

IMPROVING NORTH DAKOTA'S ARBORETA: UTILIZING LIVING MUSEUMS TO  
THEIR GREATEST CAPACITY

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**Title**

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MUSEUMS TO THEIR GREATEST CAPACITY

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## **ABSTRACT**

North Dakota has roughly 20 arboreta, though many of them are in decline. NDSU Extension developed an arboretum improvement project that included field visits, site inventories, and educational programming. North Dakota's arboreta are a diverse group with over 70 genera and more than 500 tree and shrub species represented. Soil Conservation District (SCD) arboreta have an average of 31 species per arboretum while non-SCD arboreta average about 70. Labeling methods and accuracy, condition, and maintenance varied greatly. We conducted four educational workshops for arboretum managers, but attendance was relatively low: only 21 individuals attended. Attendees include SCD employees, Extension agents, and arboretum managers. A follow-up evaluation indicated that all respondents found the labeling infographic or the arboreta locations map helpful. Roughly 62% of arboretum managers gained knowledge and skills that align with the project's objectives. However, a change in behavior amongst many arboretum managers is yet to be seen.

## ACKNOWLEDGMENTS

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I was quite fortunate to end up with the graduate committee I did. Dr. Hargiss, Dr. McGinnis, and Dr. Zeleznik were three distinct personalities, each offering something a little different, but were always patient, kind, and had my best interest at heart.

There is no part of me that believes that graduate school would have been possible without my family. Diana, a constant inspiration, always led by example and gave me the confidence to pursue a graduate degree. My wife Darcie listened to me with endless patience and talked me through the hard times. She's everything to me.

Finally, I would be remiss if I didn't acknowledge the Notorious B.I.G. Big Poppa Hypnotized me with Juicy lyrics, reminded me that the Sky's the Limit, and inspired me to demand Respect and make employers Gimme the Loot.

## **DEDICATION**

For Darcie, who always listened to me vent.

And

For Diana, who always listened to me vent.

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## LIST OF ABBREVIATIONS

ARS.....	Agricultural Research Service
IRB.....	Institutional Review Board
IUCN.....	International Union for Conservation of Nature
NDFS.....	North Dakota Forest Service
NDSU.....	North Dakota State University
NDUCFA.....	North Dakota Urban and Community Forestry Association
NRCS.....	Natural Resources Conservation Service
REC.....	Research Extension Center
SCD.....	Soil Conservation District
USDA.....	United States Department of Agriculture

## INTRODUCTION

North Dakota has approximately 20 arboreta throughout the state. These arboreta vary greatly in size, species diversity, function, condition, and public use. Ownership and management also vary greatly and include the following organizations: Soil Conservation Districts (SCDs), North Dakota State University Research Extension Centers (NDSU RECs), city and state governments, a university, civic organizations, and private citizens. Some of these arboreta are well-established, highly maintained, and functional. With the 20 arboreta scattered throughout the state, a vast majority of North Dakotans live within a 60-minute drive of an arboretum. Despite this, North Dakota's arboreta are underused. This underuse is the consequence of (1) an apparent lack of public awareness regarding North Dakota's arboreta, (2) a lack of interest in North Dakota's arboreta, in both the public and sometimes the arboreta managers themselves, and (3) many of North Dakota's arboreta managers lack the knowledge and/or resources they need to manage these sites to their greatest capacity. Unfortunately, many of North Dakota's arboreta have fallen into decline.

Generally speaking, managing a site to its greatest capacity is to make use of all the educational opportunities the arboretum provides, while maintaining healthy and attractive specimens. North Dakota's arboreta are a diverse group of public gardens with different available resources, budgets, and missions. Because of this, managing a site to its greatest capacity may mean different things at different sites. Our goal is to empower arboreta managers to make use of the resources available to them skillfully and efficiently to use an arboretum to its full potential.

Part of the reason North Dakota's arboreta are underused is simply because much of the public is apparently unaware of their existence. It was beyond the scope of my Master's project

to measure public awareness of the state's arboreta, but as I traveled throughout the state making site visits, it became quite clear that public awareness of the state's arboreta was limited.

Discussions with town locals would often lead to phrases such as, "Oh, I didn't even know we had an arboretum." As the ongoing arboretum project moves forward, it may be prudent to focus on increasing public awareness of the state's arboreta.

The lack of awareness of North Dakota's arboreta may be correlated with an apparent lack of interest in them overall. Even in circumstances in which a community is aware of an arboretum, enthusiasm towards it seems meager at best. The arboretum in Aneta, North Dakota is an example of this. This arboretum is adjacent to a community orchard and garden. In talking with the manager, who is passionate about the arboretum, both the community orchard and garden get constant use, but the arboretum gets almost no use, despite being free and directly adjacent to the orchard/garden.

The lack of interest doesn't exclusively fall on the shoulders of the public. Some of the arboretum managers themselves aren't interested in their arboretum. A majority of the arboreta in North Dakota are operated by SCDs. SCDs' main goal is to further the widespread application of sound soil and water conservation practices in North Dakota. Although it could be argued that an arboretum is in service of this goal, managing an arboretum simply isn't a priority for many of SCD employees. To further complicate this situation, some of the arboreta have been inherited from a predecessor. New employees often do not have the same enthusiasm towards an arboretum as the person that developed and maintained it before them. Many of the state's most neglected arboreta are those that have been inherited.

Perhaps the most compelling argument for the underuse of North Dakota's arboreta is that many of the arboretum managers lack the knowledge and/or resources they need to manage

these sites to their greatest capacity. This manifests itself in many ways: inability to cultivate public interest, mislabeling of specimens, absence of educational programming, improper pruning, inappropriate species selection, limited understanding of plant physiology, lack of funding, and lack of support from leadership positions. Any of these have the potential to leave a manager ill-equipped to use an arboretum to its greatest capacity, but combining two or more of these circumstances can be detrimental to an arboretum's success. Empowering arboretum managers is key to improving North Dakota's arboreta because even if we were able to raise public awareness and cultivate interest in both the public and managers, those efforts would be fruitless unless we provided arboretum managers with the skills, knowledge, and resources they need to use their arboretum to its full potential.

Some of North Dakota's arboreta are well-labeled, well-maintained, and have skilled and passionate people managing them. However, many of them are in decline. The lack of interest, skills, and resources discussed above all contribute to the state of some arboreta. Regardless of how they fell into decline, the reality is that some of North Dakota's have deteriorated to the point of being undesirable to visitors, which of course, contributes to their underuse. The state of decline only applies to some of North Dakota's arboreta and can range from unmowed grass to being overgrown with invasive species, to the point the arboretum is unrecognizable.

### **Goals**

This Master's project's main goal is to improve North Dakota's arboreta with an emphasis on their educational component. We wanted to accomplish this by providing arboretum managers with the knowledge and resources they need to manage their arboretum to their greatest capacity. Arboreta are the perfect locations to educate people in tree species diversity, benefits, and how trees function in North Dakota.

While we want to help improve these arboreta in whichever way they need, our main focus was improving their educational component. Education at an arboretum is conducted in many ways, and both active and passive learning can take place. Empowering arboretum managers in their own education efforts is a goal of the Master's project that aims to bring a manager's specific educational ideas and objectives into fruition. As previously discussed, active learning rarely occurs in North Dakota's arboreta; however, that is not to say that it doesn't occur at all. Some arboretum managers are passionate about both arboriculture and education, and facilitate learning in their arboretum; however, they may not be sure how to make it interesting or engaging. Furthermore, there are arboretum managers that do not currently have educational programming but desire to do so. Regardless of which category an arboretum manager falls into, opening a dialogue is the first step in making their vision a reality.

Cultivating public interest in arboreta and other green spaces is also important to the success of my Master's project. Assuming the project is successful in empowering arboretum managers in their educational efforts, meeting this goal would be meaningless without students that are interested in learning about trees and their environment. It's currently not possible to quantify the amount of use North Dakota's arboreta get, as most are free and open to the public, and there are no measures in place to calculate use in any of them. However, based on my time spent in these arboreta and discussions with their managers, the anecdotal evidence suggests significant underuse.

## **Context**

### **What is an arboretum?**

A formal definition of arboretum is a place where trees, shrubs, and herbaceous plants are cultivated for scientific and educational purposes (Arboretum, 2022). I like to describe an

arboretum as a living museum. Distinct from forests, nurseries, and parks, arboreta typically have a mission of research, education, conservation or aesthetic enjoyment. Another important distinction is that arboreta specimens should possess labels. Labeled specimens distinguish an arboretum from other groupings of trees. Historically, arboreta displayed exclusively woody species, but many modern arboreta are closer to botanical gardens, displaying both woody and herbaceous species (Jack, 1936).

### **Arboreta Function**

Arboreta are spaces to educate the public about trees and shrubs. They are effective learning spaces for school age children through adults. Youth programming can potentially start from young children getting outdoor exercise while being exposed to public greenspaces. There are plenty of learning opportunities in arboreta for school-aged children such as the youth and family program at The North Carolina Arboretum (Youth & Family Programs, 2022).

Additionally, formal curricula, like Project Learning Tree, are dedicated to teaching children environmental education. An arboretum is an ideal space for much of this type of programming (Learning is in our Nature, 2021). Children use their senses to explore and respond to the environment around them. Feeling the rough bark of an ash tree, seeing the difference in the margins between an oak leaf and a maple leaf, and smelling the aroma of spruce needles are invaluable experiences that are difficult to duplicate in a classroom. The learning opportunities extend to high school students. High schoolers can learn biological diversity, ecology, and the impact of climate change in programs like Morton Arboretum's summer science camp (Summer science camps, 2022).

Arboreta can be used for both active and passive learning. Active learning involves the students engaging through some sort of planned instruction, that is, educational programming. This



programming might be part of an extension program or a curriculum developed by an instructor at a learning institution. Passive learning holds the student responsible for learning, regardless of whether there is an instructor or not (Russell, 2021). In the context of arboreta, passive learning may be as simple as a student walking through a collection of trees, reading a specimen's label, and learning the species' scientific and common names. Unfortunately, a majority of the learning that occurs in an arboretum is passive. Passive learning fails to capitalize on the learning potential an arboretum has to offer. For example, a student can walk by a specimen, read the label, and learn what that species looks like, but with active instruction a student can learn about the subtle differences in a leaf margin, the unique form, or a particular bark pattern, leaving the student with tools to identify the species in the future as opposed to a general understanding of what the species looks like. In order to improve North Dakota's arboreta, there is one goal that is paramount to the others.

Arboreta have a place in higher education as well. College students could use arboreta for species identification, urban ecosystems management, and as an introduction to working in the horticulture industry. Finally, arboreta are very appropriate for adult and community education. Programs like the Extension Master Gardener program at the Minnesota Landscape Arboretum teach proper pruning, planting, and plant pathology (Schier, 2019).

Scientists often use arboreta for studies related to trees, such as mycorrhizal associations of exotic hickory trees (Rudawska et al., 2018), or the climate response of dawn redwoods (Vargo et al., 2020). Research is the focus for many arboreta. Research topics include botany (Morris Arboretum of the University of Pennsylvania, 2022), insect conservation (Cook & Martinez, 2018), genetic conservation (Westwood, 2020), ornamental species development

(Pooler, 2001), pathology (Juhasova et al., 2013), soil science (Szombathova et al., 2006), and wildlife ecology (Spinks et al., 2003).

Arboreta play an important role in conservation efforts to save endangered tree species and the wildlife that depend on them. Many of the nation's best arboreta participate in some sort of tree conservation program. Some, like the Morton Arboretum might develop and maintain lists that identify threatened trees species (IUCN, 2021), while another, such as the Minnesota Landscape Arboretum maintains and safeguards an endangered species collection Sustainability (Sustainability, 2022).

Another benefit arboreta provide is a greenspace for people to visit and enjoy nature. Humans desire time in nature, though sometimes unconsciously (Kardan et al., 2015). People in urban areas desire a place in which they can escape the stressors of the urban lifestyle. Arboreta give us a space to interrupt our constant interaction with technology, and be amongst nature.

The benefits of trees for people, society, and the environment are well documented. Numerous scientific studies have shown that trees promote health and well-being (da Costa and Kallay, n.d; Turner-Skoff & Cavender, 2019). The benefits of trees reach far beyond the mental, emotional, and physical benefits provided to humans. Trees also offer environmental benefits such as carbon sequestration, reduction in pollution, and aiding in storm water management. Trees have also been shown to provide economic benefits in urban areas (Song et al., 2018).

### **North Dakota Arboreta**

The question of what constitutes an arboretum in North Dakota is one that we have only begun to answer. The standard definition does not give a minimum number of specimens nor does it discuss how much area an arboretum should cover. Many of North Dakota's arboreta are quite small and are different than the typical perception of arboreta in that many of them are

modest neighborhood greenspaces. Additionally, none of North Dakota's arboreta require a fee for entrance and only one of them is a source of revenue for the owners. This is in contrast to most arboreta that exist exclusively to fulfill research, education, conservation goals. According to Arbnet, an organization that provides accreditation for arboreta, most of North Dakota's arboreta fail to reach Accreditation Level 1, the most basic level of accreditation (Arboretum accreditation program, 2022). It's important to note that, to my knowledge, none of the state's arboreta are aspiring to be accredited by Arbnet, and therefore shouldn't be evaluated on that metric. However, it does give us an idea of how North Dakota's arboreta compare to other arboreta in the nation

### **Challenges of Growing Trees in ND**

North Dakota's climate creates challenging growing conditions throughout the state. With USDA hardiness zones ranging from 3a to 4b, the winters can be severe. Furthermore, as part of the Great Plains, North Dakota is often windy. North Dakota's annual precipitation ranges from 14 to 22 inches, with the western part of the state being the driest. The near constant winds exacerbate North Dakota's drought conditions, often leading more transpiration from plants. Variability in weather conditions creates another challenge for trees in North Dakota. This variability is relatively large in the northern Great Plains and adds stress to trees in the region (Mishra et al., 2010).

North Dakota's soils pose an additional challenge in growing trees. Because the soils were formed under prairie vegetation, the state hosts soils that generally have a pH of 7.0 or greater, especially in the east (DeLuca et al., 2019). Soils in the western part of the state tend to be more acidic. Because much of the state's soil is alkaline, iron uptake can be a problem in some species (Morrissey & Guerinot, 2009). Soil salinity further complicates the problem.

Excessive salts in soils injure plants by disrupting the uptake of water into roots and interfering with the uptake of certain nutrients (Franzen, 2007).

## METHODS

In this project, results from one phase informed and gave direction to the next phase. Because of that, there may be an overview of some results presented in the Methods section, which will provide context for the next phase. The first step of this project was to identify and contact representatives of all arboreta in North Dakota. Following the initial contact, field visits were conducted to inventory species, observe the condition of the arboretum, and discuss the educational propensity of the site (Table 1).

The project began in June 2020. Many of the state's arboreta had already been identified by Dr. Joe Zeleznik. We had announced the forthcoming project at the North Dakota Conservation District Employees Association's annual Tree Promotion meeting the previous spring and were able to identify a number of arboreta managers. Unfortunately, unknown arboreta were identified throughout the duration of the project. We often learned about these arboreta through Extension events and other related meetings. Any unknown arboreta managers were identified by simply contacting the associated SCD. Once all managers were identified, they were contacted, which laid the foundation for the relationships that would be cornerstone of the project.

Once these components were evaluated, educational programming was conducted. Programming included a needs assessment, workshops, and the development of educational materials. Individual sites visits were conducted to address specific site objectives as well as establish a dialogue with managers to discuss site specific questions and concerns.

**Table 1**

*Sites Inventoried, Sites Seemingly Abandoned, and Sites That Received Individual Follow-up Visits*

<b>Site</b>	<b>Inventoried</b>	<b>Seemingly Abandoned</b>	<b>Individual Site Visit</b>	<b>Arboreta Managers that Attended a Workshop</b>
<b>Adams Co. SCD</b>	x	x		
<b>Barnes Co. SCD</b>	x			
<b>Bowman/Slope Co. SCD</b>	x		x	
<b>Burleigh Co. SCD</b>	x			x
<b>Cass Co. SCD</b>	x			
<b>Dunn Co. SCD</b>	x			
<b>Grant Co. SCD</b>	x			
<b>LaMoure Co. SCD</b>	x		x	x
<b>South McLean Co. SCD</b>	x			x
<b>Oliver Co. SCD</b>	x	x		
<b>Pierce Co. SCD</b>	x			x
<b>Sheridan Co. SCD</b>		x		
<b>Steele Co. SCD</b>	x			
<b>Towner Co. SCD</b>	x			
<b>Aneta</b>	x		x	
<b>Bismarck Rotary</b>	x			
<b>Forestry Park (Bottineau)</b>	x	x		
<b>Kent Pelton Nature Park (Watford City)</b>	x			
<b>Langdon Arboretum</b>	x		x	
<b>Myra Arboretum (Larimore)</b>	x		x	x
<b>Park River Centennial Trees Bike Path</b>	x			
<b>State Capitol (Bismarck)</b>	x			
<b>Tinta Tawa Park (Casselton)</b>	x		x	
<b>USDA-ARS (Mandan)</b>				
<b>Carrington REC</b>	Incomplete			x
<b>Dickinson REC</b>	Incomplete			
<b>Langdon REC</b>	Incomplete			
<b>North Central REC (Minot)</b>	Incomplete			

## **Inventory**

Inventories were completed at 27 sites. The information collected included regional location, labeling completeness and accuracy, species planted, site conditions, the arboretum's educational functionality, and any opportunities for improvement. Labeling completeness refers to the percentage of labeled specimens within a site. The list of species at each site did not include cultivars and varieties. Given the large number of labeling issues and incomplete information from arboretum managers, we simply could not know what specimens were cultivars as opposed to straight species. Site conditions and opportunities for improvement were often discernible through informal observation, while determining the arboretum's educational functionality required conference with the manager. Conducting inventories was a time-consuming undertaking, sometimes taking multiple days to inventory a given site. Data from the inventories was recorded in spreadsheets.

## **Data**

The North Dakota Community Tree Inventory/Planning Tool (ND TIP Tool) is a project of the North Dakota Forest Service (NDFS) and North Dakota Urban and Community Forestry Association (NDUCFA) with funding through the USDA Forest Service. The ND TIP Tool provides North Dakota cities an opportunity to identify and manage their trees to support healthy and diverse community forests in urban areas and green spaces (TIP Tool, 2022).

All the data taken during the inventories was added to the ND TIP Tool database. The arboreta inventory data can only be seen and manipulated by those associated with this project. Inventory data from North Dakota communities is more freely available to regular users of the TIP Tool.

## **Needs Assessment**

In order to build an understanding of the needs of North Dakota's arboreta, a needs assessment (Appendix A) was developed using Qualtrics, and distributed in mid-February 2021 with a follow up email serving as a reminder in early March. Before the needs assessment was distributed, we received approval (exemption) of the survey from the NDSU Institutional Review Board (#IRB0003456).

The assessment began by asking managers the name of their arboretum and where it is located. We then asked what level of involvement managers had in the development of their arboretum. Managers were asked to state the top two problems they face in managing their arboretum, followed by how they use their arboretum educationally and what educational materials they made available to their clients or users of their arboreta. After that, we asked managers in what ways they cultivated public interest in their arboretum. Finally, we asked what they needed to improve the educational component and if there was any more information they'd like to share with us.

Twenty-one managers were contacted and we received 9 responses, giving a 43% response rate. The responses to the needs assessment gave us a better understanding of an individual arboretum's needs, and also gave us insight on what to focus our curriculum on for the forthcoming workshops.

## **Developing Programming**

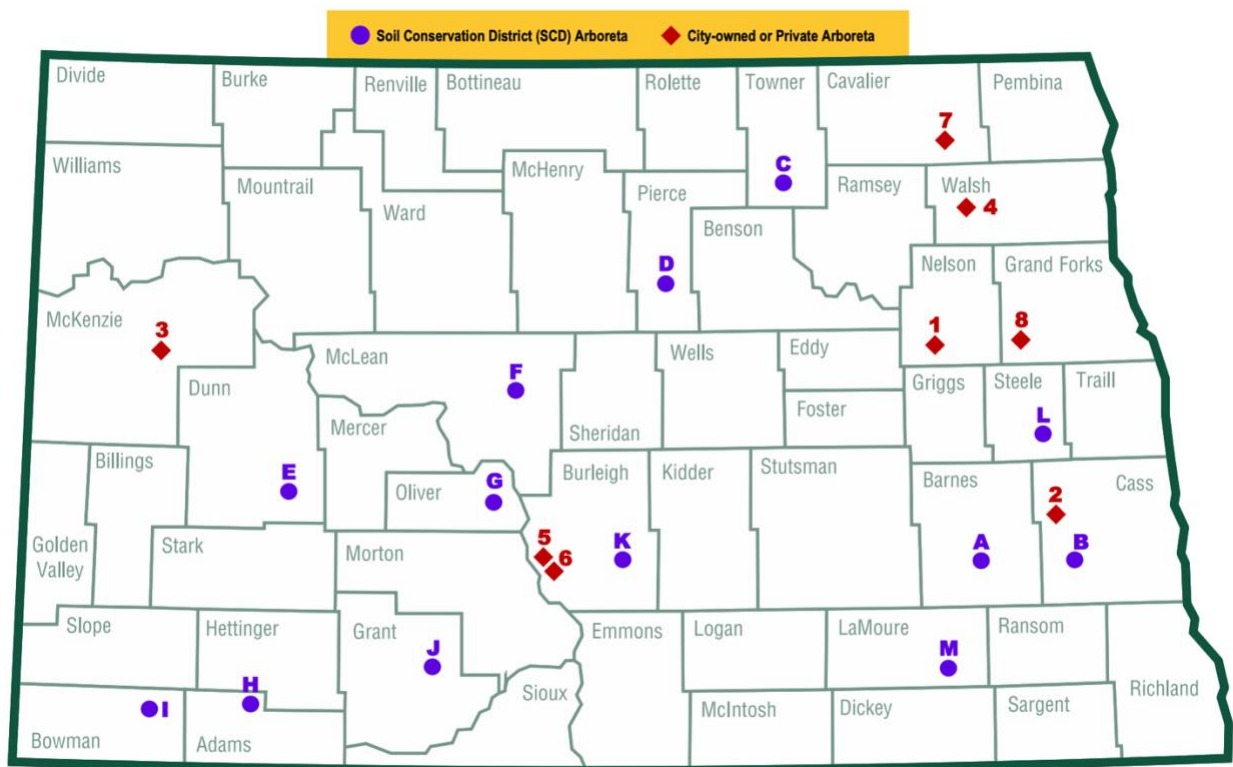
Based on the feedback we received from the needs assessment, educational programming for the summer workshops was developed. Educational programming included classroom curriculum as well as tangible educational resources, such as a labeling infographic (Appendix B) and a map of North Dakota's arboretum locations (Figure 1, Appendix C). Workshop



structure was designed to be a combination of classroom and outdoor hands-on learning. The classroom curriculum included topics such as finding funding, utilizing NDSU resources, (such as the Tree Handbook, Tree Selector, and NDSU Extension publications), labeling, and arboretum design and organization. These sessions were administered in a number of ways depending on what was most applicable for a given subject. For example, PowerPoint with a supplemental infographic was more appropriate for the class on labeling. Additionally, labeling examples were created and brought in for added visual aid.

**Figure 1**

*A Map of North Dakota's Arboreta*



*Note.* Letters and numbers refer to specific arboreta as shown in Appendix C.

The hands-on topics such as tree identification, species selection, and common species-specific problems were taught outside. These topics were presented simultaneously through an

arboretum tour/tree talk. Tree talks consisted of the group taking a tour of an arboretum together and stopping at a given specimen and discussing it in detail. This method worked quite well. It allowed us to highlight subject matters most relevant to a given region and allowed the students to ask any specific questions they might have about a species and have their questions answered in context, using the specific specimen as a hands-on educational resource.

### **Holding Workshops**

The workshops were held at: The State Capitol Arboretum (Bismarck), 07/01/2010; The North Central Research Extension Center (Minot), 07/15/2021; The Myra Arboretum (Larimore) 07/22/2021; and Absaraka Research Horticulture Research Farm (Absaraka) 07/29/2021. One workshop was canceled due to having only one interested party. In lieu of holding that workshop, we made an individual site visit to them (Divide County SCD). Following each workshop, an evaluation was administered to assess new information learned, participants' intent-to-change (behavior), and confidence in using an arboretum for education. No IRB exemption was sought for workshop evaluations, which limits the amount of information that will be shared about participants' responses in the Results section of this document.

### **Individual Site Visits**

Following the conclusion of the summer workshops, I spent the ensuing fall making individual site visits (Table 1). These individual site visits allowed for personal attention to arboretum managers, addressing specific concerns and developing a customized approach to address those concerns. I also gave information to arboretum managers that weren't able to attend a workshop. For those that had attended a workshop, I addressed questions that had been developed in the time since in an informal setting.

## **Workshop Follow-up Evaluation**

In order to assess the project's ultimate success, an evaluation was developed and distributed in the winter of 2021/2022 (Appendix D). The evaluation was developed through NDSU's Qualtrics software. Once again, before the distribution of the evaluation, we received approval (exemption – protocol amendment) from the NDSU Institutional Review Board (#IRB003456).

The evaluation began by asking what the most helpful element of the workshop was. Then we asked what changes to management practices, either currently implemented or planned, the workshop inspired. The evaluation went on to ask how educational efforts have changed, or how the managers plan to change them, in their arboretum. We then asked what we could do or provide to help managers become more willing/able to administer educational programming. Finally, we asked if managers found the educational resources helpful.

Part of the evaluation for my Master's project was structured similarly to the questions asked in the needs assessment with a 6 month follow-up evaluation, but the evaluation also utilized informal interviews and discussions with stakeholders held after the workshops' conclusion.

## **RESULTS**

The arboreta within North Dakota are a diverse group. There are over 70 genera and more than 350 tree and shrub species represented. SCD arboreta have an average of 31 species per arboretum while non-SCD arboreta average about 70. Arboreta range in size, from 8 trees surrounding a small parking lot to a massive 80-acre plot with nearly 5000 specimens. We consider small arboreta to be those with <30 specimens to be small, those within the range of 30-60 specimens to be medium-sized, and those with >60 specimens to be large. Labeling methods and accuracy of labeling varied greatly among locations. Site conditions and maintenance of the site also varied. Because of the disparities in size, mission, and funding, we also see discrepancies in public use. Location plays a role in this as well, with many of the SCD arboreta in rural parts of the state. Funding often comes from city, county, and state governments; however, North Dakota has some wonderful residents that fund and manage arboretums by themselves. For a summary of arboreta locations and contact information, and number of species, labeling completeness, and level of maintenance, please refer to Appendices E and F respectively.

### **North Dakota's Arboreta**

#### **Adams Co. SCD Arboretum**

Located west of Hettinger next to a SCD maintenance shed. This is a medium-sized arboretum with 32 species. This arboretum was in serious decline. Trees were not labeled and the arboretum needed significant maintenance. All plantings were overgrown with invasive species, tall grass and numerous. Maintenance had not been performed on the site in a long time.

### **Barnes Co. SCD Arboretum**

Located in a park five miles south of Valley City. The site rests in a small riparian area and is host to approximately 25 species. This site is an example of an arboretum being started by one entity, and inherited by another. The SCD office responsible for the area is no longer maintaining it like an arboretum, that is, the additional trees being planted on the site are utilitarian (as opposed to being planted for aesthetic or educational purposes) and they are no longer labeling specimens. However, many of the labels remain from the original plan. This leaves many specimens labeled, but there is inconsistency in labeling correctness and completeness throughout the site.

### **Bowman/Slope Co. SCD Arboretum**

An arboretum with a lot of potential. This arboretum hosts approximately 25 species. The site is fenced to distinguish it from the surrounding grounds. At the time the site was inventoried, the arboretum wasn't being maintained. The grass was mowed, but plantings were not weeded or maintained in any way. The SCD contact for the site is aware of the arboretum's condition, and showed interest in improving the arboretum.

### **Burleigh Co. SCD Arboretum**

Arguably the best SCD arboretum in the state, this is a relatively large arboretum adjacent to an SCD maintenance shed in rural Menoken. Species are planted in long rows. This arboretum likely had the most comprehensive labeling of any arboretum inventoried. We found only one labeling mistake. The site was relatively well maintained, but has no walking path or turf.

### **Cass Co. SCD Arboretum**

Located at Brewer Lake near Erie, this site is another relatively small arboretum with roughly 25 species. Each species has multiple specimens, planted in a row (i.e., each species has its own row). Most rows were labeled accurately, however, many of the labels were bent, broken, or overgrown. The grass is unkept, about hip high and invasive species were prevalent throughout the arboretum.

### **Dunn Co. SCD Arboretum**

A small arboretum with about 18 species without labels, situated around a circular walking path in Killdeer. The grass is mowed and the area looks well-kept. The established trees on site look healthy, however pruning is desperately needed in many of the shrub plantings. Most of the shrubs and less established trees are overgrown with one another and invasive species.

### **Grant Co. SCD Arboretum**

Located across the street from the SCD office in Carson. This arboretum hosts 41 species and is well maintained. The site is well suited for education due to its compact size and comprehensive labeling. The arboretum was planted in 1992 and the SCD contact stated it is likely nearing the end of its life due to underuse and lack a lack of funding to maintain it.

### **LaMoure Co. SCD Arboretum**

An impressive middle-sized arboretum on the west end of the city of LaMoure. This arboretum is newly established and is currently maintained by volunteers. The arboretum hosts about 35 species, most of which are immature and small in size. Most of the specimens are labeled, however because they are still adding plants, there are some that are without labels.

### **South McLean Co. SCD Arboretum**

The smallest arboretum in North Dakota with just eight specimens surrounding the SCD office parking lot in Turtle Lake. Specimens are labeled, however, many of the labels are broken or rusted beyond legibility.

### **Oliver Co. SCD Arboretum**

An arboretum on private land that a former SCD employee started. The arboretum is seemingly abandoned. Plantings are in rows and mostly overgrown by grass and golden currant. During the inventory we found roughly 30 species, however, it was difficult to get an accurate picture of the arboretum because of its condition. I found no labels at this site, but I did find some evidence that it was once labeled.

### **Pierce Co. SCD Arboretum**

This arboretum is located behind the SCD maintenance shed in Rugby. The arboretum hosts roughly 30 specimens, a majority of which are labeled. The site is maintained, but not well. Some specimens were in decline.

### **Sheridan Co. SCD**

A seemingly abandoned arboretum situated next to a small recreational body of water. Some of the arboretum has been turned into a campground. What remains of the arboretum is overgrown with various woody species and grasses to the point of being unrecognizable of anything with purpose or intentionality. If one looks hard enough, remnants of labels can be seen, but that would be the only way to know this was once an arboretum.

### **Steele Co. SCD Arboretum**

A small arboretum that is part of the landscaping in front of the SCD office in Finley. The arboretum is well labeled and well maintained. The arboretum is small with about 26 species, and there is little room for any growth as the site is surrounded by infrastructure.

### **Towner Co. SCD Arboretum**

About 14 species behind the youth hockey arena in Cando. The area is mowed because it's part of the arena property. The site is small and specimens were not labeled.

### **Aneta**

An arboretum and community garden in the northwest corner of Aneta. The arboretum is a moderate size with about 90 specimens. Trees are planted in neat well-maintained rows. The site was developed and is maintained by a resident in the area. The site was well labeled in both completeness and accuracy. The arboretum has an accompanying map, but it is not readily available to the public.

### **Bismarck Rotary**

An arboretum that spans about 10 acres, located on a nature walk in Bismarck. The arboretum is well-maintained and well labeled, with roughly 50 specimens, some having multiple labels. The arboretum offers an escape from city stressors without leaving city limits.

### **Forestry Park (Bottineau)**

This arboretum is a seemingly abandoned site in Bottineau. The site is no longer being maintained. Grass is about hip high, and the grounds are overrun by various shrubs to a degree that makes it difficult to discern what was planted intentionally as part of the arboretum, and what established naturally, but I estimate the site hosts roughly 35 species. The established trees



are healthy, but most of the remainder of the plantings are in decline. There were roughly 10 labels, however, they were inconsistent and all of them were in disrepair.

### **Kent Pelton Nature Park (Watford City)**

A moderately sized memorial park with an arboretum located in and owned by Watford City. The site hosts about 40 specimens and is immaculately maintained. Most specimens were labeled, however we found multiple inaccurately labeled specimens, like the Siberian elm that was labeled as a mountain-ash.

### **Langdon Arboretum**

A moderately sized arboretum with about 43 species located in a city park in Langdon. Most specimens are not labeled; however, a map is available with the location or species and a brief description. Unfortunately, the map is not up to date due to recent sewer line installation, and general loss of trees.

### **Myra Arboretum (Larimore)**

The Myra Arboretum is North Dakota's largest public arboretum with over 500 species located within the Larimore Dam Recreation Area on the south branch of the Turtle River in rural Larimore. The grounds are generally well kept, however due to neglect in recent years, many of the collections need maintenance specific to woody plants. However, the manager has taken steps to improve the site and has a plan in place for continual improvement. The labeling at Myra was full of inaccuracies and inconsistencies and was incomplete. Some of this is due to the recent extensive work that has been done on the collections. The manager is working with the NDSU Extension Forester and has a plan to replace old labels and label unlabeled specimens.

### **Park River Centennial Trees Bike Path**

A large arboretum with over 200 specimens located along a bike/walking path in Park River. The arboretum's unique mirrored design situates species across the walking path from one another. The arboretum is diverse, but unfortunately, none of the specimens are labeled at this time. There is a map associated with the site, however, it is not generally available to the public. The city mows along the path, but does not weed or prune the specimens, which is unfortunate as many of the shrubs desperately need maintenance.

### **State Capitol (Bismarck)**

A beautiful arboretum in a well-kept park on the State Capitol grounds in Bismarck. The site is a large and well-maintained arboretum, however, there are a substantial number of mislabeled specimens. There is a map of the trail is available online at the ND State Capitol website. The map has 74 specimens listed, but I estimate that only between 60-70% are correctly labeled.

### **Tinta Tawa Park (Casselton)**

A well-maintained diverse arboretum in a city park surrounding the Casselton Reservoir. This arboretum hosts 49 species and offers great diversity with 27 (55%) varieties and cultivars. I often found it hard to distinguish what trees were supposed to be part of the arboretum and which weren't. The site is well-labeled, however some of the labels need replacing.

### **Carrington REC**

A combination of landscaping, windbreak plantings and abandoned research plots. An arboretum walk was created in the early 1990s that contains more than 40 trees. The research plots were planted between the 1970s and the 1990s, and the plantings on the north side of the south driveway are in relatively serious decline. The abandoned research plots are overgrown

and would require extensive restoration. Discussions were begun in 2021 between the REC Director and the local SCD on how to rejuvenate the site and turn it into a functional arboretum.

### **Dickinson REC**

A site that is a combination of labeled landscaping and abandoned research plots. A majority of the NDSU tree research plots have been removed. There is a research plot established by the NRCS that is in relatively good shape. The REC Director intends to use the research plot, along with the landscaping to create an expanded arboretum. Many trees have already been incorporated into an [online map](#).

### **Langdon REC**

This site is divided into two sections, a small arboretum surrounding the REC building, and abandoned research plots established between the 1970s and the 1990s. The arboretum surrounding the building host approximately 30 species and is generally well kept, and well-labeled, though we did find some broken, missing, and overgrown labels. The research plots aren't an arboretum. Specimens are not labeled, nor cared for. However, the REC Director has shown interest in using the research plots as an arboretum.

### **North Central (Minot) REC**

Abandoned research plots that were established between the 1970s and the 1990s. The site is west of the REC offices. Many specimens are in very poor health. Trees are planted in rows, with approximately five trees per species per plot, and four plots per species. Despite the current condition, the REC Director has shown interest in using the site as an arboretum. The site does hold some promise, though it will be a significant undertaking, removing and replacing most of the test trees.

## **USDA-ARS (Mandan)**

Unfortunately, due to Covid restrictions, I was unable to visit this site. The site does include an arboretum. Because we did not conduct an inventory, the number of species in the arboretum is unknown, however the location has an [online map](#) in which people can review the site's copious species. The site is now open to visitors, but visitors are required to check in at the main office before walking the grounds.

### **Needs Assessment**

We sent needs assessments to 23 arboretum managers and initially received only 7 responses. After a follow up email serving as a reminder, we received another 4 responses, giving us 11 responses in total and resulting in a 48% response rate. When asked what the top two challenges arboreta managers faced in managing their arboretum, general maintenance of the grounds and proper maintenance of the trees were the main concerns. The maintenance the arboreta managers are referring to is likely the cost of maintenance rather than the knowledge and skills needed to maintain an arboretum. Because of this, a section on finding funding was added to the curriculum for the summer workshops.

Roughly 26% of respondents provide active education at their arboretum, meaning they actively guide learning through tours and workshops. This is in contrast to anecdotal observations during our inventories, and we intend to follow up with arboreta managers to see how and when they provide active learning. Most (55%) of the arboreta that cultivate public interest, do so by hosting events at their arboretum, followed by some sort of online presence (36%), e.g., website, social media, or email.

Arboretum managers responded that an onsite visit or lesson from an NDSU Extension specialist would be the most valuable tool in regards to improving their arboretum's educational

component. Once again, because of what we learned here, individual (follow-up) site visits to those who wanted them were added to the project.

### **Workshop Evaluation**

Workshop attendance was low, totaling only twenty-one individuals over four workshops (Table 2). A majority (just over half) of the workshop attendees were SCD employees. Extension agents made up roughly 30% of workshop attendees, followed by arboretum managers at just over 10%. The remaining participants were composed of a Master Gardener and an Extension intern.

**Table 2**

*Workshop Attendance*

Workshop Location	Total Attendees	Number of SCD Attendees	Number of Extension Attendees	Number of Arboretum Managers	Other Attendees
Myra	8	3	2	2	1
State Capitol	5	4	1	0	0
Absaraka	4	3	0	0	1
Minot (not evaluated)	4	2	2	0	0

All conducted workshops were evaluated aside from the Minot workshop, which wasn't due to 3 of the 4 attendees leaving prior to the end of the workshop. Seventeen attendees were given evaluation and all provided responses. However, we did not pursue IRB approval for the workshop evaluation and therefore the detailed results from those evaluations cannot be added here. Instead, we offer only general results and observations.

Most of the feedback we received was positive. In fact, when asked if topics covered would be helpful in attendees' work/field, almost all of participants answered yes. The workshops were effective in introducing new information to students. A majority of students learned new information about tree species selection and their respective needs. Roughly one

third of students learned new skills in tree identification while another third of students learned more about arboretum maintenance. About a quarter of students learned useful information on arboretum layout/design.

When asked if there was anything that wasn't covered that students would like to see covered in the future, only two students responded with suggestions. The responses focused on generating funding and the desire for information on invasive woody species.

We asked what the attendees planned to do differently with the information they learned at the workshops. Of those surveyed, almost a quarter of students answered that they would use the information learned in the workshop to educate the public. Roughly another quarter responded that they would use the information to establish/improve their arboretum. Less than 20% said they would use the information to inform clients. A marginal number of participants said they would use the information to encourage arboretum attendance and would utilize NDSU resources.

Finally, we asked if after the workshop, the students felt more confident in using an arboretum for education. Unfortunately, almost half of the students didn't answer the question. Of those that did, over half said yes, they feel more confident. Only one student said that they still needed more information.

### **Individual Site Visits**

I made six individual site visits to the following arboreta: Bowman/Slope Co. SCD, LaMoure Co. SCD, Aneta, Langdon, Myra, and Tinta Tawa Park (Casselton). These visits focused on continuing to build relationships with arboreta managers and the information gained during these visits was strictly qualitative.

## 6-Month Follow-up Evaluation

The evaluation was distributed to all 17 workshop evaluation respondents. The objective of this evaluation was to assess if there was a change in behavior in arboreta managers that attended the workshops and if they were using the information and resources provided in the workshop. Of the 17 attendees, 10 (59%) responded to the evaluation.

When asked what was the most helpful element of the workshop, 55% of participants said the tree tour was the most constructive component followed by the session on arboretum organization and development (22%) and labeling education (11%). Although the tree tour isn't necessarily an arboretum specific topic, as the Extension forester often gives similar educational programs, the information given in that type of setting is certainly valuable in the public garden industry.

Some managers are already making changes in how they manage their arboreta. For example, two respondents stated, "(We're) selecting species based on (hardiness) zone ratings" and "I'm more careful how far apart I space my trees to take into account their size at maturity." Another one is "Developing a water system for the trees to help growth rates." Regarding changes in educational efforts, one manager said, "I'll be better able to make recommendations when asked about best practices" and "We are planning more tours in the future to provide educational opportunities."

We received positive responses regarding the helpfulness of the educational resources presented in the workshops. In fact, everyone that answered the question (61%) found the resources helpful. Respondents especially found the labeling infographic to be useful, stating "YES! The labeling especially was very interesting" and "The educational resources were great. The labeling infographic was very helpful."

Finally, we asked what we could do or provide to help arboretum managers be more willing/able to administer educational programming. Participants asked for information on the establishment of new arboreta, the facilitation of idea exchanges with other arboreta managers through more workshops, and increasing distribution and availability of resources with information on suitable species for North Dakota.



## DISCUSSION

Since the start of the project, my perception of what constitutes an arboretum has changed. My experience with arboreta had been with highly established, immaculately maintained, and comprehensively labeled botanical gardens. Furthermore, I associated an arboretum with an establishment that one would have to pay to get into. Now my perception is quite different. If I were to maintain my perception of what an arboretum was, few of the sites I was exposed to over the course of the project would have fallen within those standards. Now, my perception of an arboretum also includes small public greenspaces that are owned and managed by a government agency, an SCD, or privately, free from any monetary obligation. The definition a North Dakota arboretum is still being established, however we have developed a statement about them: Arboreta in North Dakota practice scientific research, promote conservation, and engage in public outreach or education. Arboreta in North Dakota are labeled and meant for exhibition. We will continue to develop a definition as we continue to refine the role arboreta play in North Dakota.

Like most projects, we had successes and failures. The project started in June of 2020. The Covid-19 pandemic was gaining momentum and affecting business across most industries. The pandemic caused delays in the project's schedule, and even prevented me from inventorying some sites due to government guidelines. More importantly, I wasn't able to develop some of the relationships as well as I had anticipated.

Although a large majority of the state's arboreta were identified before the workshops were held, we were still learning of new arboreta after the workshops were concluded. The reason not all of the arboreta were initially identified was simply because without personal knowledge of an arboretum, the only way to learn of new arboreta was through networking. For

example, we learned of an arboretum in Wahpeton ND in October of 2021, too late to include in this project. That being said, North Dakota has a finite number of arboreta, and more will be revealed moving forward.

Unfortunately, we were unsuccessful in inspiring immediate change regarding labeling in North Dakota's arboreta. Improper and inaccurate labeling is largely what inspired the project's inception and is a fundamental component in creating a functional space for education. Because these arboreta draw funding from a variety of sources, and each have unique problems and circumstances, it may take some time to see change, and we'll likely see change occur at different rates among arboreta. Although we didn't see much action taken in adding, updating, or correcting labels in arboreta, I feel confident that we made it clear throughout the course of the project that labeling is important and provided good instruction and resources on the subject. This means that the managers that are developing new arboreta will be better equipped to implement proper labeling practices in their arboretum.

### **Inventory**

There are significant disparities in, available resources, arboretum mission and attitude towards arboreta. So, it is not surprising to see disparities in arboreta's size, number of species, labeling completeness, and condition. There was no consistency in which type of arboreta (SCD or non-SCD) might be deficient or proficient in a given area. We saw plenty of deficiencies in well-funded arboreta that one might expect to be near flawless, as well as nearly flawless arboreta that are independently funded and operated.

The inventories were challenging in some ways. In most of the arboreta, inventories went seamlessly, and we came away with a concrete understanding of the labeling completeness and accuracy, the educational functionality, and the tree species within an arboretum. However, some

of the state's arboreta were in such decline that a sufficient inventory could not be done. For example, there was an arboretum established by a retired SCD employee in a rural area. I could tell that the arboretum was established with enthusiasm and purpose. It had respectable diversity and was well-organized, however, it was also clear that any enthusiasm or pride in the arboretum had been lost. Collections were overgrown with invasive species, and the grass was unmowed. Specimens were in desperate need of pruning and any signage that once was, was no more. Furthermore, some of the state's arboreta started out as ornamental species breeding trial areas that had incomplete and obscure records. This, paired with an often-neglected site, would result in a very difficult inventory that would have taken weeks, as opposed to days or hours. This time was instead used to develop and distribute the needs assessment.

### **Needs Assessment**

I felt confident that we included all the questions that would help us assess the needs of North Dakota's arboreta, and contained no questions that weren't necessary. Additionally, I believe there weren't any questions that should have been asked that weren't. Most arboretum managers had little or no involvement in the development of their arboretum. Understandably, some of those managers have no interest in managing their inherited arboretum. This may shed light on why so many of North Dakota's arboreta are in decline. The needs assessment had a response rate of (43%). The average response rate for emailed surveys is ~ 46% (Sheehan, 2006). Still, having only a 43% response rate means we may have not gotten a comprehensive understanding of the needs of arboretum managers, which likely affected the curriculum we decided upon for the workshops. I don't believe administering another needs assessment would give us a better understanding, as I believe a majority of respondents would be composed of the

same people. Managers that did not respond to the needs assessment, typically did not participate in other parts of the my Masters project.

### **Workshops**

Even with developing the curriculum based on the assessed needs, workshop attendance was mediocre. We averaged 5.3 students per workshop, with a total of 21 students over four workshops. Despite low attendance, we considered the workshops a success. The students were engaged in the content, asked relevant questions, and left the workshop with a better understanding of how to manage an arboretum. There were a marginal number of students that stated they learned new information on labeling. This was a bit of a surprise and a disappointment, as labeling was a common issue found in our inventories. Still, I feel we did stress the importance of labeling adequately, and upon reflecting, if given the chance I wouldn't make any changes to the curriculum regarding labeling. Furthermore, because we saw a positive response from every module, I see little room for changes in workshop curriculum, providing we don't see a change in the needs of arboretum managers

### **Individual Site Visits**

It was important for us to make individual site visits, as a majority of managers reported it as what their site needed to improve their educational component. Individual site visits allowed us to give one-on-one attention to arboretum managers as well as address questions and concerns specific to their respective arboretum. I found that approaching the site visits in this way would often lead to the disclosure of additional questions and further discussion as the manager(s) became more comfortable. While the information that was gathered through informal interviews and discussions isn't necessarily quantifiable, it is valuable. They will help Extension gauge whether or not arboreta managers are improving a given arboreta. I believe that managers

appreciated personal attention, and speculate that the site visits bolstered the relationship between managers and Extension. It is unclear if the individual site visits will result in better management or an increased educational effort of a given arboretum, as that was not measured, but I again hypothesize that if an arboretum manager receives individual attention, than managers become more comfortable, discussion flows more easily, and the relationship between Extension and a given manager is strengthened. As a result, we'll see management practices and educational efforts improve. Currently, only 53% of North Dakota's arboreta specimens are labeled correctly, with the remainder being either not labeled at all (40%) or labeled but incorrect (7%). I expect we'll see a continued progress in both management practices and educational efforts such as higher percentage of accurate labels and increased instance of educational programs the more visits and individualized attention a manager gets.

### **6 Month Follow-up Evaluation**

Similar to the needs assessment, the 6 month follow-up evaluation measured the needs of arboreta managers, but also determined if there has been a change in behavior amongst them. The information we collected was largely positive. The feedback was constructive, reasonable, and valuable information as Extension advances and adjusts the program. The follow-up survey also allowed us to assess the productiveness of my Master's project and make decisions on (1) If arboreta managers are making a reasonable effort to improve, and if it is prudent to continue efforts to work with arboreta managers, and (2) What adjustments can be made in the ongoing arboretum project to ensure continuous improvement of North Dakota's arboreta.

The main conclusions of the needs assessment were (1) managers wanted individual site visits from NDSU Extension and (2) the biggest challenges arboretum mangers face are maintaining the grounds and trees. The former, we were quite successful at addressing. I was

able to make site visits to all of the arboretum managers that were interested in such a service. The latter, we could have addressed better. Because improving arboreta's educational component was our top priority we were not able to include curriculum on grounds maintenance or proper pruning techniques.

### **Evaluation Approach**

The approach used to evaluate my Master's project was a formal participant-oriented evaluation. Participant-oriented evaluations, more so than others, focus on serving the needs of those who participate in the evaluation (Boody, 2009). This is important in the evaluation of this project, as the data collected from each arboretum had to be interpreted individually, as North Dakota's arboreta differ so much. Because of this, there was a level of subjectivity within data sets. Using a participant-oriented response evaluation allowed for the use of mixed methods to collect qualitative data and organize it based on the needs of a given arboretum.

As Extension establishes the effort demonstrated and resources available at a given arboretum, arboreta can be evaluated individually based on those metrics. With the completion of my piece of the continuing arboretum project, Extension will have an understanding for the capacity of education in North Dakota's arboreta based on arboreta managers' willingness to improve, public interest, and resources available.

Understanding improvement may be a process that happens over time; consistent monitoring and evaluation of the program will be vital to its long-term success. It isn't expected that all arboreta will improve at the same rate, if at all. Because of this, intermittent informal assessments of each arboretum's progress should be kept by the Extension Forester and/or anyone else involved with the project.

## Monitoring and Communication of Progress

The Plan, Do, Check, Act (PDCA) model is an iterative design and management tool evolved from the scientific methods of Galileo Galilei and Francis Bacon. In the 1930s and 1940s it was often used for the control and continuous improvement of processes and products (Williams, 2020). A potential PDCA cycle (Figure 2) that may be useful in ensuring the continual success of North Dakota’s arboreta. We are currently in the “Evaluate Progress and Identify Areas in Need of Improvement” stage of this cycle. Hopefully, North Dakota’s arboreta will begin to implement changes soon and Extension will be able to move to the next stage in the cycle.

**Figure 2**

*PDCA Model for Continuous Improvement*



*Note.* This is where the Master’s project currently is in the cycle.

## **Moving Forward**

As previously discussed, not all of North Dakota's arboreta managers are enthusiastic about improving their arboreta. It's important to note that not all inherited sites are in decline or that their managers have no interest in improving. However, some of the managers that inherited sites and do not plan to improve them are sometimes justified in their actions: some didn't want to manage an arboreta to begin with, furthermore, some of the sites were already in serious decline. However, one of the project's biggest successes was identifying which arboretum managers are passionate about their arboretum and are interested in making improvements. It's in these relationships that Extension should focus its attention. Supporting the state's passionate arboretum managers is the best way to foster change in North Dakota's arboreta, as there is evidence that demonstrates that a shared vision and mission, enabling structure, and supportive culture are efficient methods in promoting progress within an organization (Obasi & Motshegwa, 2005).

Because of the workshops' generally low attendance, and much of the foundational information already covered, I don't recommend holding multiple workshops throughout the state moving forward. However, it may be prudent to hold an annual centrally located workshop to allow passionate managers to continue to learn and ask questions about arboreta. It may be better to nourish the relationships Extension has established with the passionate arboretum managers through individual attention. We saw a positive response when making individual site visits, and although not always realistic because of logistics, I believe that engaging managers in this way is the best course of action when possible.

A lack of public interest is a contributing factor in the decline of many of North Dakota's arboreta. Without public use, maintenance and funding often suffer as decision makers' attention



is turned toward programs and sites that see more human interaction and are perceived as a better use of time and resources. Still, green spaces are important and regular interaction would be a benefit to the community and to individual health (van den Berg et al., 2015). I believe that as citizens become more aware of the role of green spaces in well-being and health, use of arboreta by the public will increase (Balram & Dragievi, 2005). This is another direction Extension should move in. Help the public understand how an arboretum can benefit *them*. This can be accomplished in a number of ways and each arboretum manager can explore that in whichever way suits them best. Extension should encourage arboretum managers to create educational resources (such as infographics), host educational workshops of their own, and use social media to explain how arboreta benefit humans in a way that is clear and easy to understand.

It is my opinion that those willing to engage with me in an individual site visit were indeed making a reasonable effort. This is not surprising, as the choice to make time to meet and discuss ideas about their arboretum, could itself be considered as making an effort to improve. In the responses to the 6-month follow-up evaluation, a majority of managers had made, or plan to make, changes in their management practices and educational efforts.

The future landscape of North Dakota's arboreta is ambiguous at best. It has already been decided that some (19%) of the arboreta will be abandoned. Also, in recent years, the Myra Arboretum was in jeopardy of losing a portion of its funding due to lack of maintenance. Because of the extensive work that has been done in that arboretum, with a combination of efforts and resources from a number of organizations, that threat has been significantly diminished. In contrast, there are tentative plans to develop new arboreta in North Dakota. Steps such as planning the removal of specimens in decline and specimen mapping been taken at the North Central (Minot), Carrington, and Dickinson RECs. A privately-owned arboretum in

Bowman Co. has already been planted, and the manager has consulted with me on labeling. An SCD employee in Divide Co. has plans for a small learning and display arboretum on some newly acquired land.

Some arboreta are investing in new technologies to contemporize the visitor's experience like the interactive map at the ARS Station in Mandan or labels with QR codes that take the user to a website with information on that species. It is unclear what North Dakota's arboreta will look like in five years, but it is clear they will look different than today. It will be prudent for Extension to establish criteria for acceptability, in order to effectively evaluate arboreta.

Suggested criteria for acceptable standards are: a minimum of 90% labeling completeness and accuracy, a plan to, or the execution of research, conservation, or educational programming or outreach, and regular maintenance to provide a space most people would agree is aesthetically pleasing. As Extension establishes standards for education in North Dakota's arboreta and the project's landscape stabilizes, the evaluation approach may need to be adjusted.

Moving forward, through these conversations, Extension will be able to determine if those who aren't making improvements are failing to do so because they do not have a personal interest or because they cannot afford to have a personal interest in their arboretum. That is, are arboreta managers making a reasonable effort to improve their arboretum regardless of resources available? This is an important distinction, as some arboreta simply may not have the resources to make substantial upgrades in the first year following the project's conclusion. It's mainly the effort put forth by arboreta managers that Extension is interested in, as opposed to the extent of improvements made.

Much of the value in this study derives from our success in identifying which managers are willing to take steps towards improving their sites, as well as planned arboretum closures

and openings. This project documents where the opportunities for improvement lie. The continuation of this project is important because arboreta will likely play a significant role in conservation efforts. SCD arboreta will help to promote species diversity through exposure to new plants by demonstrating the multitude of species that can grow here. This is particularly important in North Dakota as many forests are dominated by green ash, a species that will inevitably succumb to emerald ash borer.

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## APPENDIX A. ARBORETUM NEEDS ASSESSMENT

Question 1a: What is the name of your arboretum?

Question 2: What city/town is your arboretum in (or closest city/town)?

Question 3: What level of involvement did you have in the development of this arboretum?

None at all. (0%)

Almost none, but I've done a little work to improve it. (< 25%)

Not everything, but I've done substantial work to improve it. (25% - 75%)

All, or nearly all. (> 75%)

Question 4: What are the top two challenges you've faced in managing this arboretum?

Maintaining the grounds.

Maintaining the trees (mainly pruning).

Finding new suitable species or varieties to add.

Labeling

Managing wildlife (deer, rabbits, etc.).

Managing insect pests and pathogens.

Other (please list).

Question 5: How do you use this arboretum educationally? (Check all that apply)

Active - We lead either group tours or individual tours.

Passive - We direct interested people to our materials and allow them to self-guide.

Others (e.g., local teachers) use this arboretum for education.

Not sure / Unknown.

It is not used for education.

Other (please list).

Question 6: What educational materials are available for your arboretum? (Check all that apply.)

A map.

List of species - Just common names.

List of species - Both common names and scientific names.

List of species - With names and species description.

None

Other

Question 7: In what ways do you cultivate public interest in your arboretum? (Check all that apply.)

Online (website, social media, email).

Local advertisements (newspapers, flyers, radio).

Hosting events at the arboretum.

None

Other

Question 8: What does your arboretum need to improve its current educational component? (Check all that apply.)

An onsite visit/lesson from NDSU Extension Specialist.

Information / Suggestions on additional species.

A field workshop at a highly developed arboretum (Absaraka, ND State Capitol, Myra).

Other (please list).

Question 9: What else would you like to tell us regarding your arboretum?

# Labeling Trees in Your Arboretum

## Information Included on a Plant Label

At a minimum, the plant's common name and botanical (scientific) name should be included on the label. Additional information may include the plant family, native range and accession number.

### Naming Rules:

- First line — the common name.
- Second line — the botanical (scientific) name.
- Botanical name — Genus is capitalized, species is not.
- Genus and species should be underlined or in *italics*.
- Cultivars — the 'Cultivar Name' is capitalized and put in single quotation marks but it is not italicized.
- Naturally occurring varieties — the variety is *italicized* and should be preceded by the abbreviation "var."
- Hybrids — the Genus is followed by an "x" followed by the name given to the result of the cross.
- Misleading common names — use a hyphen in the common name to distinguish it from the true species. (for example, Douglas-fir, which is not a true fir).

Common Name  
*Genus species*

American Linden  
*Tilia americana*

Common Name  
*Genus species* 'Cultivar'

Prairie Fire Dogwood  
*Cornus alba* 'Prairie Fire'

Common Name  
*Genus species* var. variety

Black Hills Spruce  
*Picea glauca* var. *densata*

Common Name  
*Genus x species*

Freeman Maple  
*Acer x freemanii*

Common-name  
*Genus species*

Douglas-fir  
*Pseudotsuga menziesii*

## Label Placement

Labels may be placed on or above the ground in front of the tree or in/on the tree to ensure visibility and ease of grounds maintenance. Whichever you decide, you have some important considerations:

### On Tree

**Pros:** Placing the label on the tree will ensure it is always visible. It also allows for easy grounds maintenance because the label will be protected from weed trimmer and mower damage. Placing the label in the tree also will save you from constantly righting a label that has been knocked over.

**Cons:** Attaching a label directly to the stem wounds the tree, which could leave it susceptible to pathogens and insects. As the tree grows, it may damage the label. The label will need to be monitored continually and adjusted as the tree grows. Young trees won't be able to accommodate some attachment methods.

### In Front of Tree

**Pros:** Placing the label in front of the tree will not wound the tree. This method also will allow for consistent and uniform labeling amongst specimens regardless of species, maturity or size.

**Cons:** Labels placed in front of the tree may be cumbersome and even can cause damage to equipment when mowing or doing other maintenance. These labels will have to be moved or mowed around. Depending on the type and size of the label, grass or other foliage may obstruct the label from view. Therefore, maintenance of the label area itself is sometimes necessary.



# APPENDIX C. MAP OF NORTH DAKOTA'S ARBORETA. DRAFT DOCUMENT

## FROM NDSU EXTENSION

### Arboreta Locations

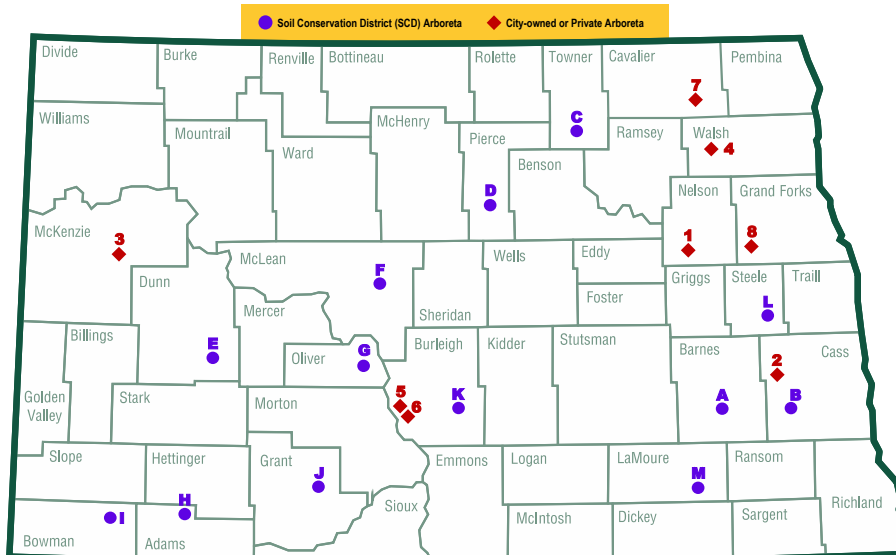
NDSU | EXTENSION

#### Soil Conservation District (SCD) Arboreta

- A. Barnes County** – Located in a riparian park 5 miles south of Valley City.
- B. Cass County** – Located at Brewer Lake near Erie, with roughly 25 species laid out in rows.
- C. Towner County** – Unlabeled arboretum, with about 15 species behind the hockey arena in Cando.
- D. Pierce County** – Located behind the SCD maintenance shed in Rugby. Roughly 30 specimens, a majority of which are labeled.
- E. Dunn County** – A small arboretum with about 18 species, situated around a circular walking path in Killdeer.
- F. McLean County** – Probably the smallest arboretum in North Dakota. Roughly 8 specimens surrounding the SCD parking lot in Turtle Lake.
- G. Oliver County** – Located on private land in rural Oliver county. The arboretum is without labels and may be abandoned.
- H. Adams County** – Located west of Hettinger next to the SCD maintenance shed. No labels and in need of major maintenance.
- I. Bowman County** – A small arboretum located next to the Bowman County fairgrounds.
- J. Grant County** – Located across the street from the SCD office in Carson. This arboretum is well maintained and well suited for grade school education due to its compact size and comprehensive labeling.
- K. Burleigh County** – A relatively large arboretum adjacent to the SCD maintenance shed in rural Menoken. Species are planted in long rows and relatively well maintained.
- L. Steele County** – A small well-kept arboretum that is part of the SCD office landscaping in Finley.
- M. LaMoure County** – An impressive middle-sized arboretum on the west end of the city of LaMoure.

#### City-owned or Private Arboreta

- 1. Aneta Community Orchard and Gardens** – Arboretum and community garden near the northwest corner of Aneta, with about 90 specimens. Developed and is maintained by a resident in the area.
- 2. Tinta Tawa Park** – Well maintained, diverse arboretum, with close to 50 species, surrounding the Casselton Reservoir. Well-labeled and maintained.
- 3. Kent Pelton Nature Park** – A well maintained memorial park owned by Watford City. The arboretum is adjacent to a small pond and a pavilion. Relatively young.
- 4. Park River Centennial Trees Path** – A relatively large arboretum located along a bike/walking path in Park River. The arboretum is diverse, however none of the species are labeled at this time.
- 5. Bismarck Rotary** – A small arboretum located on a nature walk in Bismarck. The arboretum is well labeled, with roughly 50 specimens having multiple labels.
- 6. Arboretum Trail** – A beautiful arboretum in a well-kept park on the State Capitol grounds. With roughly 75 species, it is a large and well-maintained arboretum. Information available online at the ND State Capitol website.
- 7. Langdon Arboretum** – Located in a Langdon City Park. The specimens aren't labeled at this arboretum, however, a map is available with the location of specimens and a brief description.
- 8. Myra Arboretum** – With over 400 specimens, it's North Dakota's largest public arboretum, located on the Larimore Dam Recreational Area grounds. The arboretum has recently made vast improvements, and is a hidden gem in north eastern North Dakota.



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## APPENDIX D. 6-MONTH FOLLOW-UP EVALUATION

Question 1: What was the most helpful element of the workshop?

Labeling education

Tree tour

Arboretum organization/development

Funding discussion

Other (please explain)

Question 2: Since the workshop, what management practices have you changed?

Question 3: What arboretum management practices do you plan on changing but haven't yet?

Question 4: Since the workshop, how have educational efforts in your arboretum changed?

Question 5: How do you plan to change your educational efforts but haven't yet?

Question 6: What can we do or provide to help you be more willing/able to administer educational programming?

Question 7: Did you find the educational resources helpful? (Labeling Infographic, Arboretum Map)

**APPENDIX E. SITES INVENTORIED, SPECIES REPRESENTED, LABELING  
COMPLETENESS, AND LEVEL OF MAINTENANCE**

Site	Species	Labeling Completeness	Level of Maintenance
Adams Co. SCD	32	Most	Abandoned
Barnes Co. SCD	24	Limited	High
Bowman/Slope Co. SCD	25	Most	Low
Burleigh Co. SCD	80	Most	High
Cass Co. SCD	33	Most	Low
Dunn Co. SCD	18	None	Low
Grant Co. SCD	41	Most	High
LaMoure Co. SCD	38	Most	High
South McLean Co. SCD	8	Most	Low
Oliver Co. SCD	30	None	Abandoned
Pierce Co. SCD	37	Most	Low
Sheridan Co. SCD	Unknown	Limited	Abandoned
Steele Co. SCD	26	Most	High
Towner Co. SCD	14	None	High
Aneta	89	Most	High
Bismarck Rotary	29	Most	High
Forestry Park (Bottineau)	Unknown	Most	Abandoned
Kent Pelton Nature Park (Watford City)	40	Most	High
Langdon Arboretum	43	Limited (paper map)	High
Myra Arboretum (Larimore)	500+	Most	High
Park River Centennial Trees Bike Path	217	None	High
State Capitol Arboretum Trail (Bismarck)	75	Most	High
Tinta Tawa Park (Casselton)	49	Most	High
USDA-ARS (Mandan)	Unknown	Unknown (online map)	High
Carrington REC	Unknown	Limited	Low
Dickinson REC	Unknown	Most (plus online map)	High
Langdon REC	Unknown	Limited	Low
North Central (Minot) REC	Unknown	None	Low

**APPENDIX F. SITE NAME, CONTACT INFORMATION FOR THE MANAGER, AND  
LOCATION INFORMATION.**

*Note:* These are sites that we consider to be arboreta. Criteria for inclusion/exclusion can be found in the narrative.

Site	Contact	Location
Barnes Co. SCD	Jason Elston 701-845-3114 jason.elston@nd.nacdnet.net	3823-3849 117th Ave SE Valley City, ND 58072
Bowman/Slope Co. SCD	Cassidy Fairbanks 605-929-2943 bsscd@ndsupernet.com	12 Hwy 12 East Bowman, ND 58623 Northwest corner of the parking lot.
Burleigh Co. SCD	Chad Thorson 701-250-4518 ext. 6157 Arboretum: 701-220-1721 chad.thorson@nacdn.net	1107 171st St NE Menoken, ND 58558
Cass Co. SCD	Jeffrey Miller 701-282-2157 jeffrey.d.miller@nd.nacdnet.net	Half a mile south of the Brewer Lake Campground. Campground address: 2160 146th Ave SE Erie, ND 58029
Grant Co. SCD	Connie Schily 701-622-3381 ext. 114 connie.Schily@nd.nacdnet.net	103 Dakota St Carson, ND 58529
LaMoure Co. SCD	Susan Muske 701-883-5344 susan.muske@nd.nacdnet.net	East end of the city of LaMoure. Take 4 <sup>th</sup> Ave NW east until the street ends.
South McLean Co. SCD	David Presser 701-448-2474 david.presser@nd.nacdnet	24 E 2nd Ave Turtle Lake, ND 58575
Pierce Co. SCD	Brad Jacobs 701-776-2207 ext. 3 bradley.jacobs@usda.gov	122 7th Ave SE Rugby, North Dakota 58368
Steele Co. SCD	Denise Vaagene 701-524-2840 denise.vaagene@nd.nacdnet.net	101 Industrial Drive Finley, ND 58230
Aneta	Bill Miller 701-215-8036 mandm@polarcomm.com	In the north-west corner of Aneta, ND. Take 6 <sup>th</sup> St N north until the street ends.
Bismarck Rotary	Doug Wiles 701-355-1733 publicworks@bismarcknd.gov	1329 Ward Rd Bismarck, ND 58501

Site	Contact	Location
Kent Pelton Nature Park (Watford City)	Robin Arndt 701-570-3677 info@roughridercenter.com	501 7th St SE Watford City, ND 58854
Langdon Arboretum	Holley Lyons 701-370-1421 lyonsh@utma.com	1316 7th St Langdon, ND 58249
Myra Arboretum (Larimore)	Nat Bornsen 701-425-1876 campground@larimoredam.com	3586 18th Ave NE Larimore, ND 58251
Park River Centennial Trees Bike Path	Joel Hylden 701-331-9710 joelhylden@yahoo.com	South side of Park St E and east side of Regina Ct. Park River, ND58270
State Capitol (Bismarck)	Julie Strom 701-328-2471 jastrom@nd.gov Spencer Thorston 701-328-2477 sthorsness@nd.gov	600 E Boulevard Ave Bismarck, ND 58505
Tinta Tawa Park (Casselton)	Stephen Bartholomay Office: 701-347-5386 Cell: 701-730-7275 casssparks@casselton.net	121 2nd St N Casselton, ND 58012
USDA-ARS (Mandan)	Unknown	1701 10 <sup>th</sup> Ave SW Mandan, ND 58854