PRESSURES, PRIORITIES AND STRATEGIES FOR TREE CARE ACROSS BUDGET RESTRAINTS

by

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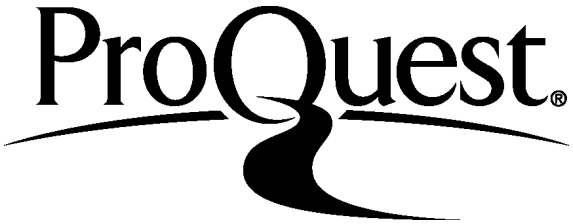

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ABSTRACT

Tree collections held by public institutions are important for educational programming, research and conservation, and visitor engagement. However, the importance of these collections to their institutions (and the broader horticultural community) is not reflected in the resources allocated to collections maintenance. In order to ensure these collections are maintained to a minimum standard of care, public institutions must prioritize the care of their collections. While every public institution faces different challenges in caretaking their tree collections, this research aimed to document innovative strategies for effective, budget-conscious tree care that are applicable across contexts.

Primary objectives of this research were to document success stories in public institutions that, because of limited resources, must rely on commercial tree care companies. This research included two surveys sent to approximately 160 public institutions with tree collections, as well as in-depth interviews with staff from 3 public institutions (Garden in the Woods, Montgomery Botanic Center, Moravian College) that were identified as representative of how successful relationships are best created and sustained.

Successful programs stand on the foundation of making tree collections an institutional priority, and creative partnerships with commercial tree care companies are central to institutions with successful collection management strategies. Further, interviewees emphasized the importance of having dedicated staff that understand the

needs of the collection and can build long-term relationships with tree care companies that are mutually beneficial to both organizations. Staff members must also build and utilize personal networks and work outside of their traditionally-defined job roles. Interviewees also highlighted the need to treat new partnerships like philanthropic relationships. Moreover, having a collections management plan and articulating a clear mission help staff to develop successful long-term relationships with outside organizations.

Chapter 1

INTRODUCTION

Human history is intertwined with a history of tree collectors. The 2,900 public gardens and arboreta that exist worldwide are much more than just static collections; they also actively engage the public (Willison, 2006). The United States has a particularly rich tradition of tree collections, starting with Native Americans who valued them for tool materials and food (Hagender, 2005), to early Philadelphia-based collectors like John and William Bartram who set the tone for an appreciation of trees as ornamentals (Wulf, 2010). Americans with wealth established collections of trees that still exist today (Monticello and Mt. Vernon) and still retain meaning and significance (Wulf, 2011). Trees are now appreciated beyond their simple market value, helping create moments of intimacy for visitors within a larger garden setting.

Although North American gardens boast some of the most renowned tree collections in the world (e.g., Morton Arboretum in Illinois and Arnold Arboretum in Boston), fostering public appreciation of tree specimens from around the world, these collections are challenging to maintain. Institutions with tree collections are as varied as the collections themselves, ranging from public gardens to arboreta to university campuses. Many times, institutions with limited resources cannot employ a full-time staff arborist. Instead, these institutions frequently rely on volunteers and the care of mature trees generally exceeds the capacity of volunteers. Long-established trees are often too tall for garden staff to properly maintain from the ground, and the

maintenance of these trees consequently requires a certified, trained arborist to perform the necessary maintenance.

Institutions with limited resources rely heavily upon commercial tree care companies to provide the variety of services that in house staff and volunteers cannot. These companies perform specialized tasks, including pruning, removals, stump grinding, and integrated pest management, as well as data collection and management on individual trees. The aforementioned services help to ensure a minimum standard of care for a tree collection, especially given the absence of a staff arborist. These services, if accessible, can help an institution with limited resources maintain their tree collections properly.

The demands of collections maintenance continue to increase as does their importance in our communities. Institutions with tree collections play an active role as public educators and conservators (Willison, 2006) and increasingly as University horticulture programs and courses are in decline. These institutions shoulder the duty of educating not only youth and visitors, but also scholars and professionals seeking opportunities for more in-depth horticultural studies. These same collections can also serve an important role in plant conservation. Institutions can actively participate in the conservation of tree species through engaging in conservation processes as members of the North American Plant Collections Consortium (NAPCC). Researcher David Aplin (2008) notes that, Institutions with tree collections are taking on the role and responsibility to care for species that may otherwise disappear (Aplin, 2008).

Despite the many positive and vital aspects of tree collections, there is seemingly a disconnect between these rich assets and the amount of resources allocated to their care. Until overtly problematic, tree collections are typically seen as

non-critical in resource allocations. Several respondents to a survey sent to American Public Garden Association and Professional Grounds Maintenance Society members commented that tree care is "not an institutional priority" and "there is not enough staff time," and reveal a general lack of support, concern and understanding for tree collections.

An indication that this is more than just a temporary problem related to the recent economic recession is that some institutions simply do not have management plans for their collections. Institutions without a management plan run the risk of not completely understanding the state of their collections or how to care for them if and when the budget improves. These results point to a widespread need for these institutions to revisit priorities and tree collections management strategies. Despite recent improvements in the economy since the 2008 recession, institutions still face – and presumably, will continue to face – tight budget constraints. The budget realities of both large and small institutions drain efforts to effectively maintain a collection on limited resources. Consequently, Hohn (2008) recognizes that a "trend that is taking hold at many institutions…is to outsource landscape management services."

Despite budgetary restraints, there are innovative methods of establishing and maintaining relationships with commercial tree care companies that can reduce the financial costs associated with tree care. [If implemented] creative collaborations between institutions and commercial tree care companies can dramatically reduce the financial burden of collection maintenance and improve the overall level of care and safety for the collection. Over time, partnering organizations can leverage expertise to better insure consistent quality for collections. As the collaboration continues and

strengthens, the relationship benefits as arborists deepen their familiarity with the institution's tree collection.

Highly-successful and mutually-beneficial collaborations between tree care companies and institutions can be challenging to initiate or, in some cases, develop quite effortlessly. In reality, this type of relationship is not very common. Institutions that need donations of in-kind tree care may find a willing company to donate services once or several times, but many fail to recognize the long-term relationship potential and take the appropriate steps to cultivate the relationship. And often when contracting with a commercial tree care company, these same institutions cannot afford a complete tree care regimen and pay for a la carte services that do not significantly enhance that company's bottom line. Further, when emergency tree care is required, these same institutions often employ a company that can provide the service at the most competitive price and not the service that can provide the highest standard of care.

In the professional tree care industry, the International Society of Arboriculture (ISA) does not track in-kind work from professional arborists to institutions despite encouraging volunteerism. However, arborist Peter Fixler (PennDel ISA) identifies a considerable amount of in-kind work donated to institutions with tree collections. Volunteerism driven by the ISA is most readily seen in the Annual Arbor Day of Service. These interactions point to a philanthropic desire to "give back" and not seek financial return on the part of commercial tree care companies. This research will explore what commercial arborists feel they gain from these relationships. If institutions can better understand their role and what they can indeed provide in return

for arborist services, there may be a greater chance they can build better relationships that are indeed mutually beneficial and have a positive impact on tree collections.

Despite the collections management issues faced by tree-collection institutions across the U.S., there are a few examples of successful partnerships that can serve as models for other organizations. Through surveys and interviews with collections management professionals from a variety of institutions, several unique and groundbreaking partnerships have been identified: the New England Wildflower Society in Framingham, MA; the Montgomery Botanical Center in Coral Gables, FL; and Moravian College in Bethlehem, PA. The research aimed to discover several key aspects of these relationships:

1. How are relationships established with arborists, and who manages them?
2. How institutions minimize tree care costs?
3. Can these examples be standardized?
4. Does the partnership result in an adequate level of care for the collection?
5. When commercial arborists donate in-kind work, what do they feel they receive?

This research seeks to identify the commonalities among these examples and teases out lessons that can be applied to or used as a model for other institutions. Several times the staff members responsible for care of the collections were in themselves key to finding these relationships, and some work has been done to analyze the personalities and leadership styles of these individuals/institutions that allowed them to build productive relationships with commercial partners.

Chapter 2

LITERATURE REVIEW

Although many institutions have tree collections, there is not an abundance of literature available on the topic of managing tree collections and even less so about relationships between commercial arborists and institutions. Advice on developing new tree collections focuses on preparing and selecting appropriate planting locations and species (Toomer, 2010, and Lape, 1998). The collection is then left to fend for itself in an uncertain future, as Lape suggests, "when plants have got beyond their vulnerable stage, an arboretum's personnel may find more leisure time or [have] acquired more funds and wish to expand its services" (Lape, 1998). Unfortunately, the evidence from a survey of APGA and PGMS members contradicts the hopeful idea of institutions finding more "leisure time and funds" as trees mature. Rather, it seems to suggest that the latter years of a tree collection may indeed be more difficult and expensive to manage than initially recognized.

Excellent resources are available on the cost savings that can be realized from proper pruning of young trees, but large mature trees are a different matter (Gilman, 2012). If proper structural pruning is not done when trees are young, "more hours and higher disposal fees will be incurred pruning large neglected trees infrequently compared to instituting a pruning program when trees are young" (Gilman, 2012). Deferring maintenance inherently increases costs. Unfortunately, many institutions find themselves in precisely the situation Gilman warns against. Again, the survey indicates that many institutions have tree collections with large mature trees that have

been pruned infrequently. One respondent commented, "the reality is that we do the bare minimum because it's all we can afford," and another "our aging work force, lack of the ability to handle the large work and [having] the superintendent up in the [cherry picker] bucket resulted in a not efficient and/or effective operation" (Callahan, 2014). Creating opportunities for institutions to perform the work recommended by Gilman (2012) are crucial for the future of tree collections.

Strategies for tree collections maintenance may build on available models from institutions managing other types of collections or facing similar budget restraints. One general example with potential similarities is the field of facilities maintenance. Deferring maintenance of physical facilities follows a pattern similar to that of tree collections, since "one of the most common methods of making 'invisible' cuts during budget reductions is to cut maintenance of the NP [nonprofit] facilities" (Smith, 2011). Such a strategy of reducing costs by deferring maintenance provides only temporary solutions, and eventually, funds (or alternative strategies) must be found to make up for years of neglect (Smith, 2011).

Trees, unfortunately, have a finite lifespan and go through a natural life cycle of growth from sapling, maturity, over-maturity, senescence and ultimately death. This lifespan can be affected by a number of environmental factors, including sun, water, temperature fluctuations, wind, pests, disease, and human influence (Gilman, 2012). Every life stage of a tree requires the attention of a skilled arborist – especially in the early years of formative growth (Gilman, 2012). Mature trees that have not been pruned at all due to such factors as budget constraints and lack of skilled staff face a number of consequences. These consequences include a variety of potentially dangerous structural issues like low limbs in and over pathways, co-dominant stems

that weaken the tree's core structure, and an accumulation of dead branches that present falling hazards (Gilman, 2012). Unfortunately, this is an exponential problem, as the cost of not maintaining trees increases the longer the trees are not maintained. Small, easily-correctible problems in young, newly-planted trees become expensive, involved problems in large, mature trees. Furthermore, large corrective pruning cuts can adversely impact the health of a mature tree at such a late stage because they create scars with large surface areas that are slow to heal.

Safety is the primary reason that a tree at any institution needs care and maintenance. Small and large limbs, or entire trees, if dead or diseased, pose a risk to staff and visitors who frequent these institutions. Many times, smaller institutions can allocate resources *only* in response to safety concerns. Survey respondents indicated that many (71%) do not have a disaster management plan in place, and consequently many (57%) respondents indicated that they have little choice but to seek the services of commercial arborists in the case of an emergency. Care and maintenance practices that will extend the life of a tree, or pruning for aesthetic purposes, often become low on an institution's priority list. This approach reveals the troubling reality that these institutions are largely operating reactively instead of strategically. One survey respondent from a university commented, "The prior tree care plan allowed for most trees to decline until they posed a serious threat to the campus community and then were removed. This 'leave it and forget it until it becomes a problem' [approach] left me with a long list of hazard trees and threats" (Callahan, 2014).

In general terms, non-profit institutions with limited budgets have difficulty providing funds for areas or projects that are not perceived as critical for the institution to remain alive. David Callahan notes that most nonprofits never reach the necessary

scale to have the impact they desire; instead, too many are just getting by (Callahan, 2015). Fifty three percent of responding institutions report that they feel they do not have sufficient funds to adequately maintain their tree collections. Nevertheless, botanical gardens and arboreta are challenged to conduct their plant preservation and maintenance programs effectively and efficiently (Hohn, 2008), and ideally they would operate with a more forward-thinking mandate than simply responding to the latest crisis.

Indeed, the feeling of constraint prompted by limited resources is one not likely to dissipate soon. The cost of maintaining tree collections is continually rising, whether an institution performs all of the required work with in-house staff or whether it outsources the work. Survey responses indicate that institutions have chosen to outsource some (87%) or all (49%) of their tree care, with only 13% indicating they perform all tree care work in-house. Hohn recognizes a trend of organizations that focus their energies on collections preservation and less so on "housekeeping" activities (Hohn, 2008). (For these purposes, Hohn uses the term "preservation "for "any action taken to stabilize and prolong the life of the collection" (Hohn, 2008).

Hohn simply recommends finding a qualified contractor and choosing the provider that can provide a specified service at the lowest price (Hohn, 2008). He advocates the implementation of a lengthy questionnaire for prospective providers to complete before work can be done. Despite the advice to choose the lowest bidder, the suggestion of using a "lengthy questionnaire" seems to indicate that the problem Hohn is addressing is one of quality control and project oversight instead of budgetary constraints. Many small-budget institutions do not have the resources to manage an extensive contracting process.

However, Hohn's point that a possible solution to lower costs is outsourcing is well-made when compared to other theorists. Toomer (2010) makes general recommendations for institutions facing budgetary hurdles, but offers little concrete advice to overcome such issues. Lape (1998) offers advice on creating a collection but almost none on long-term collection care. These authors do not acknowledge the perspective of smaller institutions with budget restraints concerning their collections, although they do outline important aspects of collections preservation and conservation for institutions that have more extensive financial resources. Hohn recommends outsourcing to save costs, but the unfortunate reality is that outsourcing has associated costs that remain out of reach for many smaller institutions.

Some institutions, like the Crosby Arboretum in Piscayune, Mississippi, work to keep maintenance costs low by creatively designing exhibits that focus on natural areas and "utilizing natural processes to create and maintain exhibits" (Brzuszek, 2014). This can translate to a suggestion that institutions perform no preventative maintenance for trees in exhibit areas and do only minimal clean-up when trees or branches fall on or near pathways. This practice is ideal for some institutions, especially those developing new collections, but for others the realities of important historic trees, heavy foot traffic, general public presence, structures (historic and otherwise), parking areas, roadways and public utilities make this management technique difficult to replicate. What is admirable about the approach Crosby took – and what other institutions should consider replicating – is the sober recognition of the long-term costs inherent in all managed collections and the careful planning that either addresses or avoids these costs (Brzuszek, 2014). Crosby founders also "did not have a large endowment of funds," and because of that they took time to "consider several

options to prevent hasty mistakes that can easily occur when there are ample funds" (Brzuszek, 2014). Many institutions aim to minimize "change" in their tree collection through practices to keep trees healthy, but Crosby instead recognized, "this propensity for change would be embraced, not lamented".

These institutions all understand the costs in both staff time and financial resources entailed in maintaining a tree collection. For some institutions, it is simply the cost of providing a great experience for visitors or safety for those using the grounds. Unfortunately, some institutions struggle with large collections and long-deferred maintenance as well as budget constraints. These institutions unfortunately face many pressures for funding dollars, but still face the need to maintain their collections.

Creative collaborations between institutions and contractors may be one way to alleviate some of these pressures. These collaborations exist on many levels, and oftentimes they are started through professional or personal relationships. The steps that have led to these successful relationships, however, are not well defined. A lack of understanding exists on how these collaborations are begun and sustained.

Finding generous commercial tree care companies is not difficult as one interview respondent commented "a contractor that has worked for us was a longtime friend of a previous manager" and conversations like this came up several time through interviews and emails with institutions (Sisney, 2014). Transitioning to a longer-term collaboration is not well known. Through happenstance or cultivation these relationships continue, and institutions often come to rely on in-kind work and professional advice from contractors. Many times, institutions simply perpetuate tree collection practices that have proven adequate over a period of time, as reflected in an

interview comment, “Our in-house crew was also only taking down severe hazard trees or responding to storm cleanups and not taking a maintenance approach to maintaining trees” (Callahan, 2014). This research explores the correlation between innovative collections management techniques and the people who implement these changes. Is it simply that necessity is the mother of invention, or is it that the person responsible has a high degree of internal motivation (Dubinsky and Skinner, 2004)? Is it possible that these creative problem solvers have something in common that facilitates long-lasting, mutually-beneficial relationships with commercial tree companies?

James Hodge writes about the “transformational philanthropy” that occurs when an organization cultivates a relationship with an individual donor so that they can move beyond a basic “‘give-and-take’…we ask and donors give” to a model of donors “meaningfully sharing of themselves and their assets” (Hodge, 2003). Many of the same principles seem to apply to institutions as they seek collaborations with contract service providers beyond merely settling on pay-for-service transactions. In fact, the three stages of philanthropic giving that Hodge outlines – transactional, transitional and transformational – can apply to the relationship tree care contractors have with institutions. The problem with a strict focus on financial giving is the translation from the giving of finances to the giving of time and resources. According to Peter Fixler from the ISA PennDel, arborists will not recoup the costs of in-kind work with tax write-offs and/or promotion of their services to staff/board/members of the institution (a frequent service offered by institutions in trade for tree care)(personal communication, December, 2013). The need to explore successful long-term relationships further, paying particular attention to why select commercial arborists

actually do give time and resources and to what they get in return, is important for other institutions if they want to learn how to replicate such productive relationships.

However, other institutions have difficulty establishing these types of relationships or simply cannot accept in-kind work and must find ways to work effectively with contractors while keeping within their budgets.

Institutions with both the need to maintain a collection and financial restraints are faced with the more basic question of how to keep their collection safe for the public, and how to do this work effectively given their budget realities. Managers within these institutions are generally not certified arborists (Only 1% of survey respondents identified as arborists). They wear many hats and are responsible for a wide variety of tasks within their institutions. One survey respondent commented, "we have more than tree work to do," when asked why maintaining the collection was difficult. These people, while often dedicated and energetic, need practical advice on envisioning and implementing long-term care of their collections given the budget realities they face (and will largely continue to face moving forward). Aligning collections care with the institution's larger mission will help managers better cultivate "transformational philanthropic relationships" with tree care contractors while acknowledging the overall financial context of the institution.

Chapter 3

MATERIALS AND METHODS

A mixed methods approach was used to collect data for this research. Quantitative data was collected through a preliminary survey administered in May 2014 and a second, more comprehensive survey was launched in November 2014. Qualitative data was collected from in-depth, on-site visits and interviews at three institutions with tree collections representing a variety of institutions, including a collection-based garden, a natural/woodlands garden and a university campus (Table 1). Phone and email interviews/conversations were also conducted with 13 institutions that participated in one or both of the surveys and expressed a willingness to participate in additional interviews regarding the institutional management of their collection. The researcher completed the University of Delaware Human Subject Research Board (HSRB) online training in the fall of 2013 and all survey questions were approved by the HSRB in advance.

Quantitative Research

Preliminary Survey

This survey aimed to gain a better understanding of the budget and staffing realities that institutions with tree collections face, as well as current maintenance and management techniques, so that further research efforts could be refined. It was sent to 453 institutions through the American Public Gardens Association (APGA) professional sections: Green Buildings and Landscapes, College and University

Gardens, Plant Collections, and Small Gardens sections. In addition to the APGA sections, members of the American Society for Horticultural Science also received the survey. In total, 69 surveys were started and 64 were completed.

Second Survey

A second (final) survey was sent to the aforementioned sections of the APGA and members of the Professional Grounds Management Society (PGMS) in November 2014 with focused questions on identifying institutions that were finding some measure of success in maintaining their tree collection(s) despite budget constraints. Upon recommendation of the committee, members of the PGMS were sent the survey. In total, 158 individuals started the survey and 130 finished. Forty-eight individuals expressed a willingness to participate in future research and all participants were guaranteed confidentiality.

Qualitative Research

Interviews were conducted at three different U.S. institutions that have tree collections and were selected following recommendations of the graduate committee. Recommendations were made to maximize diversity in the goals and geography of the institutions. They represented a collection-based garden, a natural/woodlands garden and a university campus (Table 1). Interviews at these three institutions began with a basic set of questions (Table 2) and the conversations developed organically. Institutions were only selected who self-identified as having a small budget allocation for contractual work (< $10,000 annually) or having departments facing budget constraints. Participating institutions were also characterized by an exclusive reliance

on commercial tree care companies for mature tree care and did not employ climbing arborists on staff. Tree care management techniques and relationships these institutions have with tree care companies and the departments in their institutions were discussed. The number of staff interviewed at each institution ranged from one to four. Some interviewees were not staff but associated contractors working at the related institutions. Contractors are indicated by their titles in Table 1. Interviews were also conducted with 13 other institutions in person, on the phone or via email to attain a well-formed perspective. The criteria, for these institutions, were broadened to attain a well-formed perspective.

Table 3.1 - List of Institutions, Interviewees, and Mode of Contact for Those Contributors to the Qualitative Data Gathered in This Study

Institution Name and Location	Interviewee Name and Title	Phone	Email	In-Person
New England Wildflower Society Garden in the Woods, Framingham, MA *Natural/Woodlands Garden*	Mark Richardson – Horticulture Director			X
	Rolf Briggs – Owner; Tree Specialists, Inc.	X		
Moravian College – Bethlehem, PA *University Campus*	Randy Haffling – General Services Manager			X
	Frank Kuserk – Professor of Biology (1977) Director, Environmental Studies & Sciences Program	X		
Montgomery Botanical Center – Coral Gables, FL *Collection-based*	Chad Husby – Collections Manager and Botanist			X
	Lee Anderson – Manager, Horticulture and Facilities			X
	Christina Dupuy – Arborist			X

Garden	Bob Brennan – Chief Arborist, Fairchild Tropical Botanical Garden			X
Brooklyn Botanic Garden – Brooklyn, NY	Melanie Sifton – Vice President of Horticulture & Facilities		X	
The College of Wooster – Wooster, OH	Beau Mastrine, CGM – Director of Grounds		X	
Delaware Valley College – Doylestown, PA	Patrick P. Callahan – Director of Grounds, Landscaping and Turf		X	
Filoli – Woodside, CA	Jim Salyards – Manager of Horticultural Collections & Education Internship Coordinator		X	
Green Valleys Association at Welkinweir – Pottstown, PA	Victoria Laubach – Executive Director			X
Gwinnett Technical College – Lawrenceville, GA	Gail Zorn – Grounds Manager		X	
Kalamazoo College – Kalamazoo Twp., MI	Victor M. Garcia – Grounds Coordinator		X	
Keene State College – Keene, NH	Bud Winsor – Assistant Director Physical Plant/Grounds	X		
Lewis Ginter Botanical Garden – Richmond, VA	Grace Chapman – Director of Horticulture		X	
Northwest Missouri State University – Maryville, MO	Shawn Stisney – Arborist/Certified Grounds Technician		X	
Toronto Botanical Gardens – Toronto, Canada	Harry Jongerden – Executive Director		X	

University of Maryland Baltimore County – Baltimore, MD	Donna Anderson – Manager of Landscape and Grounds		X	
University of Pennsylvania – Philadelphia, PA	Robert E Lundgren, ASLA – University Landscape Architect	X		

Table 3.2 – Basic Interview Questions

1.	Please describe the type of relationship(s) you have with the arborist(s) that work on your tree collection.
2.	How do you make decisions on what tree work gets done with your limited funds?
3.	How long have you been here working/managing the tree collection?
4.	How big is the garden/tree collection?
5.	How many staff work with the tree collection?
6.	Do you track what work is done on the tree collection?
7.	What is your highest priority for your tree collection?
8.	How much do you budget for tree care annually?
9.	Tell me about yourself and your background.
10.	Do you feel you are maintaining the tree collection well?

Chapter 4

RESULTS

Throughout this chapter, the most salient and/or relevant survey responses are presented. Complete surveys with all responses can be found in the Appendix.

Preliminary Survey

To establish how respondents perceived the importance of tree collection maintenance, 74% indicated that their garden's operational budget did not accommodate their institution's tree care requirements (Table 4.1), and 63% believed that their institution did not consider tree care a high priority (Table 4.2). When queried if their tree collections had value to their institution or the broader community, almost half (48%) of survey participants noted that they did have historic or state champion trees in their collection (Table 4.3). Second, participants rated their tree collections' importance on the overall visitor experience a 7.64 (with 1 being "not important" and 10 "very important"; Table 4.4).

To establish the outstanding need for tree care, participants were asked if any trees in their collection were currently safety hazards and over half (59%) responded affirmatively (Table 4.5).

Lastly, several questions aimed to determine if these institutions had arborists on staff to maintain their tree collections. Over half of the respondents (55%) indicated that they did not (Table 4.6), and that 70% of respondents who do have a

staff arborist indicated that the staff arborist does not have the primary responsibility of caring for the tree collection (Table 4.7).

Second Survey

This survey sought to establish a baseline of information from participant institutions. When asked to identify their position within the institution the most common were Head of Grounds (23%), Executive Director (19%), and Head/Director of Horticulture (15%) (Table 4.8). The survey audience was represented by over half College/University Campuses (63%), 27% Botanical Gardens, 17% Arboreta, 8% Historic Landscapes, 7% Other, 4% Managed Natural Areas, 3% Municipal Gardens/Parks, and 1% Private Gardens (Table 4.9). Institutional budgets ranged from 21% managing annual funds over $10 million, 4% at $5-10 million, 16% at $2.5-10 million, 20% at $1-2.5 million, 5% at $750-1 million, 5% at $500-750,000, 14% at $250-500,000, and 14% have budgets up to $250,000. An error was made in the survey questions in which two figures included a range that included $10 million (Table 4.10).

To gauge the prevalence of formal conservation practices for the institutions' tree collections, participants were asked if their institutions held any North American Plant Collections Consortium (NAPCC) collections: 63% answered that they did not (Table 4.11).

To ascertain if preventative measures were practiced for the long-term preservation of their tree collections, participants were asked if they had a disaster management plan for their collection. Seventy-one percent answered having none (Table 4.12).

As in the preliminary survey, several questions queried about the arborists' care for the trees in their collection. 60% have an arborist on staff (Table 4.13) but for almost half (48%), caring for tree collections is not their primary responsibility (Table 4.14). When asked about the use of commercial arborists for general tree collection maintenance, 87% indicated they had a relationship with a commercial arborist (Table 4.15); and more specifically, 49% use commercial arborists for the majority of their tree care work, 69% use them for specialty work, and 61% use them for emergency work (Table 4.16).

Similar to the preliminary survey, participants were asked about the value of their tree collections to their institutions and the broader botanical community. These questions were asked to determine if there is an incentive to care for the collections beyond managing safety concerns for visitors, as well as to prolong the life of the individual trees and the collection as a whole. Eighty-seven percent (87%) had trees considered highly valuable to their collection (Table 4.17). Sixty-three percent (63%) had trees considered valuable to the broader botanical community (Table 4.18). To determine how these institutions use their tree collections and where their "value" is derived, participants were asked how their tree collections were used. Education was the primary use, at 81%, then 80% are used for display, 68% to attract visitors, 43% for conservation, 38% research, and 11% Other (e.g., LEED certification, fundraising, and food production) (Table 4.19). Participants were asked if, given the level of importance the collection has (from the uses noted above), there are adequate resources available to maintain their collections to a minimum standard of care. 53% responded that they did not have adequate resources given the collection's importance (Table 4.20).

To get a better understanding of why their collections were not appropriately cared for, participants were asked what they viewed as their greatest impediment. The greatest impediment in caring for their collection was overwhelmingly budget constraints, with a total weighted score of 307pts.[1] The second impediment was having insufficiently-trained staff, with 197 points (Tables 4.21 & 4.22).

Table 4.1

In your opinion, does your garden's budget accommodate your institution's tree care requirements?		
Answer	*Response*	*%*
Yes	17	26%
No	49	74%
Total:	66	100%

Table 4.2

Is tree care a high priority in your institution's budget?		
Answer	*Response*	*%*
Yes	24	37.5%
No	40	62.5%
Total:	64	100%

[1] Points were given to weight the responses. Participants ranked their #1 through #6 impediments in descending order. Points were assigned as 6 points for their #1 impediment , 5 points for their #2, 4 for their #3, and so on. Total points were tallied per impediment.

Table 4.3

Do you have historic or state champion trees in your collection?		
Answer	*Response*	*%*
Yes	31	48%
No	33	52%
Total:	64	100%

Table 4.4

One a scale of 1 to 10, how important is your tree collection to the overall visitor experience?		
Average Value	*Standard Deviation*	*Results*
7.64	2.16	64

Table 4.5

Does your collection have any trees that are safety hazards?		
Answer	*Response*	*%*
Yes	38	59%
No	26	41%
Total:	64	100%

Table 4.6

Does your institution have an arborist on staff?		
Answer	*Response*	*%*
Yes	28	45%

No	34	55%
Total:	62	100%

Table 4.7

Is the primary role of the staff arborist to manage or care for your tree collection?		
Answer	*Response*	*%*
Yes	11	25.5%
No	30	70%
Unsure	2	4.5%
Total:	43	100%

Table 4.8

What is your position in your institution?		
Answer	*Response*	*%*
Director/Executive Director	28	19%
Head/Director of Horticulture	22	15%
Arborist	2	1%
Curator/Plant Recorder	14	9%
Head of Grounds	35	23%
Other	38	26%
Horticulturist	10	7%
Total:	149	100%

Table 4.9

What would best describe your institution? (Please check all that apply)		
Botanical Garden	40	27%
Arboretum	25	17%
College/Univ. Campus	94	63%

Cemetery	0	0%
Private Garden	1	1%
Municipal garden/park	5	3%
Other	10	7%
Historic landscape	12	8%
Managed natural area	6	4%

Table 4.10

What is the size of your institution's budget?		
Answer	*Response*	*%*
Up to $250,000	19	14%
$250,000 – $500,000	20	14%
$500,000 - $750,000	7	5%
$750,000 - $1,000,000	7	5%
$1 - $2.5 million	28	20%
$2.5 - $10 million	23	16%
$5 - $10 million	6	4%
Over $10 million	30	21%
Total:	140	100%

Table 4.11

Does your institution hold any North American Plant Collections Consortium (NAPCC) collections?		
Answer	*Response*	*%*
Yes	28	19%
No	92	63%
Unsure	25	17%
Total:	145	100%

Table 4.12

Does your institution have written plans in place that address specific threats to your tree collections (severe weather events, pests and disease, vandalism, etc.)? Such documents are sometimes referred to as disaster management plans.		
Answer	*Response*	*%*

Yes	37	29%
No	90	71%
Total:	127	100%

Table 4.13

Does your institution have an arborist on staff?		
Answer	*Response*	*%*
Yes	76	60%
No	50	40%
Total:	126	100%

Table 4.14

If you do have a certified arborist on staff, is their primary role to care for the tree collection?		
Answer	*Response*	*%*
Yes	39	43%
No	44	48%
Unsure	8	9%
Total:	91	100%

Table 4.15

Does your institution have a relationship with a commercial arborist(s) or arboriculture service company?		
Answer	*Response*	*%*
Yes	110	87%
No	16	13%
Total:	126	100%

Table 4.16

If you do have a relationship with a commercial arborist, what type of relationship(s) do you have? (please check all that apply)		
Answer	*Response*	*%*
A commercial arborist serves on our board.	9	8%
A commercial arborist who is not on the board but serves on a board committee	6	6%

Friend of the institution	27	25%
Hired for emergencies	61	57%
Volunteer services / in-kind work	19	18%
Other	10	9%
Hired for most tree care work done at the institution	52	49%
Hired for specialty work, e.g. crane removals, work around electrical lines, etc.	69	64%

Table 4.17

Does your institution have trees that it considers highly valuable to its collections?		
Answer	*Response*	*%*
Yes	108	87%
No	11	9%
Unsure	5	4%
Total:	124	100%

Table 4.18

Does your institution have trees that are considered highly valuable to the broader botanical community?		
Answer	*Response*	*%*
Yes	77	63%
No	28	23%
Unsure	18	15%
Total:	124	100%

Table 4.19

How does your institution use its tree collections?		
Education	100	81%
Research	47	38%
Conservation	53	43%
Display	98	80%
Attracting visitors	84	68%
Other	13	11%

Table 4.20

Given the level of importance the collection has to the institution, do you feel adequate resources are available to maintain the collection to minimum standards of care?		
Answer	*Response*	*%*
Yes	55	45%
No	65	53%
Other	3	2%
Total:	123	100%

Table 4.21

Please rank what you feel is the greatest impediment to your ability to adequately care for the tree collection? (1 being the greatest impediment, 2 the second most, and so on)							
Answer	*1*	*2*	*3*	*4*	*5*	*6*	*Total Responses*
Budget constraints	39	9	4	3	1	1	57
Lack of partnerships	3	2	6	14	11	11	47
Absence of a tree management plan	3	7	14	14	11	6	55
Insufficient trained staff	5	16	11	4	11	4	**51**
Insufficient equipment	4	10	11	13	11	5	54
Other	2	6	2	0	0	1	11
Total:	56	50	48	48	45	28	-

Table 4.22

Totals from Table 4.21 with points assigned to response.							
Answer	*1*	*2*	*3*	*4*	*5*	*6*	*Total: Points*
Budget constraints	39 x 6	9 x 5	4 x 4	3 x 3	1 x 2	1 x 1	307
Lack of partnerships	3 x 6	2 x 5	6 x 4	14 x 3	11 x 2	11 x 1	127
Absence of a tree	3 x 6	7 x	14 x	14 x	11 x	6 x 1	179

management plan		5	4	3	2		
Insufficient trained staff	5 x 6	16 x 5	11 x 4	4 x 3	11 x 2	4 x 1	192
Insufficient equipment	4 x 6	10 x 5	11 x 4	13 x 3	11 x 2	5 x 1	184
Other	2 x6	6 x 5	2 x 4	0 x 3	0 x 2	1 x 1	51

Interview Results

Moravian College

Moravian College is the 6th oldest college in the United States, founded in 1742 by the religious order of Moravians. Located in the small city of Bethlehem, PA (pop. 75,018), the college is 80 miles from New York, NY, and 70 miles from Philadelphia, PA. Moravian College is a part of the Lehigh Valley Association of Independent Colleges, comprising six area institutions. It is a private, residential, liberal arts college with roughly 1,600 undergraduate and graduate students combined. Its mission is to "draw on the Moravian traditions of community, engagement in the world, and balance among body, mind, and spirit in the life of the individual" and "develop …the capacity to learn, reflect, reason, communicate, and act with integrity as individuals and in association with others." Within the college, the Facilities Management, Planning and Construction Department (which is responsible for the maintenance of the college tree collection) shares the college's mission, but also to "provide (*services*) in a prompt, efficient, safe, cost-effective manner which will result in the care, protection and preservation of the facilities, and will provide the students, faculty and staff with a safe, comfortable, clean and efficient environment in which to live, learn, work, and develop." These responsibilities are also reflected in their most

recent strategic plan, which states that they "have focused on enhancing every aspect of the College that affects the quality of student experience, from our engaged faculty, to new and technologically up-to-date academic facilities…" (Moravian website)

The college comprises three campuses on 85 total acres, which includes trees in landscaped as well as natural areas. There are approximately 750 landscape trees across the three campuses (not including trees in natural wooded areas). Most trees are adjacent to roadways, walking paths, residence halls and academic buildings, and include several historic, non-native trees estimated to be over 200 years old. These trees could conceivably be the oldest of their species in the United States. Early Moravians were avid plant collectors and botanists, and several herbaria collections still exist at the Academy of Natural Science in Philadelphia, PA (Troyer, 2009).

The seven-person department, headed by General Services Manager, Randy Haffling, maintains the grounds, facilities and tree collection. Haffling was hired in 2009 with a background in horticulture and project management for the national landscape services firm, Brickman, Inc. Upon starting at Moravian, Haffling started to develop a more proactive approach to tree collection care with an annual tree care budget of $5-8,000, a small staff and no arborist. Before his arrival, tree maintenance was described "reactionary and not holistic." Integral to his proactive approach to tree care was the initiation of an inventory system for the campus trees. Without the available budget or staff, Haffling contracted the services of Bartlett Tree Services Company and their Bartlett Inventory Solutions (BIS) to begin the tree inventory. The $6,000 initial cost of the inventory was funded through a partnership Haffling developed with Biology Professor Frank Kuserk and the student sustainability group. The partnership shared the initial start-up costs of the inventory. Today this

partnership has continued to what is now a web-based, publicly-accessible tree inventory.

To maintain the collection and prioritize tree care, Haffling records all tree work and regularly assesses the condition of trees in the inventory. Despite using Bartlett for the inventory, Bartlett does not perform all tree work in the collection. He has sought out ways to reduce costs through a careful selection of arborist services. Four tree care companies are on contract and he seeks to maximize his limited resources by capitalizing on each company's strengths. One company performs half of the grounds work during the growing season, while a local company that specializes in fine tree care performs work on signature and historic trees. A small company, which offers less expensive services, performs general deadwood pruning; and a fourth, the least expensive of all, is employed for removals. Haffling says, "let companies do what they are good at and not waste time or money in areas they are not." It also adds a bit of administrative work on his end, but it allows him to care for the trees on his relatively small budget.

Most notably, Haffling has reached across traditional culture lines. Dr. Frank Kuserk notes "before Randy there was little to no dialogue with facilities," and "he actively seeks out collaboration with the entire campus." He has also "involved faculty, students and contractors in projects normally limited only to his department." Haffling also seeks to achieve arboretum status for the campus tree collection, apply for state champion tree status, and he generally raises the priority and importance of the planted landscape at the college. Haffling acknowledges the regional competition he feels with other Lehigh Valley college campuses and how they are improving their grounds. He is aware of his impact on the overall mission of the Moravian College

and student life, and he sees himself as a caretaker of the grounds. In spring 2015, Kuserk and Haffling will continue their partnership when they present a poster of their collaboration efforts at the Ecological Society of America conference.

One of the elements that came across from Haffling and confirmed by Kuserk was the incredible passion and devotion Haffling has for the tree collection and grounds at Moravian. Haffling tells his staff, "this is your home; you spend more time here day-in and day-out than your real home. With grounds, it is the most visible trade and it is noticed, so take ownership of it and do it for the future." He enjoys getting them excited, and wants to make the campus a destination for plant lovers as much as for those interested in Moravian as an educational institution. Haffling also enjoys the deep horticulture roots at Moravian and sees himself as a caretaker of a legacy. When he makes decisions about trees, he admits to thinking, "100 years down the road … is this the right plant in the right place?"

Garden in the Woods – New England Wildflower Society

Garden in the Woods in Framingham, MA, is the public face and headquarters of the New England Wildflower Society (NEWFS). Founded in 1900, it is the nation's oldest plant conservation organization. NEWFS is located 21 miles from Boston, and is a showplace for New England native plants, as well as being a resource for local and international visitors. The organization's mission is, "to conserve and promote the region's native plants to ensure healthy, biologically diverse landscapes." In its own description, the Garden in the Woods' "towering canopy of trees" plays a central role in enticing visitors to walk its entire site.

NEWFS uses its 45-acre botanic garden and 2 miles of pathways to highlight native plants in a "naturalistic setting." Mark Richardson, Director of Horticulture, oversees all horticultural activities, including care for the tree collection. Richardson notes that when he started the job in 2012, "he did not inherit a lot of problems with the trees" but "being a forest, there are always a lot of issues and a lot of work to be done." All horticultural activities are handled by Richardson and his two horticulturalists and plant propagator. He budgets roughly $4,000/year for tree collection maintenance, which is performed exclusively by a commercial tree care company. Given the limited budget and staffing, NEWFS focuses on safety pruning where trees pose a threat for visitors. Richardson also explains that the trees at NEWFS "are utilitarian and not specimen trees" and consequently not mapped or catalogued.

When asked to describe his tree maintenance plan, Richardson explains that safety is his top priority and "whatever is riskiest gets done first." He was lucky to inherit a longstanding relationship with the owner of a commercial tree care company, Rolf Briggs, who was attracted to the educational mission of NEWFS and first became involved in 1990. This partnership continues into its 25th year, and today includes a variety of in-kind services from Briggs and his tree care company, Tree Specialists, located in Holliston, MA. Briggs and his staff come to the garden twice a year to perform work identified by Richardson, whereby NEWFS receives a 33% discount. NEWFS saves additional costs by using their own staff to clean-up after the tree work is completed. The Garden also receives priority status after severe storms to minimize downtime following bad weather. Tree Specialists and Briggs also donate a variety of additional goods and services as a gesture of confidence in NEWFS.

The longstanding relationship between Briggs and NEWFS has enabled the garden to maintain a minimum standard of care for its trees at a fraction of the cost. When asked why he provides these services, Briggs notes a strong connection to the mission of the organization and a strong desire to help them accomplish their mission. He also notes that he strongly identifies with the educational mission of NEWFS and believes the work they are doing is having a positive impact in the community. He is a huge proponent of raising public awareness about trees, shrubs and pruning. Briggs also believes the strong science foundation makes NEWFS unique in their advocacy work for native plants and landscapes.

What is clear is the intense connection Briggs has with the garden, and he sees his role as more than just a tree trimmer giving discounted work. He comments, "I was volunteering with four organizations and just couldn't continue with all of them – but I continued with NEWFS". Briggs also has an emotional connection with the garden, as he and his wife were married in the garden. The devotion exhibits itself with Briggs commenting, "I became an instructor; I got speakers and other instructors to come" to the garden and help move the institution forward. Briggs mentions the importance of the strategic plan and "knowing what the plan was really helped to know where to focus my resources and work."

Montgomery Botanical Center

Montgomery Botanical Center (MBC) is a small collections-based garden in Coral Gables, FL. It was founded by Robert and Nell Montgomery, who are better known for the founding of Fairchild Tropical Botanic Garden. According to their mission, they strive to "advance science, education, conservation, and horticultural

knowledge of tropical plants, emphasizing palms and cycads, and to exemplify excellent botanical garden design." MBC has a considerable collection of tropical trees (900+) across its 120-acre garden. The garden focuses their energy on research and allows visitors only by appointment and with a guided tour. Scientists, researchers, educators, and students compose the majority of visitors to MBC, where they are proud to offer an on-site guesthouse to make MBC a leader in tropical plant research facilities. Though not the emphasis of the collection, these trees fit within the institution's vision to have "well-documented, wild-collected, population-based, tropical plant collections that are extraordinary in their scientific, educational, and conservation value" (MBC website).

Within the tree collection, there are over 20 state champion trees and many examples of tropical trees rarely found elsewhere in North America. The multipurpose tree collections at MBC are under the care of a staff arborist, Christina Dupuy, who does all pruning from the ground. All climbing work is done by two tree care companies that barter climbing work in exchange for using the garden to store vehicles and equipment and as a site to dump clean woodchips. Because of the relationships established by MBC, the budget for contract tree care is negligible, as most years there is little need for additional tree work. When asked about the budget for tree care maintenance, director Patrick Griffith explained, "In 2015 we've budgeted $74,000 for tree care." He defines "Tree Care" for this $74,000 figure as "personnel costs for staff that are dedicated to arboriculture of non-palm, non-cycad collections; 1 full time person, and a part of the staff time of three other staff; and the amount of funds budgeted for chemicals, plant purchases, and supplies for non-palm, non-cycad collections".

One of the greatest assets MBC has leveraged is their available space in a community with extremely high real estate costs. MBC has used their available space to allow several tree care companies to store vehicles and equipment in exchange for work in the center.

The priorities for climbing tree work are set by the Curator of Trees (Christina Dupuy), Superintendent (Lee Anderson), Executive Director (Dr. M. Patrick Griffith) and a part-time landscape architect. Those tasks are then left for the tree crew to complete alone without assistance from MBC staff. In the event of a storm that causes severe damage, MBC also has an agreement that the companies give priority for necessary work to be done at MBC above other clients. MBC also has close ties with Fairchild Tropical Botanical Garden, and Chief Arborist Bob Brennan regularly consults on work being done at the center. The first relationship was established in 1995 through a friend of Anderson's spouse. Certified Arborist Douglas Parks needed a space to keep his truck and chipper and a casual agreement began for Parks to exchange several days a month of work in the garden for the space. Parks continues in this agreement, as he has since 1995. Banyan Tree Care exchanges 3-4 days of work a month at MBC for the ability to park vehicles and dump clean hardwood chips for the center to use in the garden. Dupuy explains how they arrived at their second relationship with an arborist "Banyan (*Tree Care*) had a similar relationship with the University of Miami until several years ago when the space was no longer available" after which they entered into the relationship with MBC.

In addition to these relationships, MBC also has a board member that owns a heavy equipment company and has donated a loader to MBC that is extremely helpful

in the care of the tree collection for activities such as mulching and planting of new trees.

Short Interviews

Short interviews were done to establish how gardens successfully manage the relationships they have with commercial arborists. These participants represent a variety of institutions and budgets and helped provide a broader view of managing tree collections. These participants completed the survey and expressed an interest in future participation. These interviews were useful for forming a broader perspective of how tree care work is done across a wide variety of institutions.

The interviewed institutions all manage tree collections. Many, but not all, of these institutions use commercial tree care companies for varying degrees of their work. Several institutions use exclusively in-house staff arborists and do not use commercial tree care companies.

A common theme across many of the institutions was the need for clear communication from the institution about what is expected of the tree care company. The practical realities of working at a publicly-accessible institution with foot traffic were mentioned several times (D. Anderson, P. Bohlen). Institutions found success in communication developed through a long-term working relationship with a company (or companies). One participant echoed the experience of several others in noting that commercial arborists "take ownership of the collection," and using the same arborist crew over the long-term allows them to take more pride in their work (J. Salyards, B. Mastrine, G. Zorn, and V. Garcia). While establishing long-term relationship with a company, several respondents mention a similar system of stretching their thin budgets by hiring several tree care companies. Knowing the strengths and weaknesses

of each company and their associated costs is critical for some to stretch their budgets just enough to keep trees safe and reduce liability. These people also take on the role of noticing problem trees and prioritizing work for the companies to perform. They also select the company best per job and hire them for specific types of work they can do best (P. Callahan, V. Laubach).

Several institutions mentioned their limited use of commercial tree care companies. One participant commented that they "would never go back to relying on tree care companies" and another saying they "haven't used a commercial tree care company for at least the past 10 years" and another acknowledging "we may be rare these days, but we try to get all our work done using our in-house union arborists" (M. Sifton, P. Bohlen, S. Sisney). A grounds manager for a college lamented "I totally miss having a staff arborist for small jobs like hangers (broken hanging branches) and small storm damage" that aren't worth calling a company for but are too high off the ground for his grounds crew to manage (B. Winsor). Some commented on the desire to hire a staff arborist in the future for exactly this reason, but Patrick Callahan from Delaware Valley College summed up the budget realities that many face.

I did research the cost of hiring a full-time arborist/climber, and to maintain tree equipment, but the benefit of outsourcing the work to trusted and valued partners is no costs for equipment maintenance and upkeep, safety of the employees, no restriction or work limits, and removal/disposal of chips and wood. I get everything handled by the contractor and don't have to worry about much."

Ideally, given no budget constraints, almost all participants recognized the advantage to having in-house staff arborists to care for their tree collections. What the majority of institutions face, however, are budget limitations that restrict their ability

to hire and retain such staff. Also, as Callahan explains, purchasing and maintaining equipment is also a cost factor many cannot afford.

Chapter 5

DISCUSSION

Introduction

The institutions interviewed in this research demonstrated creative strategies to manage their tree collections with limited financial and staff resources. They rely heavily on tree care companies and developed varied approaches to managing their collections. A discussion of their shared and unique strategies, common themes derived from interviews and survey findings, and recommendations for other institutions are presented in this chapter.

Foundation For Successful Tree Care Across Budget Restraints

In order to have a successful tree care management program, the collection manager (and ideally the entire institution) must first value *having* a healthy tree collection. Institutions cannot indefinitely defer maintenance on their tree collections, and the old "reactionary" model cannot continue as an acceptable practice. When tree collection managers base their management strategies on a broader sense of what is possible, they create new opportunities for envisioning and planning for the long-term health and safety of their trees. Successful collection management strategies are often developed and sustained by dedicated staff members such as Haffling, but greater success could be found with increased interdepartmental collaboration throughout an institution, again modeled by Haffling (2014). Long-term tree health relies on

successful collaborative relationships. Institutional leadership can actively foster generative collaboration by supporting such relationships more broadly and inclusively. One example is the relationship NEWFS has maintained with Briggs over several decades. All of the successful relationships discovered by this research have been productive and beneficial not only due to dedicated staff members, but *also* because the value of these relationships are recognized throughout the institutions. Recognition by institutional leadership adds to the long-term sustainability of these relationships, which can measure their relationships in decades.

Relationship Development

Professional collaborations can differ greatly, but all show how a successful relationship can transform a reactionary tree care management program with a daunting list of deferred maintenance tasks, into one that is able to focus on both routine maintenance and proactive collection management. When developing new strategies to maintain a tree collection that include seeking a collaborative relationship with a tree care company, there must be a staff member who understands the current condition of the collection and/or has a plan for where they would like the collection to be. When new staff inherits a collection, there can be considerable deferred maintenance. The ability of a new manager to define priorities is critical to future success. Employing a categorization system (e.g., Signature, Specimen, General, and Cull) that identifies the descending importance of trees in their collection can be very useful. Using this can prioritize which trees are worth saving and which are not, devoting resources to maintain trees where needed most.

The institutions highlighted in this research were selected because they have a range of organizational constraints. Public gardens have a greater ability to accept pro bono services from a commercial tree care company, where college and university collections oftentimes face tighter restrictions with pro bono labor (e.g., a unionized workforce). Consequently, colleges must garner support from the student body and faculty. Despite these differences, having a plan for the collection and a dedicated staff person is critical for the success of any tree care management program.

Both MBC and NEWFS have successfully developed relationships with outside arborists that began through friendships or professional relationships. These instances demonstrate the need to treat seemingly small offers of help (from friends, colleagues, or strangers) as potential avenues to long-term relationships. These collaborations also underscore the importance of staff having a broad professional network of friends and colleagues. Collaborative relationships can emerge through a friend or through being an active member of the greater garden and arboriculture community.

Relationships with long-term success are cultivated through dedicated staff with the freedom and resources to explore new relationships and build professional networks. Successful institutions must be open to new collaborations, and having a staff member that is a "people person," one who enjoys relationship-building is an important strategy for current and future tree collection managers to adopt – especially if they don't have an in-house crew or the resources that allow for full payment of services whenever they are needed.

The ability to sustain these relationships can be more successful with a broad base of support from the institution as a whole, especially when all departments

recognize the value of the relationship. At Moravian College and the New England Wildflower Society, collection managers work across departments to gain support in welcoming their collaborating organizations. Their partners are invited to participate in the institution's mission through greater involvement in educational activities and fundraising events.

Relationship Types, Hybrids And Strategies

Tree collection managers use a variety of strategies to maximize limited budgets, but two distinct strategies emerged from this research. First, the strategy modeled by Haffling at Moravian was echoed by others (Callahan, 2014, and Laubach, 2014). When working with tree care companies, managers must recognize the actual needs of their collections, understand their budget and staffing limitations, and work with multiple tree care companies (or individuals) to meet specific collection needs. Managers may prefer to work with a single company (such as Bartlett Tree Experts), but budgets cannot accommodate the premium price for comprehensive service. On the other hand, a strategy that uses multiple companies requires established relationships with all of them, along with a proper assessment of each company's strengths relative to their costs. Significant time is required to develop effective relationships built on trust and understanding to accomplish projects as quickly and economically as possible.

Cultivating a relationship with a commercial tree care company is also a strategy employed by institutions to maintain their tree collections. Partnering with a tree care company to provide most if not all of the institution's tree work for reduced or no cost can greatly benefit both parties. Although these relationships can begin

casually, they can be sustained for decades. The institutions highlighted in this research (MBC & NEWFS) represent unique relationships with commercial companies in which both parties benefit. The benefit to the institution is regular, consistent attention from trained arborists that take ownership of the collection and build relationships with staff. The benefit to the tree care company is not as readily apparent because they will not recoup the costs of their pro bono services through tax write-offs or through referrals to new customers (Briggs, 2014, and Fixler, 2014). What these companies do receive, however, is the gratification that they are giving back, a sense of meaningfulness in doing work for the institutions and greater community, and a sense of pride in the arborists' work. Seeking and developing a relationship with the owner of a tree care company is a strategy other institutions could more actively pursue and find success.

Collections Maintenance Challenges

Tree collections, like any collection, require a consistent level of attention and influx of resources for proper maintenance. In contrast to non-woody plant collections, trees have a life cycle that is much longer; they are often most notable and valuable when they are mature and unique by virtue of their large size, such as state champion trees. Trees, though beautiful, live through a natural cycle in which they become mature, over-mature, and then senescent. Senescence can result from a variety of biotic and abiotic forces, and causes the tree to shed branches and become smaller, which causes particular anxiety to collection managers since unexpected branch failure can cause injury or death to individuals. Tree collection managers must minimize the risk of such incidents. Complicating this goal is the expense of pruning

trees, either with an in-house tree care crew and equipment or by hiring a tree care company. Managers can provide or facilitate a variety of non-safety-related services, but most small institutions have the primary goal of keeping their collections safe and often lack the resources for extensive aesthetic pruning or heritage preservation techniques.

Challenges When Working With A Tree Care Company

Institutions that employ tree care companies must pay close attention to detail, have excellent communication skills, and clearly define their projects. Every institution must understand the skillsets of the tree care companies that are hired – and then use that information to leverage the companies' best suited to the job. Predictably, the most capable and well-trained companies generally demand a higher hourly rate, while those that are less skilled compete by offering lower bids to institutions. The wise use of tree care companies allowed managers to match the best company to the intended work at the lowest price. Lower-cost companies may not be skilled enough to prune correctly, but they can perform removals safely and cheaply. Institutions can leverage their limited budgets by matching varied skillsets and pricing structures to jobs where those skills and pricing are most beneficial. In all cases, however, expectations must be clearly defined for tree care providers in order to ensure a standard of work and protect an institution's visitors.

Relying on a tree care company is difficult for institutions used to having an arborist on staff. Not having an arborist able to take care of small problems such as small hangers (broken, hanging branches) can be difficult. Having a staff member capable of effectively managing interactions with tree care companies is important, as

this staff member will largely set the tone for the relationship between the institution and the company. Small issues will arise, but should not be serious impediments to working with tree care companies. By cultivating a manager's sense of ownership regarding both the collection *and* the commercial relationship, institutions can foster a manager's willingness to solve small problems proactively. With proper preventative maintenance, challenges like these become minor, infrequent inconveniences, and the organizational relationship is not taxed unnecessarily.

Budget Restraints

Tree collections do not directly generate revenue. A collection of mature trees does, however, create a profitable environment. Institutions benefit from a well-maintained collection: it attracts visitors and researchers, aids educational programming initiatives, and improves the overall aesthetic of the institution as only mature trees can. A well-maintained mature tree collection also creates the necessary ecological conditions for a variety of other plantings. Both NEWFS and MBC have "working trees," in that individual trees are cultivated for shade gardens instead of as research specimens. It is not surprising that collection managers feel that the resources allocated to maintaining tree collections are not adequate, given the collection's importance to the institution.

Today, institutional budgets are being critically evaluated, and outsourcing work is an increasingly-common practice across institutions despite a preference for having an in-house arborist crew with a bucket truck and chipper. The associated costs for an in-house crew are not feasible for many small institutions. The overarching themes from the survey are striking for the arboriculture community.

Despite the fact that trees constitute the *raison d'être* for arboreta and are a primary asset for many public gardens and college grounds, many organizations do not adequately fund tree care or salaries for tree care professionals. Instead, arboreta, public gardens, and academic institutions rely significantly on outsourcing work to commercial tree care.

Budget constraints have resulted in institutions phasing out aging crews and equipment and relying more heavily on tree care companies. Some institutions experience their collections go from receiving routine, proactive maintenance to receiving attention only when trees were at risk of completely failing. Professionals responsible for maintaining tree collections are increasingly responsible for other institutional. Commonly, institutions do not have the resources to have a certified arborist on staff to manage the collection.

The consequences of significant budget constraints have left some institutions with aging tree collections and minimal resources to manage them effectively.

Benefits Of Properly-Maintained Tree Collections

Through intentional relationships with tree care companies, institutions can be more successful in maintaining the long-term health and safety of tree collections Successful tree care management programs can move beyond reacting to tree problems to being proactive.

A properly-maintained collection, as established by the institutions featured in this research, proves itself especially beneficial in major storm events. Costs for emergency tree removal and cleanup are reduced drastically when baseline maintenance tasks have been completed.

Other benefits of a properly-maintained collection are the activities outlined by Haffling (Haffling, 2014). When not constantly reacting to problems, managers can take the appropriate time to be proactive with any construction activities that could potentially impact tree collections. By actively working with contractors and engaging with land use plans, managers can prevent the premature death of trees in the collection.

A more holistic, proactive approach can also be useful in developing comprehensive tree care plans. These plans can allow managers to forecast general maintenance schedules, as well as provide the opportunity to carefully formulate disaster management plans. Using a more strategic approach also allows grounds staff to adopt proactive techniques in areas under their care. Thorough plans provide greater latitude in choosing management techniques for particularly valuable trees in the collection.

A well-maintained collection improves the appearance of an institution and projects a positive image for visitors, passively building the institution's reputation. This is especially important for colleges and universities, where visitors are often prospective students deciding whether the campus would be an appealing place to spend several years (and significant money). In this regard, investing in tree care can reap direct financial dividends for an institution.

Recommendations

The research points to 5 clear strategies for institutions at all levels:

Successful relationships between institutions and commercial tree care companies are treated as philanthropic relationships.

Tree collection managers successfully navigate complex, important relationships that are extending beyond bottom-line-focused operational arrangements. These relationships can be cultivated more intentionally and developed more effectively through increased cross-departmental collaboration.

With NEWFS, Briggs has personally connected with and become part of the important work NEWFS is doing to forward native plant appreciation in New England. Richardson's role is crucial in serving as the main point of contact for Briggs. Richardson ensures that Briggs remains informed about how his donation is positively impacting the institution. This relationship is not one that can be easily replicated, as Briggs is clearly a uniquely generous individual with his time and money. What can be taken from this model, however, is that professionals such as Briggs – owners of successful and responsibly-run companies – are often willing to become more active with an institution. Organizations can recognize the opportunity presented by these relationships and devote more intentional care to cultivating their long-term success.

Having a collections management plan and a relevant mission is critical to a successful relationship with a tree care company.

Having a plan is effective in attracting and maintaining relationships with tree care companies offering pro bono work.

Briggs mentions that knowing NEFWS has a clear plan for the collection, and the clear mission of educating the public about New England native plants, were instrumental in his continued relationship with the institution. NEWSFS's mission

attracted Briggs and keeps him committed to the garden. The educational aspect of the mission statement attracts Briggs to NEWFS, as Briggs has a passion and drive to educate the public about native trees and how to care for them. NEWFS is the ideal partner for him to meet his objective.

It is critical to have a dedicated staff member at the institution that is clearly implementing the plan and is able to provide guidance to other staff members.

Each institution, no matter the size, needs to have a person who understands the demands of maintaining their respective tree collection. This person must know the collection and what it needs.

The managers interviewed in this research all know their collections intimately. Richardson, as Head of Horticulture, knows that status of the garden and has a staff that notices problems and brings them to his attention. Haffling constantly walks the grounds and inspects the status of the collection. He has a clear vision for the campus. Dupuy also knows her collection extremely well, and knows how it fits into the goals of the institution. All of these individuals have goals for their collections, what needs to be done to achieve those goals, and how to communicate effectively with their partner tree care companies.

Institutions should encourage staff to work across traditional department lines and avoid working in silos.

Staff members that seek support for collection management strategies across an organization can raise the level of attention for the collection, which appeals to innovative programmatic opportunities.

Haffling came into his position as General Services Manager, saw deficiencies, and strove to meet those challenges by seeking support across the entire institution. He has worked across many institutional lines to succeed. This also goes beyond the institution, as Haffling has reached out to community groups and schools to develop programs that raise support for his collection. Now even pre-K teachers in the area know about the collection of trees at Moravian, through Haffling's tireless efforts to garner attention and support for the tree collection.

Institutions must recognize that prolonged lack of resources devoted to maintaining tree collections is not sustainable.

While institutions in this study have found success in meeting minimum safety standards through intentional professional relationships, increased funding and staff will allow tree collections to move beyond basic maintenance standards more quickly.

The intention of the research is to highlight successes despite limited budgets, and these programs cannot be compared with those spending tens or hundreds of thousands of dollars annually to implement truly state-of-the-art tree care programs. All of the institutions in the research would benefit from greater allocation of resources (funding and staff) toward the maintenance of their tree collections. If institutions wish to truly see their tree collections achieve their greatest potential, resources should be devoted to allow this goal realized. A greater awareness of the collections' value, and cross-departmental investment in the health of the collection, will greatly advance the possibility of more fully integrating collection care into an institution's operating budget.

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Appendix A

COMPLETE PRELIMINARY SURVEY RESULTS

1. In your opinion, does your garden's budget accommodate your institution's tree care requirements?			
Answer	*Bar*	*Response*	*%*
Yes	0.257576	17	26%
No	0.742424	49	74%
Total:		66	100%
2. Does you institution have a tree care management plan?			
Answer	*Bar*	*Response*	*%*
Yes	0.393939	26	39%
No	0.606061	40	61%
Total:		66	100%
3. Can your institution feasibly implement its tree care management plan?			
Answer	*Bar*	*Response*	*%*
Yes	0.54717	29	55%
No	0.45283	24	45%
Total:		53	100%
4. Is tree care a high priority in your institution's budget?			
Answer	*Bar*	*Response*	*%*
Yes	0.375	24	38%

No	0.625	40	63%
Total:		64	100%

5. Do you have historic or state champion trees in your collection?

Answer	*Bar*	*Response*	*%*
Yes	0.484375	31	48%
No	0.515625	33	52%
Total:		64	100%

6. On a scale of 1 to 10, how important are your mature trees to your collection? Please use the sliding scale to record your response.

Answer	*Min Value*	*Max Value*	*Avg Value*	*Std Dev*	*Responses*
1	2	10	8.03	1.75	64

7. On a scale of 1 to 10, how likely is it that your institution will have an independent tree assessment done in 2014? Please use the sliding scale to record your response.

Answer	*Min Value*	*Max Value*	*Avg Value*	*Std Dev*	*Responses*
1	0	10	2.85	2.96	52

8. Does your collection have any trees that are safety hazards?

Answer	*Bar*	*Response*	*%*
Yes	0.59375	38	59%
No	0.40625	26	41%
Total:		64	100%

9. Has your institution made any effort to propagate your historic or important trees?

Answer	*Bar*	*Response*	*%*
Yes	0.5	32	50%
No	0.453125	29	45%
Unsure	0.046875	3	5%
Total:		64	100%

10. Does your institution have an arborist on staff?			
Answer	*Bar*	*Response*	*%*
Yes	0.451613	28	45%
No	0.548387	34	55%
Total:		62	100%

11. Is the primary role of the staff arborist to manage or care for your tree collection?			
Answer	*Bar*	*Response*	*%*
Yes	0.255814	11	26%
No	0.697674	30	70%
Unsure	0.046512	2	5%
Total:		43	100%

12. Does your institution utilize your tree collection for educational purposes? (e.g. children's programming or historic tree tours)			
Answer	*Bar*	*Response*	*%*
Never	0.03125	2	3%
Rarely	0.03125	2	3%
Sometimes	0.3125	20	31%
Often	0.28125	18	28%
All of the Time	0.34375	22	34%
Unsure	0	0	0%
Total:		64	100%

13. One a scale of 1 to 10, how important is your tree collection to the overall visitor experience? Please use the sliding scale to record your response.					
Answer	*Min Value*	*Max Value*	*Avg Value*	*Std Dev*	*Responses*
0	1	10	7.64	2.16	64

Appendix B

COMPLETE SECOND SURVEY RESULTS

1. What is your position in your institution?			
Answer	*Bar*	*Response*	*%*
Director/Executive Director	0.187919	28	19%
Head/Director of Horticulture	0.147651	22	15%
Arborist	0.013423	2	1%
Curator/Plant recorder	0.09396	14	9%
Head of Grounds	0.234899	35	23%
Other	0.255034	38	26%
Horticulturist	0.067114	10	7%
Total:		149	100%
2. What would best describe your institution? (Please check all that apply)			
Answer	*Bar*	*Response*	*%*
Botanical Garden	0.268456	40	27%
Arboretum	0.167785	25	17%
College/University Campus	0.630872	94	63%
Cemetery	0	0	0%
Private Garden	0.006711	1	1%
Municipal garden/park	0.033557	5	3%
Other	0.067114	10	7%
Historic landscape	0.080537	12	8%
Managed natural area	0.040268	6	4%
3. What is the size of your institution's budget?			

Answer	*Bar*	*Response*	*%*
Up to $250,000	0.135714	19	14%
$250,000 - $500,000	0.142857	20	14%
$500,000 - $750,000	0.05	7	5%
$750,000 - $1,000,000	0.05	7	5%
$1 - $2.5 million	0.2	28	20%
$2.5 - $10 million	0.164286	23	16%
$5 - $10 million	0.042857	6	4%
Over $10 million	0.214286	30	21%
Total:		140	100%
4. How many full-time staff does your institution employ?			
Answer	*Bar*	*Response*	*%*
0-5	0.125874	18	13%
6-10	0.132867	19	13%
11-15	0.041958	6	4%
16-20	0.090909	13	9%
21-50	0.174825	25	17%
51-100	0.153846	22	15%
100+	0.27972	40	28%
Total:		143	100%
5. What is the size of your institution in acres?			
Answer	*Bar*	*Response*	*%*
up to 25	0.137931	20	14%
25-50	0.062069	9	6%
50-75	0.055172	8	6%
75-100	0.075862	11	8%
100-250	0.186207	27	19%
250-500	0.2	29	20%

500-1,000	0.103448	15	10%
Over 1,000	0.17931	26	18%
Total:		145	100%

6. What is the source of your institution's funding? Please check all that apply.

Answer	*Bar*	*Response*	*%*
Endowment	0.496552	72	50%
Gifts	0.57931	84	58%
Grants/Contracts	0.496552	72	50%
Admission fees	0.441379	64	44%
Public monies (Federal, City and/or Municipal funding)	0.289655	42	29%
University/College allocated budget	0.57931	84	58%
Other	0.158621	23	16%

7. What percentage of your institutions plant collection are trees? Do not include plants in natural area.

Answer	*Min Value*	*Max Value*	*Average Value*	*Standard Deviation*	*Responses*
Percentage of trees in your collection	0	95	41.19	23.47	139

8. Does your institution hold any North American Plant Collections Consortium (NAPCC) collections?

Answer	*Bar*	*Response*	*%*
Yes	0.193103	28	19%
No	0.634483	92	63%
Unsure	0.172414	25	17%
Total:		145	100%

9. Which NAPCC collection(s) does your institution hold?

Text Responses

Acer, Metasequoia, Aesculus (soon Hamamelis)	Camellia
Primula	Boxwood
Trillium	Magnolia
Provisional Penstemon collection	Maples and Oaks (2 respondents)
Dudleya	Boxwood Collection
Buck Roses	Not sure about names
Cercis Magnolia (multi-site)	Quercus
Stewartia	Peonies (2 respondents)
Quercus	Nymphaea (2 respondents)
Two NAPCC: Pine, Ornamental Grass	Hamamelis
Buck Roses	Oak Collection

10. Does your institution have a written collections policy?

Answer	*Bar*	*Response*	*%*
Yes	0.412587	59	41%
No	0.475524	68	48%
Unsure	0.111888	16	11%
Total:		143	100%

11. Does your institution have a formal written plan addressing the management/care of your collections/landscape?

Answer	*Bar*	*Response*	*%*
Yes	0.461538	66	46%
No	0.454545	65	45%
Unsure	0.083916	12	8%
Total:		143	100%

12. If you do have a formal written plan addressing the management/care of your collection/landscape, please describe:

Answer	*Bar*	*Response*	*%*

What year was the latest version of the plan created?	1	50	100%
How often is the plan reviewed?	0.94	47	94%

12a. What year was the latest version of the plan created?	**12b. How often is the plan reviewed?**
2011	Every 2 years
2010	Yearly
2011	Every 5 years
2003	2012 and amended
2008 - being updated now	Annually
1996	Never
2010	Planned for every two years
2009	Not enough- to be revised this season
This year for my room	Once every few years
2008	Has not been reviewed since inception in 2008
2013	~5 years
2011	Every 5 years
2012	Should be every 10 years
approximately 2009	No schedule for such
2011	As needed
2009	Every 5 years (or so)
2007	5 years
No idea	No idea
Approximately 2010	Approximately every 5 years
2006	
2011	Not yet
2012	Yearly
Two years ago.	A Landscape Committee was just re-established. The committee will review plan.

2014	5 years
2011	Every year
2005-2006	?
2011	Not sure
2013	Yearly
2013	Every 3 years
2010	N/A
2013	Yearly
2013	
2012	Varies
2008	Every 2 years
2011	3 years
2014	Yearly
--	Five years
1989	Yearly
2010	Annually
2014	Yearly
2013	Yearly
2010	Every year
2011	5 years
2013	yearly
2012	5 years
2012	Annually
2013; Trees only	Annually
2014	Every 5 years

13. If you do not have a formal written plan addressing the management/care of your collection/landscape, what is the reason why one is not in place?			
Answer	*Bar*	*Response*	*%*

Budget	0.033898	2	3%
Time	0.338983	20	34%
Resources	0.20339	12	20%
Institution doesn't feel it is necessary	0.084746	5	8%
All of the above	0.338983	20	34%
Total:		59	100%

14. To what extent does your landscape/collections management/care plan address tree care?

Answer	*Min Value*	*Max Value*	*Average Value*	*Standard Deviation*	*Responses*
Click to write Choice 1	0	100	51.8	30.57	105

15. What aspects of tree care are addressed in your management plan? (Check all that apply)

Answer	*Bar*	*Response*	*%*
General care	0.813725	83	81%
Priorities	0.529412	54	53%
Installation	0.539216	55	54%
Integrated Pest Management (IPM)	0.45098	46	45%
Pruning	0.666667	68	67%
Soils	0.235294	24	24%
Public safety	0.529412	54	53%
Tree risk assessment	0.539216	55	54%
Cabling and bracing	0.176471	18	18%
Lightning protection	0.137255	14	14%
Other	0.137255	14	14%

16. What plant record keeping database does your institution use to manage information related to its tree collection?

Answer	*Bar*	*Response*	*%*
BG Base	0.203252	25	20%

Iris Bg	0.04065	5	4%
Custom MS Excel	0.195122	24	20%
Custom MS Access	0.03252	4	3%
Paper records	0.138211	17	14%
Other	0.325203	40	33%
Records are not kept	0.065041	8	7%
Total:		123	100%

17. Why do you not have a record keeping database for your tree collection?			
Answer	*Bar*	*Response*	*%*
Budget constraints	0.3125	5	31%
Lack of time	0.3125	5	31%
Not an institutional priority	0.5	8	50%
Other	0.125	2	13%

18. Does your institution have written plans in place that address specific threats to your tree collections (severe weather events, pests and disease, vandalism, etc.)? Such documents are sometimes referred to as disaster management plans.			
Answer	*Bar*	*Response*	*%*
Yes	0.291339	37	29%
No	0.708661	90	71%
Total:		127	100%
Answer	Bar	Response	%
What year was the latest plan created?	0.862069	25	86%
How often is the plan reviewed?	0.793103	23	79%
Have you had to implement the plan?	0.896552	26	90%

18a. What year was the latest plan created?	18b. How often is the plan reviewed?	18c. Have you had to implement the plan?
2003	Not yet	Minimally
2010		Yes
2013		Yes
2013		2011
2010	Every 10 years	Yes
pre 2005	Unknown; by others	Yes
2010 for Emerald ash borer	Annually	Partially
2012	?	Yes
2007	5 years	No
don't know	Don't know	Don't know
2006		
2012	No set schedule	No
2010	5 years	No
2012	Annually	
2006	Yearly	Yes
2011	Yearly	Yes
2013	It’s a work in progress	No
2013	Not often enough	It is a work in progress
2009		Yes
1989	Yearly	Yes
2012	Yearly	No
2013	Yearly	Yes
2012	Annually	No
not sure	Not sure	Not sure
	Has been	No

	Not sure	Yes
	Yearly	

20. Do you feel that having a collections care/management and/or disaster management plan has been useful in securing additional funds or resources for your tree collections?

Answer	*Bar*	*Response*	*%*
Yes	0.245283	26	25%
No	0.358491	38	36%
Unsure	0.396226	42	40%
Total:		106	100%

21. Does your institution have an arborist on staff?

Answer	*Bar*	*Response*	*%*
Yes	0.603175	76	60%
No	0.396825	50	40%
Total:		126	100%

22. Does your institution have a relationship with a commercial arborist(s) or arboriculture service company?

Answer	*Bar*	*Response*	*%*
Yes	0.873016	110	87%
No	0.126984	16	13%
Total:		126	100%

23. If you do have a relationship with a commercial arborist, what type of relationship(s) do you have? Please check all that apply.

Answer	*Bar*	*Response*	*%*
A commercial arborist serves on our board	0.084112	9	8%
A commercial arborist who is not on the board but serves on a board	0.056075	6	6%

committee			
Friend of the institution	0.252336	27	25%
Hired for emergencies	0.570093	61	57%
Volunteer services/In-kind work	0.17757	19	18%
Other	0.093458	10	9%
Hired for most tree care work done at the institution	0.485981	52	49%
Hired for specialty work, e.g. crane removals, work around electrical lines, etc.	0.64486	69	64%

24. If you do have an arborist on staff, please choose what type of training your arborist(s) has.

Answer	*Bar*	*Response*	*%*
ISA Certified Arborist	0.743243	55	74%
Board Certified Master Arborist (BCMA)	0.067568	5	7%
Registered Consulting Arborist (RCA)	0.040541	3	4%
Other	0.067568	5	7%
Two or four year degree in arboriculture or related field	0.472973	35	47%
Apprenticeship or other former training	0.135135	10	14%
Arborist certification from state of residence	0.148649	11	15%
Other than work experience the Arborist does not have any formal education, training or certification in arboriculture.	0.067568	5	7%

25. If you do have a certified arborist on staff, is their primary role to care for the tree collection?

Answer	*Bar*	*Response*	*%*
Yes	0.428571	39	43%

No	0.483516	44	48%
Unsure	0.087912	8	9%
Total:		91	100%
26. If the primary role of your arborist is to care for the tree collection, what position do they hold?			
Answer	*Bar*	*Response*	*%*
They are the chief arborist	0.538462	21	54%
They are the head of horticulture	0.051282	2	5%
They are the curator	0.025641	1	3%
Other	0.384615	15	38%
Total:		39	100%
27. Who prioritizes tree care projects for your institution?			
Answer	*Bar*	*Response*	*%*
Director/Executive Director	0.193548	24	19%
Head/Director of Horticulture	0.241935	30	24%
Arborist	0.080645	10	8%
Horticulturist	0.064516	8	6%
Curator/Plant Recorder	0.048387	6	5%
Head of grounds	0.298387	37	30%
Other	0.072581	9	7%
Total:		124	100%
28. Does your institution have trees that it considers highly valuable to its collections?			
Answer	*Bar*	*Response*	*%*
Yes	0.870968	108	87%
No	0.08871	11	9%
Unsure	0.040323	5	4%

Total:		124	100%

29. Does your institution have trees that are considered highly valuable to the broader botanical community?

Answer	*Bar*	*Response*	*%*
Yes	0.626016	77	63%
No	0.227642	28	23%
Unsure	0.146341	18	15%
Total:		123	100%

30. How important are the valuable trees in your collection to the success of your institution?

Answer	*Min Value*	*Max Value*	*Average Value*	*Standard Deviation*	*Responses*
Valuable Trees	4	100	63.97	24.78	71

31. How does your institution use its tree collections? (Check all that apply.)

Answer	*Bar*	*Response*	*%*
Education	0.813008	100	81%
Research	0.382114	47	38%
Conservation	0.430894	53	43%
Display	0.796748	98	80%
Attracting visitors	0.682927	84	68%
Other	0.105691	13	11%

32. Given the level of importance the collection has to the institution do you feel adequate resources are available to maintain the collection to minimum standards of care?

Answer	*Bar*	*Response*	*%*
Yes	0.447154	55	45%
No	0.528455	65	53%

Unsure	0.02439	3	2%
Total:		123	100%

33. Please rank why you feel you are able to care for the tree collection(s). (1 being most important, 2 second most, and so on)

Answer	*1*	*2*	*3*	*4*	*5*	*6*	*Total Responses*
Budget	14	13	9	2	0	0	38
Crucial Partnerships	2	10	8	13	7	2	42
Thorough and clear management plan	5	5	12	10	7	1	40
Key staff members (knowledge/capabilities)	19	13	3	6	3	2	46
Availability of equipment	4	4	10	7	17	0	42
Other	1	1	1	0	0	1	4
Total:	45	46	43	38	34	6	'-

34. Please rank what you feel is the greatest impediment to your ability to adequately care for the tree collection? (1 being the greatest impediment, 2 the second most and so on)

Answer	*1*	*2*	*3*	*4*	*5*	*6*	*Total Responses*
Budget constraints	39	9	4	3	1	1	57
Lack of partnerships	3	2	6	14	11	11	47
Absence of a tree management plan	3	7	14	14	11	6	55
Insufficient trained staff	5	16	11	4	11	4	51
Insufficient equipment	4	10	11	13	11	5	54
Other	2	6	2	0	0	1	11
Total:	56	50	48	48	45	28	'-

35. Would you be interested in participating as a case study in this research?			
Answer	*Bar*	*Response*	*%*
Yes	0.439024	54	44%
No	0.560976	69	56%
Total:		123	100%

Appendix C

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Bryan Thompson-Nowak (ID: 3661578)
- **Email:** bst@udel.edu
- **Institution Affiliation:** University of Delaware (ID: 1198)
- **Institution Unit:** Agriculture and Natural Resources
- **Phone:** 302-831-2517

- **Curriculum Group:** Course In The Protection Human Subjects
- **Course Learner Group:** Human Subjects Protections for Graduate Students
- **Stage:** Stage 1 - Basic Course

- **Report ID:** 11022573
- **Completion Date:** 08/23/2013
- **Expiration Date:** 08/23/2016
- **Minimum Passing:** 85
- **Reported Score*:** 88

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction (ID:1127)	08/23/13	2/3 (67%)
Students in Research (ID:1321)	08/23/13	10/10 (100%)
History and Ethical Principles - SBE (ID:490)	08/23/13	5/5 (100%)
Defining Research with Human Subjects - SBE (ID:491)	08/23/13	5/5 (100%)
The Federal Regulations - SBE (ID:502)	08/23/13	4/5 (80%)
Assessing Risk - SBE (ID:503)	08/23/13	5/5 (100%)
Informed Consent - SBE (ID:504)	08/23/13	5/5 (100%)
Privacy and Confidentiality - SBE (ID:505)	08/23/13	5/5 (100%)
Internet-Based Research - SBE (ID:510)	08/23/13	3/5 (60%)
University of Delaware (ID:12245)	08/23/13	4/5 (80%)
Conflicts of Interest in Research Involving Human Subjects (ID:488)	08/23/13	3/5 (60%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK TRANSCRIPT REPORT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Bryan Thompson-Nowak (ID: 3661578)
- **Email:** bst@udel.edu
- **Institution Affiliation:** University of Delaware (ID: 1198)
- **Institution Unit:** Agriculture and Natural Resources
- **Phone:** 302-831-2517

- **Curriculum Group:** Course In The Protection Human Subjects
- **Course Learner Group:** Human Subjects Protections for Graduate Students
- **Stage:** Stage 1 - Basic Course

- **Report ID:** 11022573
- **Report Date:** 07/21/2015
- **Current Score**:** 88

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Students in Research (ID:1321)	08/23/13	10/10 (100%)
History and Ethical Principles - SBE (ID:490)	08/23/13	5/5 (100%)
Defining Research with Human Subjects - SBE (ID:491)	08/23/13	5/5 (100%)
Belmont Report and CITI Course Introduction (ID:1127)	08/23/13	2/3 (67%)
The Federal Regulations - SBE (ID:502)	08/23/13	4/5 (80%)
Assessing Risk - SBE (ID:503)	08/23/13	5/5 (100%)
Informed Consent - SBE (ID:504)	08/23/13	5/5 (100%)
Privacy and Confidentiality - SBE (ID:505)	08/23/13	5/5 (100%)
Internet-Based Research - SBE (ID:510)	08/23/13	3/5 (60%)
Conflicts of Interest in Research Involving Human Subjects (ID:488)	08/23/13	3/5 (60%)
University of Delaware (ID:12245)	08/23/13	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

Appendix D

RESEARCH OFFICE

210 Hullihen Hall University of Delaware Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: August 6, 2014

TO: Bryan Thompson-Nowak, BS
FROM: University of Delaware IRB

STUDY TITLE: [542907-3] Pre-thesis survey. Pressures, priorities and strategies of tree care management across budget restraints.

SUBMISSION TYPE: Amendment/Modification

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: August 6, 2014

REVIEW CATEGORY: Exemption category # *(2)*

Thank you for your submission of Amendment/Modification materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: December 3, 2013

TO: Bryan Thompson-Nowak, BS
FROM: University of Delaware IRB

STUDY TITLE: [542907-1] Pre-thesis survey. Pressures, priorities and strategies of tree care management across budget restraints.

SUBMISSION TYPE: New Project

ACTION: ACKNOWLEDGED

Thank you for submitting the New Project materials for the above research study. The University of Delaware IRB has ACKNOWLEDGED your submission. A final determination letter will be issued following review of your project.

The following items are acknowledged in this submission:

- Application Form - new project protocol form (UPDATED: 12/1/2013)
- Data Collection - Survey for participants (UPDATED: 12/1/2013)

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: December 4, 2013

TO: Bryan Thompson-Nowak, BS
FROM: University of Delaware IRB

STUDY TITLE: [542907-1] Pre-thesis survey. Pressures, priorities and strategies of tree care management across budget restraints.

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: December 4, 2013

REVIEW CATEGORY: Exemption category # *2*

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

cc:

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: May 16, 2014

TO: Bryan Thompson-Nowak, BS
FROM: University of Delaware IRB

STUDY TITLE: [542907-2] Pre-thesis survey. Pressures, priorities and strategies of tree care management across budget restraints.

SUBMISSION TYPE: Amendment/Modification

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: May 16, 2014

REVIEW CATEGORY: Exemption category # *(2)*

Thank you for your submission of Amendment/Modification materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.