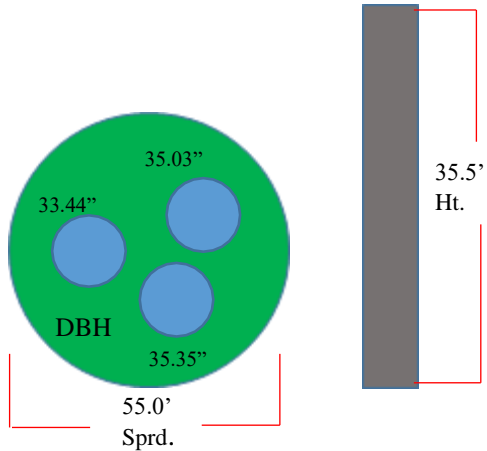
Tree Profile and Assessment Form

Accession #: 1948-480*A

Scientific name: *Prunus x yedoensis* f. *perpendens*

Date: 01/10/2019

Tree Overview

<p><i>Last Recorded Measurements:</i></p> <p>Date recorded: 12/18/18</p> <p>Measured at: 4.5'</p> <div style="text-align: center; margin-top: 20px;">  </div>	<p><i>Tree Support Info</i></p> <p> <input type="checkbox"/> Cable <input type="checkbox"/> Brace <input type="checkbox"/> Prop <input type="checkbox"/> Lightning Protection </p> <p> # Cable _____ # Brace _____ # Prop _____ # Conductors _____ </p> <p>Date(s) of install: _____</p> <p>Notes: <u>Cobra cable installed (~02/10/02) to support union between three codominant leaders; removed following extensive storm damage (02/10/10).</u></p> <p>_____</p> <p>_____</p> <p>_____</p>
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Tree Bio

Date	Event / Action performed
Spring 2012-18	Full flower
04/03/17	Frost damage
02/05/14	Extensive snow and ice damage
02/10/10	Significant storm damage
02/10/02	Pruned for deadwood; inspected Cobra cable (<i>since removed</i>)

Notes: _____

Current assessment: *P. x yedoensis* has three primary leaders joined at the base in a questionable union. It has proven to be susceptible to winter storm damage, and yet has continued to display good vigor on internal and lower branches, and consistent flowering in the spring. It seems to be a candidate for crown reduction and propping.

Tree Profile and Assessment Form

Accession #: 1948-480*A

Scientific name: *Prunus x yedoensis* f. *perpendens*

Date: 01/10/2019



Image Legend

Support Systems

Cable - - - - -

Brace ○ ○ ○ ○ ○

Prop □ □ □ □ □

Lightning Protection

Defects

Decay **D**

Breakout **B**

Cavity **C**

Stub **S**

Crossing / rubbing **X**

Deadwood **W**

Hazard **H**

Poor union ○

Hazard △

End-weight reduction □



Tree Profile and Assessment Form

Accession #: 1948-480*A

Scientific name: *Prunus x yedoensis* f. *perpendens*

Date: 01/10/2019





Tree Profile and Assessment Form

Date: 01/10/2019

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

APPENDIX B: PRIORITY TREE MANAGEMENT FORMS

The attached *Priority Tree Management Form* was selected as a representative of the style and format of the twelve management documents created based on the recommendations of those present at the Arborist's Round Table assessment and discussion. In addition to this singular document, a complete collection of management forms can be found within the Morris Arboretum S-drive (*Morris > Horticulture > NoBackups > Arborists > Sax – Intern Project 2018-19 > Final Intern Project > Priority Tree Management Forms*).

Tree Management Plan

Accession #: 1948-480*A

Scientific name: *Prunus x yedoensis* f. *perpendens*

Date: 02/07/2019

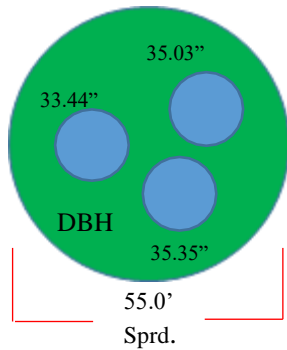
Tree Overview

P. x yedoensis has three primary leaders joined at the base in a questionable union. It has experienced extensive winter storm damage (02/10/10 and 02/05/14) as well as frost damage (04/03/17), and yet has continued to display good vigor on internal and lower branches and consistent flowering in the spring (*full flower Spring 2010-18*). Prior work performed includes deadwood pruning (02/10/02) and the installation of a Cobra cable (02/10/02) that has since been removed.

Last Recorded Measurements:

Date recorded: 12/18/18

Measured at: **4.5'**



Tree Support Info

☐ Cable ☐ Brace ☐ Prop ☐ Lightning Protection

Cable _____ # Brace _____ # Prop _____ # Conductors _____

Date(s) of install: _____

Notes: Cobra cable installed (~02/10/02) to support union between three codominant leaders; removed following extensive storm damage (02/10/10).

Management Strategy: The long-term strategy for *P. yedoensis* f. *perpendens* is to help it maintain its current form for as long as possible while, simultaneously, encouraging the growth of new shoots (~25 year timeline). In pursuit of this goal, the most immediate steps are to **assess the state of basal decay** using sonic tomography and to perform reductions on the most extended laterals -limb 1 and limb 2 (see *P. yedoensis* imaging) –before *bud break in Spring 2019*. Following reductions (*by Winter 2020*), **props will be installed to further support the reduced limbs**. The tree is to be propagated to ensure its succession. The bench traditionally placed under the tree is to be moved to reduce risk to visitors.

Tree Management Plan

Accession #: 1948-480*A

Scientific name: *Prunus x yedoensis* f. *perpendens*

Date: 02/07/2019

Management Schedule:

Rate of Action	Work Performed
Annual	
Biannual	assessment of basal decay; visual assessment of tree structural integrity
Every 5 Years	
Every 10 Years	
Future Concerns	propagate and plant out

Management Log:

Date	Action Performed	Comments	Performed by:
2/10/2002	deadwood pruning		in-house
2/10/2002	Cobra cable install	Cable was installed as a temporary measure to improve stability at base. It has since been removed.	in-house
<i>immediate future</i>	assess basal decay	resistograph or sonic tomography of base	in-house
<i>early Spring 2019</i>	reductions	reduce most vulnerable laterals before bud-break	in-house - A. Hawkes
<i>Winter 2020</i>	prop install	prop vulnerable laterals	in-house - A. Hawkes

Additional Comments: Prop construction should be proportionate to small stature of tree. Consider bamboo rounds or Shou Sugi Ban (charred cedar rounds).

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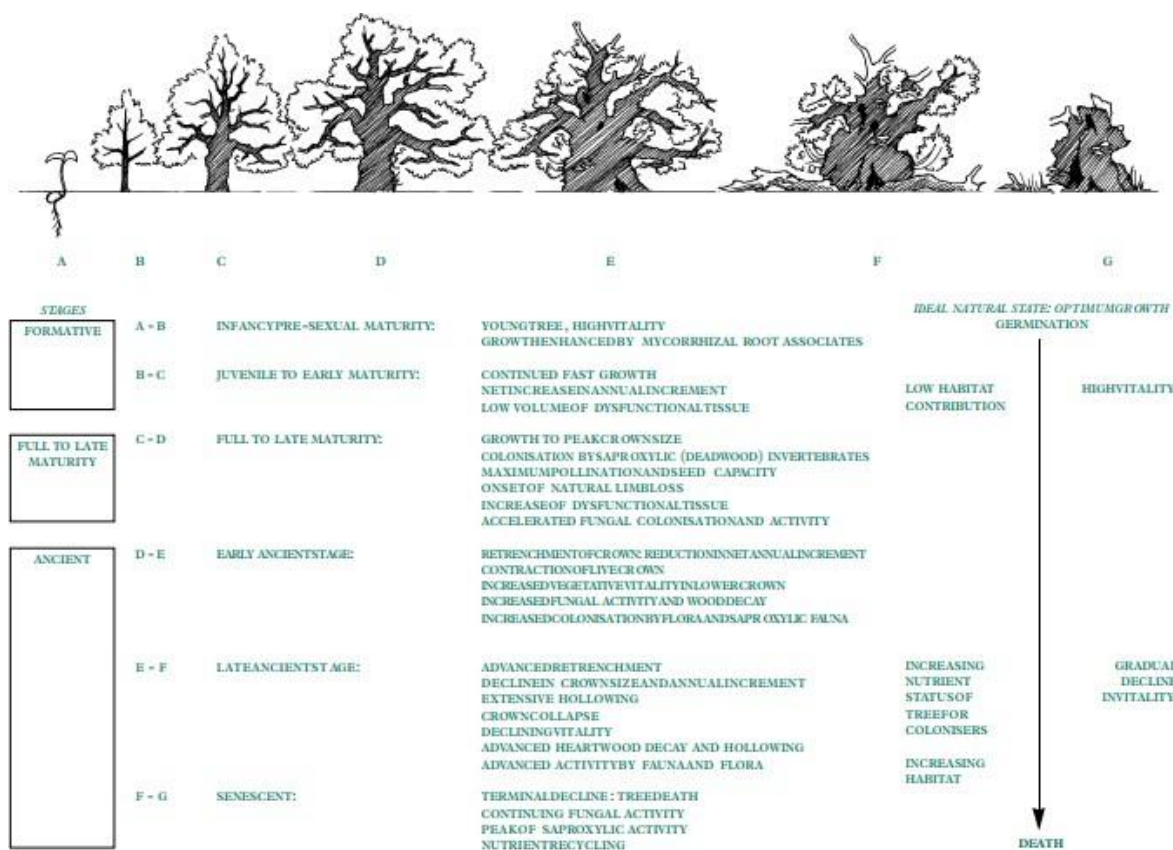
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ⁱ Figure 1 (originally published in Read et al. 2000): This graphic reviews the life cycle stages of trees. All heritage trees fall within the range of ‘full to late maturity’ and ‘ancient.’



ⁱⁱ Figure 2 (originally published in Read et al. 2000): This image provides a visual representation of the various defects a heritage tree may develop. Each of these natural features has the potential to provide lasting habitat to

wildlife in both the macro and microenvironment.

