Developing a Resilient Campus Forest at Allegheny College

23 January 2024

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[1] Recommended Citation. Ave, O.C., K.R. Greenlaw, H.B. Kneiser, J.R. Lutz, M.A. Miller, K.T. Murphy, D. Torrance, and R.D. Bowden 2023. Developing a Resilient Campus Forest at Allegheny College Campus. Allegheny College Department of Environmental Science and Sustainability Publication 2024-1.

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Executive Summary

The Allegheny College campus contains a large amount of beautiful trees that add to the aesthetic appeal of the institution for current students and employees, alumni, visitors, and prospective students. We examined the composition of the forest to help develop a resilient campus forest plan that maintains its ecological integrity and performs ecological services in spite of climate change, natural disturbances, and potential pests and diseases. Factors that we assessed included the composition of the forest, decision-making, and forest management. Our major findings include:

- **Non-native Trees.** Of the species found on campus, only 35% are native to PA. However, of the total number of trees, more than half (52%) are native to PA, with an additional 17% that are native to the US. Non-native trees comprise 31% of all trees on campus. By basal area, which better addresses the ecological dominance of trees than does the number of species or number of trees, 73% of the total basal area occurs in trees are native to PA.

- **Forest Regeneration.** The present policy on campus is to replace trees as soon as is practically possible after they are removed due to health or safety reasons. However, although many campus trees are young and small, there are no plantings of seedlings or saplings that will move into the canopy to become the next generation that will replace old, large, cathedral trees.

- **Tree Maintenance.** Many trees have sustained damage around their bases caused by lawn mowers or string trimmers. This damage creates entry points for insects, fungi, and bacteria that can weaken or kill trees.

- **Tree Placement.** Some trees have been planted in places that do not optimize their growth and survival. Many trees are in locations that will reduce energy needs for buildings, but there are additional opportunities for strategic planting that will help reduce building energy costs.

- **Centralized Planning and Management.** Tree planning decisions fall mainly to the Department of Physical Plant, but tree species selections and placement can be made by other departments (e.g. Development and Alumni Affairs) or by landscape architects involved in building construction or renovation. Faculty members with tree-related expertise have only recently been approached for tree-planting advice and input.

- **Forest Management Plan.** The college has two tree inventory reports produced by outside consultants in the last 20 years, but there is no written policy or strategy that guides long-term decision-making on overall management of the forest.

To develop an ecologically resilient campus forest that enhances environmental benefits and provides social attributes to students and employees, and that addresses short-comings from our major findings, we provide the following list of recommendations:

- Develop a forest ecosystem management task force that provides input on tree placement and planting strategies, and overall forest management.
- Prioritize trees that will be climate and pest resilient, as well as enhance wildlife.
- Develop a written forest management plan.

- Inventory campus trees regularly.
- Develop guidelines and strategies for planting and maintenance.
- Prioritize native trees and wildlife-enhancing trees.
- Consider reducing lawn-mowing under trees to protect trees and enhance wildlife.
- Construct a tree nursery that will provide a source of low-cost saplings that can be planted on campus as needed.
- Become a member of the Arbor Day Foundation Tree Campus Program

Planting a tuliptree alongside Steffee Hall to help provide shade in summer and help reduce building energy costs. Students, from L to R: Kinsley R. Greenlaw, Molly A. Miller, Daniel Torrance, Jenna R. Lutz, Kevin T. Murphy, Olivia C. Ave, and Hana B. Kneiser,

Acknowledgments

We thank Christine Scott Nelson '73 Endowed Professor in Environmental Science & Sustainability (ESS) Eric Pallant, Director of Sustainability Kelly Boulton, and Director of Physical Plant Joe Michael for conceiving and facilitating the resilient forest project, and ESS Professor Chris Shaffer for assistance with maps. We also thank Professor Jesse Swan-Quinn for careful editing and Doug Tallamy (’73) for insightful guidance and support of this project. The project was an effort of students, included as authors in this report, in the Environmental Research Methods class in fall 2021.

Tables, Figures, and Appendices

Introduction

The campus is a featured asset of Allegheny College, with an aesthetic quality that is spoken of positively, nostalgically, and lovingly by visitors, students, alumni, and employees. It is a primarily forested landscape containing lawns with large, beautiful "monarch" trees, flowering shrubbery, and numerous recent plantings to replace trees that fell or needed to be removed. The beauty of the campus forest is supported by a number of environmentally sustainable practices. For example, the college no longer applies fertilizers to lawn areas, but instead regularly applies a compost leachate "tea" to grassy areas to stimulate a healthy soil microbial community that provides a healthy soil environment. Pesticides are used rarely, and applied only on a "spot" basis. In autumn, fallen leaves are mulched into the lawns during normal lawn-mowing activities, and the college works with a professional arborist to maintain the health and vigor of campus trees.

Despite the beauty of the campus forest, important underlying issues threaten to compromise the sustainability of this important asset. For example, a healthy natural forest contains a range of tree age classes, including young saplings that will eventually grow into the overstory to replace aging trees. However, the campus forest contains relatively few saplings that can serve this role. In addition, the campus contains many trees that are not native to the region. Non-native plants do not enhance the native biodiversity of the campus landscape, and can be less tolerant to changing environmental conditions or threats. Relatedly, the process of tree selection and placement lacks an organized approach that will enhance the viability of individual trees or the diversity of forest composition.

This report documents the status of the campus forest and describes or quantifies these major issues to

- Provide guidelines and suggestions for developing a resilient campus forest that enhances survival of individual trees,
- Suggest a plan for tree-planting decision-making,
- Recommend trees that should be planted on campus, and
- Provide an initial set of suggestions for tree removals or plantings that will help develop a resilient forest that balances forested areas with appropriate open lawn spaces.

Importance of Urban Campus Forests

Forests are often considered to be ecosystems that are natural, separate from our day to day lives, and existing "somewhere else." However, urban forests provide important ecological, environmental, and social benefits[2]. The presence of vegetation, soils, and habitat enables these ecosystems to provide water conservation, soil nutrient retention, wildlife habitats, and sources of biodiversity. Environmentally, urban forests mitigate air pollution, enhance water storage, reduce storm runoff, prevent soil erosion, reduce the urban heat island effect, and reduce energy consumption through shading and transpirational cooling. Nearly 80% of US citizens call urban areas home, thus the natural world found in urban spaces is the closest regular connection to the environment for most people. As such, urban forests' societal role is just as

[2] Swann-Quinn et al. 2023. Growing a resilient campus forest: Opportunities, barriers, solutions. 5th World Symposium on Sustainable Development at Universities. Ch. 25. Springer-Nature. In press.

important as their ecological role. On campuses especially, forests heavily contribute to residents' sense of place and mental wellbeing. For example, on-campus forest therapy programs have shown a decrease in students' stress levels. Urban forests also provide scenery that many colleges, such as Allegheny, value for their charm and beauty. Many students' choice to come to Allegheny has been heavily influenced by our green spaces. Campus forests are also often intertwined with surrounding communities. Therefore, improving the forest health of campus green spaces also fosters opportunities to improve the entire community's environment through improved community access to campus and educational outreach.

Status of the Allegheny Campus Forest

Our approach

To quantify the status of the campus forest, we students and faculty in the Fall 2021 Environmental Research Methods course (ENVSC210) in the Department of Environmental Science and Sustainability focused on the main campus adjacent to Park Avenue, North Main Street, and Highland Avenue (Figure 1), and did not include the Robertson Field Sports Complex area or the Bousson Environmental Research Reserve located approximately eight miles east of campus. The most recent inventories of trees on campus were produced by Hazlett Tree Service in 2000[3] and Van Yahres Associates in 2011[4]. The Hazlett report mapped and identified 88 species of trees, with 1257 individual across the core campus area, and also including the President's Residence and the immediate vicinity of Robertson Field. Similarly, the Van Yahres report mapped and identified trees, however only 196 trees were mapped. Both reports measured tree diameter (at breast height (DBH: 4.5 ft)), however the VanYahres report contained more information on each individual tree, including age class, crown size, overall condition, and arboricultural recommendations. The Van Yahres study did not use the same tree numbering system as the Hazlett study.

Given the larger sample size of the Hazlett report, and considering that it was completed only ten years prior to the Van Yahres report, we elected to use the Hazlett report to describe the species composition of the forest and to estimate the number and relative importance of native versus non-native trees. We looked at each of the species in the Tree Inventory Management section of the report, using the data to calculate the average diameter and total basal area[5] for each species. We also used these data to characterize the forest by dominant species, conifers and broadleaf trees, and native v. non-native species (Appendix 1). In our analysis, we removed the white ash because they have been removed due to mortality from the Emerald Ash Borer. We did not attempt to correct the dataset for trees that had been added or removed from the campus grounds since the 2000 report. The college does not maintain a tree inventory available for routine and up-to-date analyses.

Abundant Species

Among the conifers, white pine, Norway spruce, red pine, Colorado blue spruce, and eastern hemlock are the most numerous trees (Figure 3), ranging from 14 to 23% of the total conifers, and in sum, constituting 90% of the coniferous trees. These five species also made up 82% of the total basal area. For hardwoods, the top five most numerous trees, thornless honeylocust, pin oak, sugar maple, flowering crabapple, and red maple made up 53% of the total trees, and also 53% of the basal area.

[3] Hazlett Tree Service, Inc. January, 2000. Tree Inventory Management. Evaluation for Allegheny College Property, Meadville, PA. G.B. Nirmaier, Certified Aborist, J.O. Smith, Certified Arborist.
[4] Van Yahres Associates. August 3, 2011. Arboricultural Assessment, Allegheny College.
[5] Basal area = area of the bole of the tree at DBH.

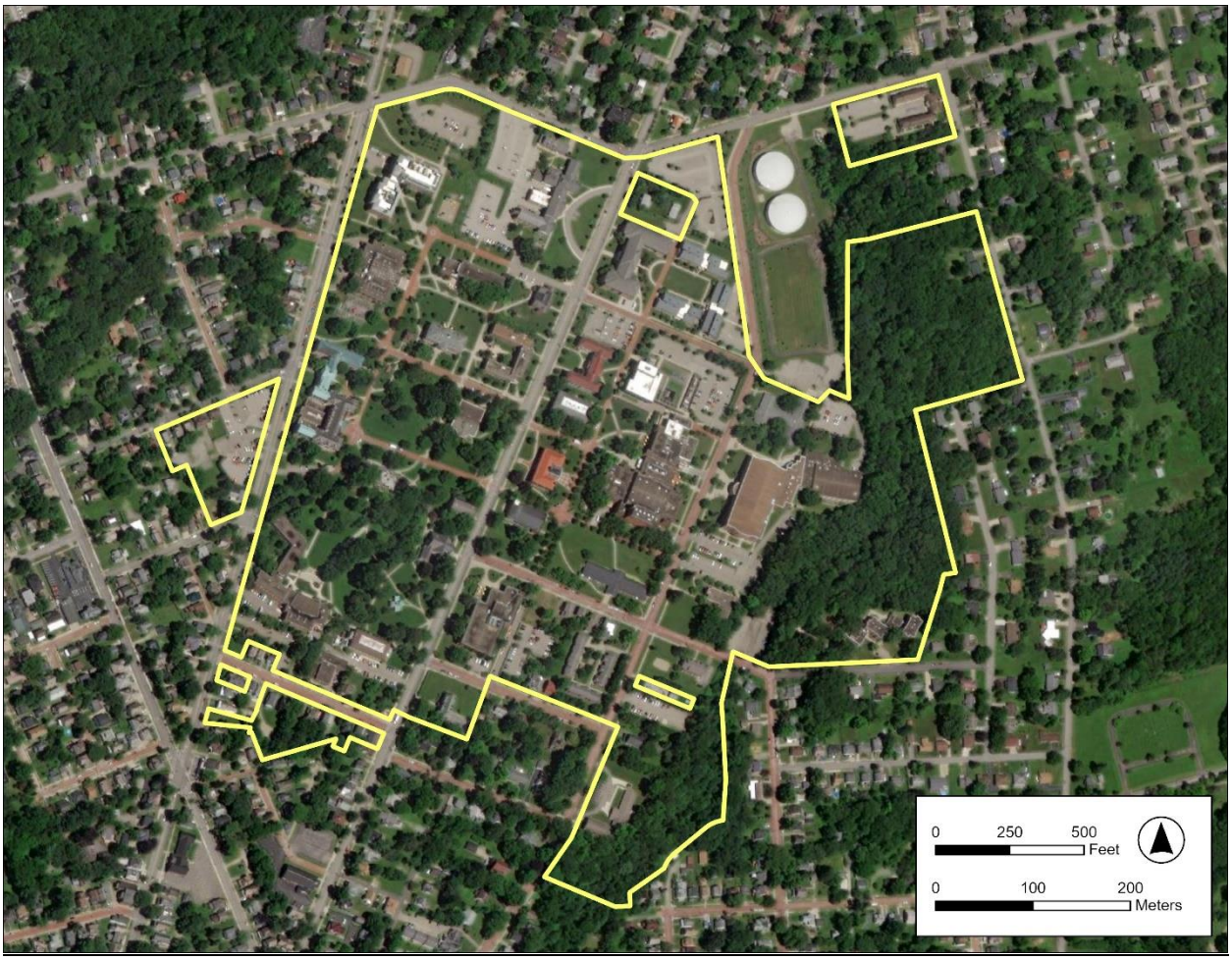

Figure 1. Central campus of Allegheny College

Forest Composition

Our database included 1257 trees with a total basal area of 914.2 ft². Generally, the forest on campus is reflective of northern hardwood and oak-hickory forests in northwestern PA that are dominated by hardwoods with low percentage of conifers.[6]

Of the 88 tree species present on campus, 16% are conifers and 84% are hardwoods (Figure 2). Tree numbers and total basal area per species showed the same trend; conifers comprised 26% and 15% of the total number of trees and total basal area, respectively.

We point out that it is important to consider both tree numbers and basal area in assessing the relative importance of trees within the overall distribution of trees on campus. Numbers alone do not account for differences in size among the trees. In many ways, basal area rather than numbers is more

[6] Stout, S.L. 1991. Stand density, stand structure, and species composition in transition oak stands of northwestern Pennsylvania. General Technical Report. Northern Research Station. In: McCormick, Larry H.; Gottschalk, Kurt W., eds. Proceedings, 8th Central Hardwood Forest Conference; 1991 March 4-6; University Park, PA. Gen. Tech. Rep. NE-148. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 194-206.

reflective of the biological importance of a species because large trees are more likely to be better seed producers, have a higher biomass, store more carbon, and contain more wildlife habitat. In the conifers, for example, red pine and Scots pine were less numerous than hemlock and blue spruce, but had more basal area than those two species. Similarly in the hardwoods, sugar maple was the third most abundant hardwood tree, but had the most total basal area. Pin oak showed a similar trend, being the fourth most numerous tree, while having the third most basal area.

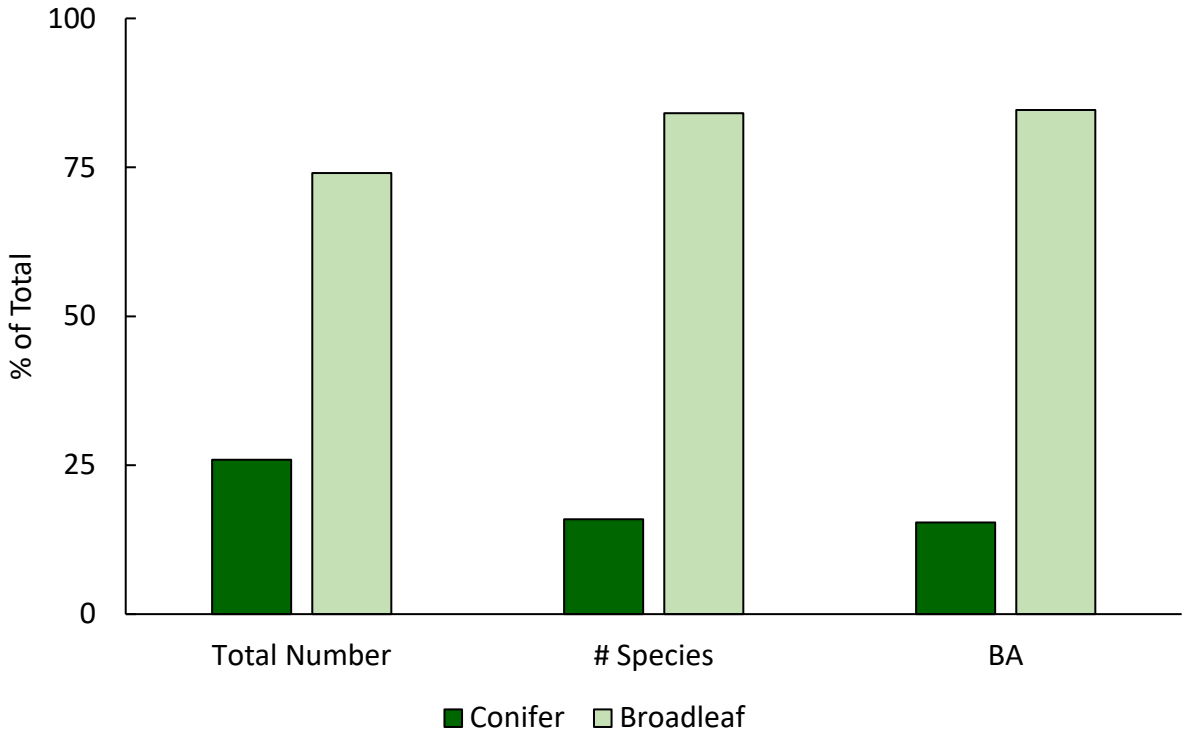

Figure 2. Distribution of trees, tree species, and basal area among conifers and hardwoods on the Allegheny College campus.

Native v. Non-native Species – All Trees

It is common on college campuses as well as on other urban or suburban forests to plant non-native trees. This occurs for a variety of reasons, including suitability in the built environment, cultural familiarity, aesthetics, and maintenance considerations. Non-native species, however, can create a host of problems, however, including susceptibility to pests and diseases, incompatibility with the native habitat, and spread to areas beyond where they are planted. To assess the amount of non-native trees on the campus, we divided the trees into three categories; native to Pennsylvania (PA Native), native to the US, (US Native), and non-native, using the USDA Plants Database[7] as a guide. PA native trees are those found in the commonwealth, though not necessarily indigenous to northwestern PA. US native trees are not native to PA, but are indigenous to the US. Non-native trees are not native to the US.

[7] https://plants.usda.gov/home

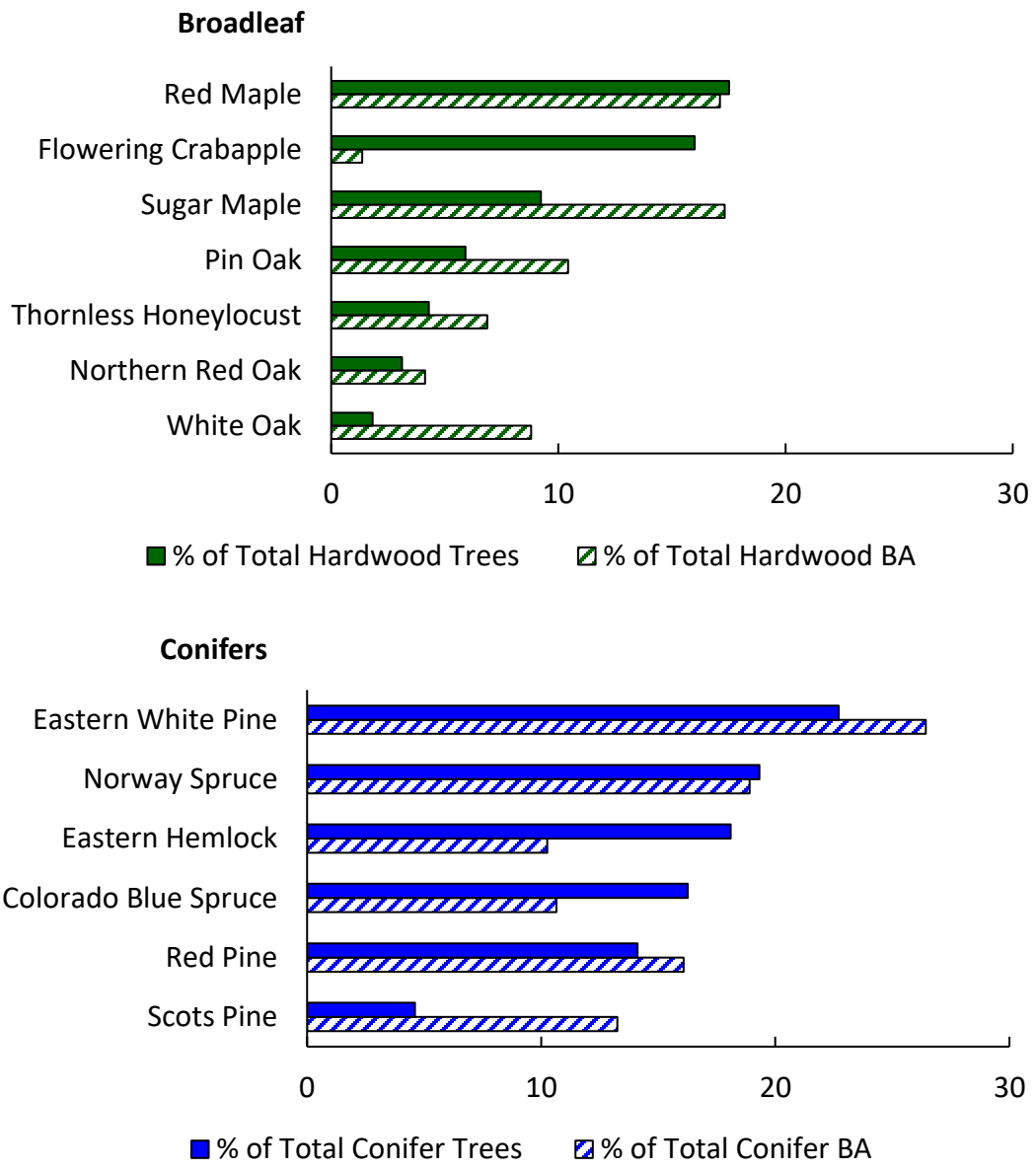

Figure 3. Most numerous conifer and hardwood tree species on the Allegheny campus, by numbers and basal area.

Of the species found on campus, only 35% are native to PA (Figure 4). Of the three categories, most tree species are in the non-native species category (40%), and most of the tree species (65%) are not native to either PA or the US. This indicates that of tree species selected to be planted on campus, most are not native to this area. However, when looking at the percentage of total trees that fall within the various categories, that situation is more encouraging than when looking at the list of species alone. PA Native trees constitute more than half (52%) the total trees, and 17% are native to the US. Nonetheless, 31% of all trees are not native to the US. By basal area, which better addresses the ecological dominance of trees than does the number of species or number of trees, 73% of the total basal area occurs in trees are native to PA, indicating that the ecological impact of trees on campus is dominated by trees native to PA. This bodes well for maintaining ecological relationships and environmental benefits endemic to this region.

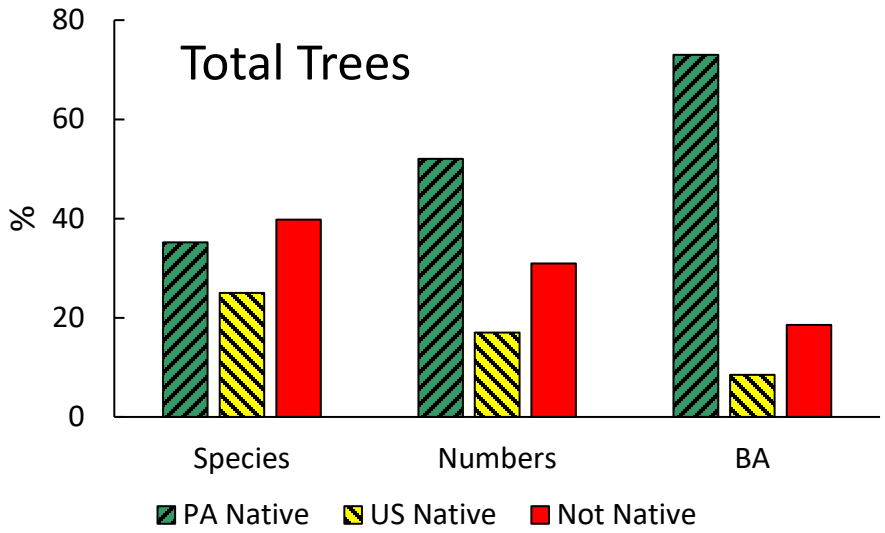

Figure 4. Percentage of Allegheny College campus trees that are native to PA, native to the US (but not to PA), or not native to the US, by species, total number of trees, and basal area (BA).

Native v. Non-native Species within Conifers and Hardwoods

Generally speaking, the hardwood presence on campus was dominated by trees native to PA, with 79% of the basal area and 56% of the total numbers (Figure 5). Trees not native to PA were still a large component of the species list, but were not so dominant in numbers or basal area. Conifers, however, were more dominated by non-native trees, with PA-native trees representing only 42% of the total number of trees and 38% of the basal area.

Forest Management

Tree Maintenance

We did not evaluate tree maintenance (e.g. trimming, pruning, cabling, removal) on campus however we did note two issues that deserve consideration. First, many trees showed slight girdling around the tree base and root collar, often 2-4 inches above ground level, which is consistent with being damaged by string trimmers or decks from lawnmowers. Unfortunately, this damage can lead to long-lasting effects on the tree. Girdling the trees causes entry wounds that can lead to insect or disease issues that can weaken or kill the tree. Girdling is easily prevented by exercising care during lawn care activities.

We also observed that most trees have what can be described as a lollipop appearance – a large canopy with the main trunk extending downward toward a mowed grass lawn. Although this is a common landscaping approach and may have aesthetic appeal, it does not represent the complex structure of a natural forest with a variety of tree sizes and a groundcover of seedlings and native plants. Trees are filled with numerous insects that provide approximately 50% of the diet of birds[8]. As part of their natural lifecycle, insect larvae fall from the trees to the ground where they mature and enter their adult stage. This process is important in maintaining a healthy food source for campus birds. However, a grass lawn provides a poor habitat for

[8] Doug Tallamy. 2021. The Nature of Oaks: The Rich Ecology of Our Most Essential Native Trees. Timber Press, Portland, OR 200pp.

developing insects. The areas under trees would be far more suitable habitat if they consisted of underplantings of shrubs or herbaceous plants. Even mulch would provide a much more suitable habitat than the manicured lawn.

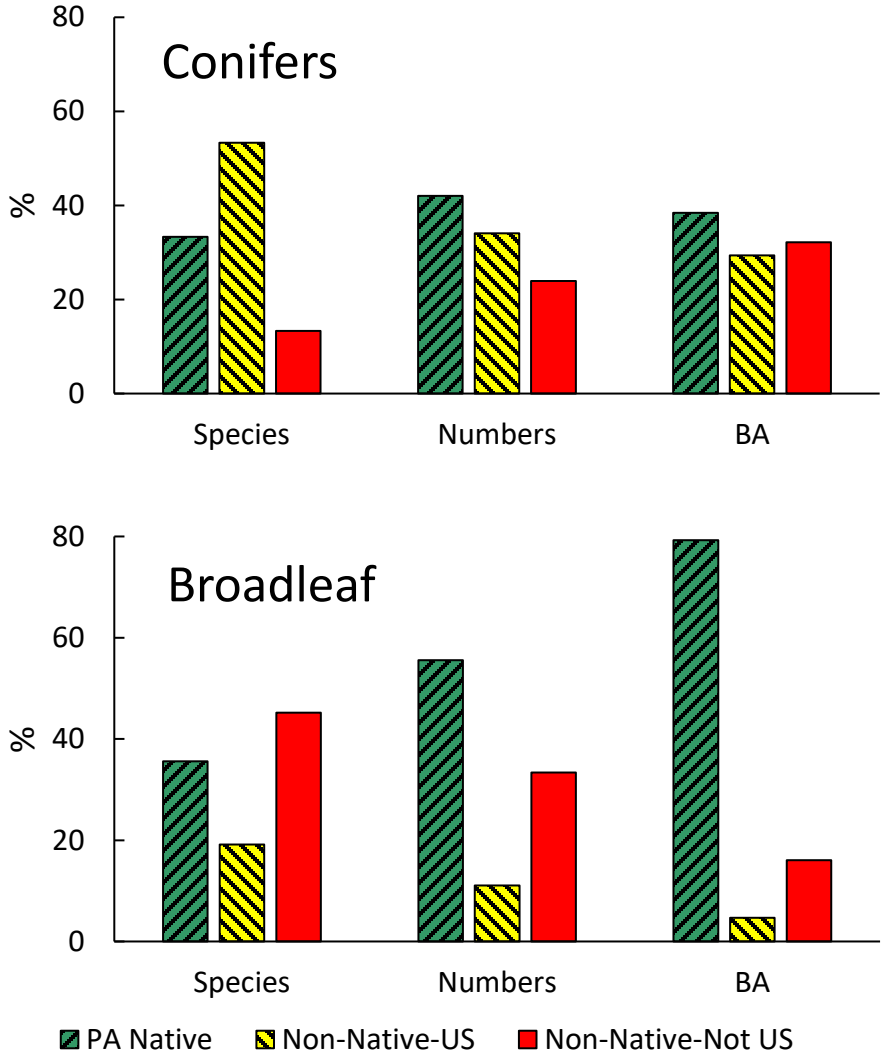

Figure 5. Percentage of Allegheny College campus coniferous and broadleaf trees that are native to PA, native to the US (but not to PA), or not native to the US, by species, total number of trees, and basal area (BA).

Regeneration

A natural forest consists of a diversity of age and size classes, and notably contains saplings and small trees that are poised to enter into the upper canopy when mature, older trees eventually die. Particularly in areas where we have large, mature, cathedral trees, such as the Bentley lawn, there are no trees planted that may develop into the next overstory. We learned that the current practice is to replace trees as they are removed, which is a solid approach. However, this is a reactionary approach that does not address the need to have a vibrant reservoir of younger trees. Furthermore, it will never be possible to replace a very tall, old tree with a tree of the same size. To plant a large sapling, on the order of 20' tall,

for example, is expensive (several thousand dollars), and the survival of that planting is not a sure thing. A better approach would be to begin planting small saplings (much less than $100) so that they can become well established and begin moving into the upper canopy. This way if a mature tree succumbs to a natural disturbance or needs to be removed for maintenance and safety reasons, a new tree will be well positioned to occupy this space.

Tree Habitats

Long-established trees are usually faring well where they have been planted, but we did note trees that are not planted in ideal locations. For example, on the northwest side of Arter Hall, in the last decade, a sycamore was planted at the top of the slope alongside the building (Figure 6). At the bottom of the slope, a tulip tree was also planted at about the same time. These species are perfectly appropriate trees for this region and for the campus, but they are planted in exactly the opposite places of where they should be. Sycamores grow well in moist soils, but this tree was planted in the well-drained site. Tuliptrees, however, prefer moderately well-drained soils, but in this case, the tuliptree was planted where soil is routinely wet. These trees are 100 feet apart, and switching the planting locations would have placed each tree in the correct growing locations.

We suggest that more care is given in the future to not only which trees are planted on campus, but also which trees are most suitable for each specific habitat.

Energy savings

We explored the campus to assess placement of trees that would assist with energy savings. Deciduous trees planted on the south or southwestern side of buildings reduce sunlight entering buildings in summer, thus helping to reduce cooling needs. In winter, after autumnal leaf fall, and when the sun sits lower on the horizon, natural light enters the classrooms, helping to reduce energy needed for lighting needs. Coniferous trees planted on north and western sides of buildings help to reduce prevailing westerly winds, reducing winter heat loss.

An excellent example of appropriate plantings is at Quigley Hall, where there are three large, mature pin oak trees on the south side of the building (Figure 7). In summer, foliage will shade the building, thus reducing heat entry into the building. In winter, the absence of leaves combined with the sun being lower on the horizon will allow sunlight to pass through the windows and enhance natural lighting in the classrooms. These trees also provide an aesthetically pleasing element as well, adding to their benefit. Trees planted similarly on the south side of Steffee Hall, including a tuliptree planted in fall, 2021, will perform similar roles.

Generally, trees near many buildings will result in energy gains, but it would be beneficial to assess other buildings and locations where such plantings will be useful. For example, on the west side of the Quigley parking lot, ash trees that succumbed to the Emerald Ash Borer have been removed but there have been no replanting. Trees along parking lots will help to reduce the large heat impact of paved surfaces that occurs in summer, thus reducing what is known as the urban heat island effect.

Centralized Planning and Management

As we explored campus forest management, it became apparent that forest management decisions are dispersed with no central authority for decision-making. Physical Plant is responsible for maintaining trees, primarily by contracting with a local arborist. Physical Plant has also taken on the role of replanting

trees that have been removed recently. It is unclear as to what role Physical Plant has in taking the initiative in planning tree plantings on campus. The Development and Alumni Affairs has long had a program whereby donors can plant a tree on campus. When a donor is interested in a memorial tree, the donor is allowed to lead the direction of where. Once a general location is established, Development and Alumni Affairs office works with Physical Plant to obtain a list of trees that would thrive in that location, often offering the donors a few options from which to choose. Tree decisions can also be made by landscape architects when campus buildings are renovated or built. The rationale for choices of trees is not well known. Presently there is no master campus forest management plan that provides guidance on tree species choices and planting locations. We also found that members of the college faculty with expertise in trees and forest ecology have not been historically consulted in tree planting choices. Recently, Physical Plant has come to a member of the ESS Department (Professor Richard Bowden) for advice in tree species selection and planting location. Although ESS is willing and pleased to provide input, the ad hoc nature of soliciting advice can make it hard for Physical Plant to plant trees in a timely manner if an ESS department member is not available to provide advice. This approach also gives a single person a large responsibility in making a decision that will have long-term consequences.

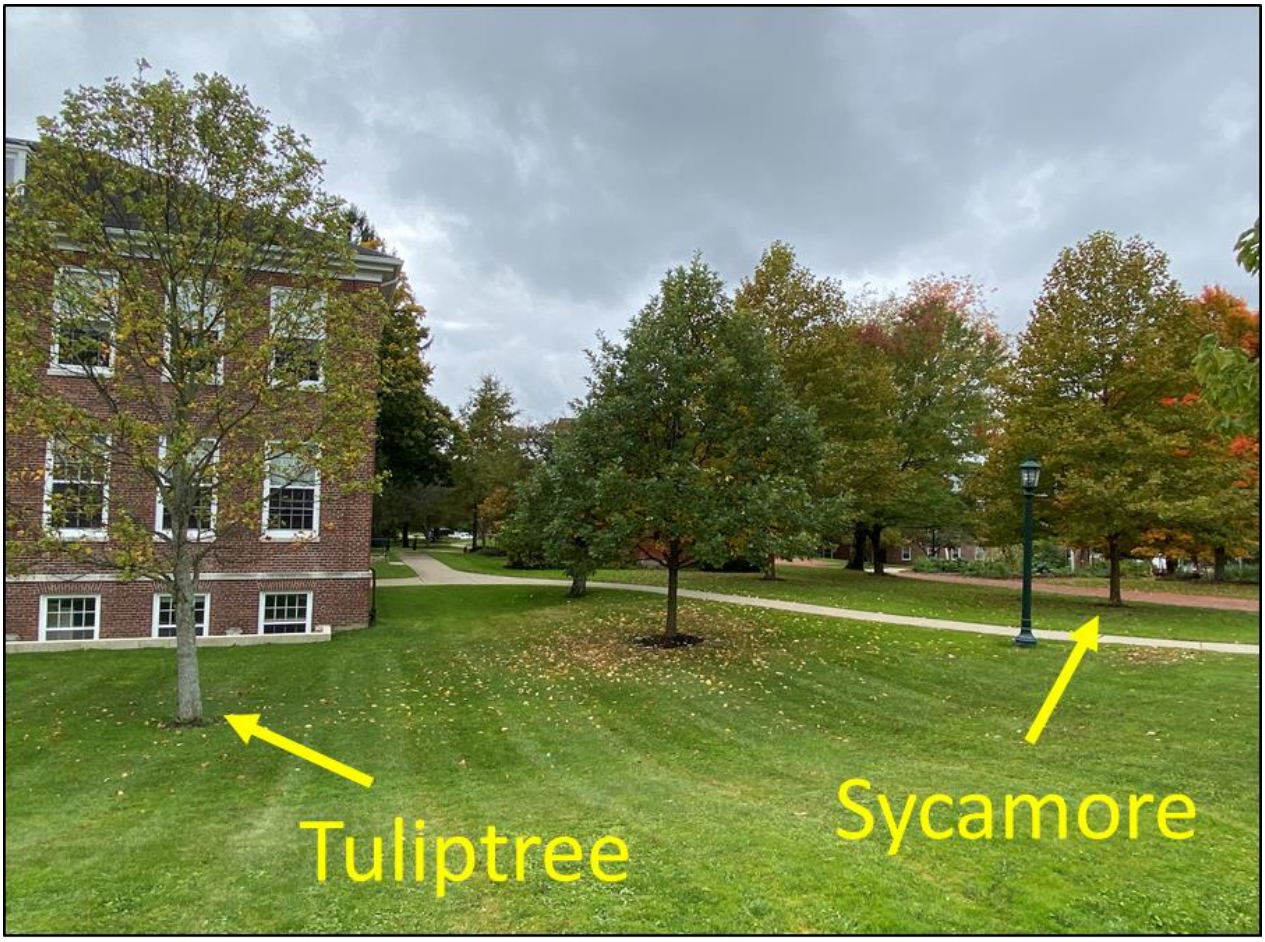

Figure 6. Tuliptree and sycamore planted outside Arter Hall. The sycamore, which grows well in moist soils, is planted atop the slope in well-drained soils. The tuliptree, which grows best in relatively well-drained soils, is planted in routinely moist or wet soil.

To better manage the forest, we propose that the college consider developing a committee that centralizes decision-making that is based on sound ecological and environmental principles. Since the beginning of this campus forest management research effort, the Allegheny College Office of Sustainability has developed a Campus Resilient Ecosystem Task Force whose members include the Director of Sustainability, the Physical Plant Director, two faculty members, two additional members of Physical Plant, and several students. This working group is intended to draw together many separate conversations and meetings that have been had over the years regarding management of the grounds and forests of our campus into one consistent body.

Figure 7. Large pin oak trees planted on the south side of Quigley Hall provide shade during summer, helping to cool the building. After leaf fall in winter, and when the sun sits lower on the horizon, sunlight can enter the classrooms, enhancing natural light.

Forest Management Plan

We also believe that a formalized management plan should be developed that routinely assesses the trees on campus. As we found in this study, the two most recent contracted campus tree studies developed different tree maps and numbering systems, and developed different sets of information. With a solid Geographic Information Systems (GIS) laboratory on campus, our tree locations can all be georeferenced, with data (e.g. species, size, management issues) provided for each tree. This tree inventory

can then be easily updated, and summarized as needed to assess the campus forest. Discussions with Chris Shaffer, manager of the GIS Laboratory, indicate that he could be able to begin such an inventory by incorporating this effort into GIS courses.

We believe also that the plan should not be only an inventory of current trees, but should indicate where trees should be planted in the future. Informed by the Campus Resilient Ecosystem Task Force, this plan could also provide a list of recommended tree species. This would be a valuable tool that considers important ecological, aesthetic and management concerns into planting decisions, and provides a guide to Physical Plant.

Recommendations

Recommended Trees for Planting on the Allegheny Campus

Based on conversation with Douglas Tallamy, Ph.D., a 1973 Allegheny graduate, noted conservationist, entomologist and educator, and 2022 Allegheny Honorary Degree recipient, we explored a number trees that we have deemed suitable to be planted on the Allegheny Campus. We optimized for PA native trees where possible, but also considered that climate change will lead to warmer conditions in this region. Hence, we also selected trees that live in warmer climates that are likely to grow successfully in this area in future years. Additional factors that we considered included the tree's geographic range, value to wildlife, planting conditions that are healthiest for the tree (moisture, shade, and soil composition), tree height, potential pest issues, and maintenance issues. We sought both conifer as well as broadleaf trees. We also considered as broad a species assemblage as possible to develop a campus forest that is resilient to potential insect and disease outbreaks as well as climate change

We produced a list of 22 trees deemed to be most suitable for planting on campus (Table 1). Of those, 20 are native to PA; one is not native to PA and one is not native to the US. Three conifers were selected, one of which, Norway spruce, is not native to the US. Finding conifers, which can provide an aesthetic element to campus as well as providing wildlife cover is challenging. Hemlock and white pine are the only conifers native to this area, however, hemlock is under threat from the introduced hemlock wooly adelgid (HWA), which has been decimating hemlock populations in the eastern US. It is likely to reach this area, and preventing HWA infestation is costly. We do include white pine, but acknowledge that the white pine weevil, which frequently lays eggs and thus kills the terminal shoot, often results in trees with unwanted form and weakened structural integrity. Norway spruce, though, non-native, is not invasive, and grows well in this region. Eastern red cedar is native to PA, and grows well in dry soils, and thus may be a valuable option in a warming climate. It is also a short-statured tree (~20 feet tall) and thus offers a tree that might be valuable in locations where tall trees are not suitable.

Of the broadleaf trees, Florida maple is the only species that is not considered native to PA. However, its ability to tolerate warm climates makes it an acceptable tree to consider developing a climate resilient campus. Overall, the broadleaf trees include a mix of trees that can be used in a variety of soil moisture and shade conditions. There is also some diversity in maximum height growth; American plum, gray birch, and hophornbeam are small trees; black birch and sassafras typically do not get very tall.

Wildlife-important trees

The wildlife value of trees is important as it promotes high levels of biodiversity in an area by attracting several different species of mammals and insects. Of the trees on our recommended list, all will provide different shelter, food, and nesting sites for different species (Table 2.). More than half the trees

were indicated as having high value for birds, 10 were considered important for mammals, and 15 of the 22 were considered important for insects or pollinators specifically. We have included three oak trees, primarily due to their acorn-producing ability which benefits both birds and small mammals.

We point out that trees other than those on this list may be acceptable on campus. For example serviceberry is an important small tree for wildlife, and may be suitable in appropriate areas. In addition, other native trees may have important value in particular locations. We recommend that this list be reviewed regularly to insure its suitability as well as to assess upcoming pathogens that might threaten these recommended species.

Table 1. Trees recommended for planting on the Allegheny College campus.

	Native Status		**Wildlife Value**			**Moisture Need**			**Light Need**		
Tree	*Native*	*Non-native*	*High*	*Medium*	*Low*	*Wet*	*Medium*	*Dry*	*High*	*Med*	*Low*
Coniferous											
Norway spruce		X			X		X			X	
Red cedar	X		X				X		X		
White pine	X		X				X			X	
Deciduous											
American plum	X		X				X			X	
Black birch	X			X			X		X		
Black cherry	X		X				X			X	
Black walnut	X		X				X		X		
Black willow	X		X			X			X		
Blackgum	X		X			X			X	X	X
Florida maple		X		X				X			X
Gray birch	X		X				X		X		
Hackberry	X		X				X		X		
Hophornbeam	X			X		X					X
Red Oak	X		X					X		X	
Sassafras	X			X		X				X	
Shagbark hickory	X		X			X			X	X	
Shumard oak	X		X				X		X		
Slippery elm	X				X		X			X	
Sugar Maple	X		X				X				X
Sweetgum	X			X			X		X		
Sycamore	X		X			X			X		
Tuliptree	X		X			X	X		X		
White oak	X		X				X		X		

Table 2. Wildlife value of trees recommended for the Allegheny College campus.

	Wildlife Value			
Tree	*Birds*	*Mammals*	*Insects*	*Pollinators*
Coniferous				
Norway spruce	x			
Red cedar	x			x
White pine	x	x	x	
Deciduous				
American plum		x		x
Black birch	x	x		
Black cherry	x	x		x
Black walnut			x	
Black willow				x
Blackgum	x			x
Florida maple	x			x
Gray birch				x
Hackberry	x			x
Hophornbeam	x			
Red oak	x		x	
Sassafras		x		
Shagbark hickory	x	x		
Shumard oak	x		x	x
Slippery elm		x		
Sugar Maple				x
Sweetgum	x	x		
Sycamore		x		
Tuliptree	x			x
White oak	x	x	x	

Tree Nursery

Small tree seedlings are relatively inexpensive ($1-5 each) and planting them carefully to provide the promise for their success is not difficult. However, large saplings are expensive ($500-$5000) and it is very difficult to plant them successfully. We advocate that the college would benefit from a nursery established on college grounds whereby seedlings of desired species can be grown until such time as they are needed on campus. The college has sufficient space at the composting facility at Robertson Field, and college personnel are their regularly who could potentially provide the maintenance (planting, watering) to foster the success of seedlings and saplings. Indeed, since we proposed this activity, the college proceeded to construct the nursery (Figure 8), and has already planted a number of trees that can be used on the campus.

Figure 8. Tree nursery constructed at the Allegheny college campus to grow seedlings into saplings that can be planted on campus.

Arbor Day Foundation Higher Education Tree Campus

The Arbor Day Foundation supports National Arbor Day, including nationwide and year-round efforts to support tree-planting efforts. The Tree Campus Higher Education program of the foundation was founded in 2008 to provide a framework for colleges and universities to grow their community forests, achieve national recognition, and create pride among students and campus employees for campus forests. As of 2021, the program includes 411campuses, engaging more than 25,000 students. As we have conducted this assessment of Allegheny's campus, we see that the college is well suited to be recognized as an Arbor Day Foundation Higher Education Tree Campus. We surpass most of the program requirements for this recognition, and have in place nearly all the elements needed to qualify.

Major requirements for the application include establishing a campus tree advisory committee, providing evidence of a campus tree-care plan, verification of the school's dedicated annual expenditures for trees, observing Arbor Day, and creating a service-learning project aimed at engaging the student body. After achieving these five goals, we would join other college campuses in caring for their community forests and get national recognition for this achievement.

Elements that we have in place or nearly so include:

- A Campus Resilient Ecosystem Task Force that will advise the college on tree management,
- This report, as well as a recent Forest Ecology and Management Course report[9], contain most of the elements needed for a tree-care plan
- A dedicated budget item for tree maintenance on campus
- 2022 participation in a campus-based Arbor Day celebration, and plans for 2023
- Numerous service-learning projects that engage students in forest protection on campus and regionally.

[9] Adams, D., R. Amsdell, K. Brozell, T. Cade, N. Claudio, A. Corso, M. Dosch, A. Ferguson, J. Folaron, H. Hersh, A. Hunt, S. Jones, E. Kerr, E. Manning, B. Michael, K. Mowry, S. Olsen, A. Peachey, R. Walters and R.D. Bowden. 2022. Recommendations for Managing the Urban Forest on the Allegheny College Campus. Report submitted to the Allegheny College Physical Plant and Allegheny College Office of Sustainability.

Many of our competitor or nearby schools (Table 3) are also already a part of the Tree Campus USA program. Being a part of the Tree Campus USA program would allow Allegheny College to advance our status in being sustainable and having a resilient forest.

Table 3. Nearby and competitor Arbor Day Foundation Tree Campuses.

Boston College	Bryn Mawr College	Bucknell University
Carnegie Mellon University	Case Western Reserve University	Chatham University
Clarkson University	Colby College	College of the Holy Cross
Cornell University	Denison University	Franklin & Marshall College
Haverford College	Hiram College	Hobart and William Smith Colleges
John Carroll University	Juniata College	Kenyon College
La Roche College	Messiah College	Middlebury College
Moravian College	Ohio Northern University	Ohio University
Otterbein University	Penn State Erie, Behrend College	Pennsylvania State University
Ramapo College	Salve Regina University	Smith College
St. Bonaventure University	The College of Wooster	Thiel College
University of Mount Union	University of Pennsylvania	Ursinus College
Villanova University	Washington & Jefferson College	

Summary of Management Recommendations

- Tree Maintenance
    - Continue the professional level of individual-level tree maintenance using a professional arborist
    - Train campus personnel and lawn service contractors on preventing lawn maintenance damage to the base of trees
- Native Trees
    - Use the list of recommended conifer and broadleaf trees to begin implementing a strategy that favors native trees. Non-native trees should be used only if native trees that provide similar services are not appropriate, as long as those species are not invasive.
- Regeneration
    - Begin planting saplings under mature trees that are currently in the overstory.
    - As small, young trees mature, continue the underplanting strategy
- Tree Habitats
    - Plant trees in the correct ecological locations
- Energy savings
    - Where appropriate, plant trees to maximize summer shading and winter wind protection of campus buildings
- Centralized Planning and Management
    - Use the Campus Resilient Ecosystem Task Force as the primary advising group for strategies and plans to plant trees.
- Forest Management Plan
    - Develop an on-going tree inventory that also includes suggestions for replacement of individual trees when replacement is warranted.

    - Prepare a written, accessible forest management plan that articulates policies and practices
- Recommended Trees for Planting on the Allegheny Campus
    - Use the recommended tree list as a guide in planting decisions
    - Review and update this list regularly and as needed
- Wildlife-important trees
    - Prioritize trees that will enhance campus wildlife
- Tree Nursery
    - Maintain the recently constructed tree nursery, augmenting the seedling stock with trees acceptable for campus planting
    - Near the nursery, develop an area where saplings can be banked for planting on campus
- Arbor Day Foundation Higher Education Tree Campus
    - Submit an application for Allegheny College to be recognized as an Arbor Day Foundation Higher Education Tree Campus

The Allegheny College ravine bridge.

Appendix 1. Tree information obtained from the 2000 Hazlett Report used to assess the Allegheny College campus forest.

AC Campus Tree Diversity Inventory							
from Hazlett 2000 Report							
Native Status Native to PA(PA-N) Native to US (US-N) Non-Native (NN) Unknown (U)							
Tree Code	*Scientific Name*	Common Name	No. Trees	Ave DBH (in)	Native Status	Basal area (in2)	Basal area (ft2)
ABBA	*Abies balsamea*	Balsam Fir	2	12.7	PA-N	253.4	1.8
ABFR	*Abies fraseri*	Fraser Fir	1	6.1	US-N	29.2	0.2
ACBU	*Acer buergeranum*	Trident Maple	8	1.7	NN	18.2	0.1
ACCR	*Acer platanoides 'Crimson King'*	Crimson King Maple	16	9.1	NN	1040.6	7.2
ACGR	*Acer griseum*	Paperback Maple	1	1	NN	0.8	0.0
ACPA	*Acer palmatum*	Japanese Maple	2	4.2	NN	27.7	0.2
ACPL	*Acer platanoides*	Norway Maple	22	14.2	NN	3484.1	24.2
ACPS	*Acer pseudoplatanus*	Sycamore Maple	3	9.3	NN	203.8	1.4
ACRU	*Acer rubrum*	Red Maple	163	12.2	PA-N	19054.5	132.3
ACSA	*Acer saccharum*	Sugar Maple	86	16.9	PA-N	19291.3	134.0
ACSN	*Acer saccharinum*	Silver Maple	1	49	PA-N	1885.7	13.1
AEHI	*Aesculus hippocastanum*	Horsechesnut	10	28.4	PA-N	6334.7	44.0
AMAR	*Amelanchier arborea*	Downy Serviceberry (Juneberry)	27	3.6	PA-N	274.8	1.9
BEPA	*Betula papyrifera*	Paper Birch (White Birch	1	0	US-N	0.0	0.0
BEPO	*Betula populifolia*	Gray Birch	10	7.4	PA-N	430.1	3.0
CABE	*Carpinus betulus*	European Hornbeam	1	8.3	NN	54.1	0.4
CACO	*Carya cordiformis*	Bitternut Hickory	1	17.5	PA-N	240.5	1.7
CADE	*Castanea dentana*	American Chestnut	1	9.2	PA-N	66.5	0.5
CAFA	*Carpinus betulus 'Fastigiata'*	Upright European Hornbeam	3	7	NN	115.5	0.8
CAOV	*Carya ovata*	Shagbark Hickory	2	15.3	PA-N	367.7	2.6

CASP	*Catalpa speciosa*	Northern Catalpa	2	25.5	US-N	1021.4	7.1
CECA	*Cercius canadensis*	Eastern Redbud	5	1.6	US-N	10.1	0.1
CEJA	*Cercidiphyllum japonicum*	Katsuratree	2	13.5	NN	286.3	2.0
CLKE	*Cladrastis kentukea (lutea)*	American Yellowwood	5	4.6	US-N	83.1	0.6
COFL	*Cornus florida*	Flowering Dogwood	14	3.3	PA-N	119.7	0.8
COKO	*Cornus kousa*	Kousa Dogwood	25	2.5	NN	122.7	0.9
CRCR	*Crataegus crusgalli*	Cockspur Hawthorn	2	5.6	PA-N	49.3	0.3
CRLA	*Crataegus laevigata*	English Hawthorn	2	8.1	NN	103.1	0.7
CRMO	*Crataegus mollis*	Downy Hawthorn	7	4.7	US-N	121.4	0.8
CRPH	*Crataegus phaenopyrum*	Washington Hawthorn	16	4.5	US-N	254.5	1.8
FAGR	*Fagus grandifolia*	American Beech	2	6.5	PA-N	66.4	0.5
FAPU	*Fagus sylvatica 'Purpurea'*	Purple European Beech	1	40.1	NN	1262.9	8.8
FRPE	*Fraxinus pennsylvanica*	Green Ash	11	4.5	US-N	174.9	1.2
GIBI	*Ginkgo biloba*	Ginkgo (Maidenhair Tree)	12	16.2	NN	2473.4	17.2
GLTR	*Gleditsia triancanthos var. inermis*	Thornless Honeylocust	40	15.6	PA-N	7645.4	53.1
ILOP	*Ilex opaca*	American Holly	10	4.9	US-N	188.6	1.3
JUCI	*Juglans cinerea*	Butternut	2	8	PA-N	100.5	0.7
JUCO	*Juniperus communis*	Common Juniper	1	3.2	US-N	8.0	0.1
JUNI	*Juglans Nigra*	Black Walnut	7	13.9	PA-N	1062.2	7.4
KAPI	*Kalopanax pictus*	Castor Aralia	1	19.7	NN	304.8	2.1
LALA	*Larix laricina*	Tamarack	1	9.2	PA-N	66.5	0.5
LIST	*Liquidambar styraciflua*	Sweetgum	12	9.6	US-N	868.6	6.0
LITU	*Liriodendron tulipifera*	Tuliptree	7	7.3	PA-N	293.0	2.0
MASP	*Malus spp.*	Flowering Crabapple	149	3.6	U	1516.6	10.5
MAST	*Magnolia stellata*	Star Magnolia	5	2.4	NN	22.6	0.2
MASY	*Malus sylvestris*	Common Apple	7	9	NN	445.3	3.1
MEGL	*Metasequoia glyptostroboides*	Dawn Redwood	1	30.9	NN	749.9	5.2
MOAL	*Morus alba*	White Mulberry	4	8.1	NN	206.1	1.4
NPS	*N/A*	New Planting Site	7	0	NN	0.0	0.0
NYSY	*Nyssa Sylvatica*	Black Tupelo	9	9.7	US-N	665.1	4.6
OXAR	*Oxydendrum arboreum*	Sourwood	1	2.5	US-N	4.9	0.0

PHAM	*Phellodendron amurense*	Amur Corktree	1	21	NN	346.4	2.4
PIAB	*Picea abies*	Norway Spruce	63	8.8	NN	3831.7	26.6
PIGL	*Picea glauca*	White Spruce	1	12.1	US-N	115.0	0.8
PIPU	*Picea pungens*	Colorado Spruce	53	7.2	US-N	2157.9	15.0
PLOC	*Platanus occidentalis*	American Sycamore	6	13.5	PA-N	858.8	6.0
PNPE	*Pinus strobus 'Pendula'*	Weeping Eastern White Pine	1	6.7	PA-N	35.3	0.2
PNRE	*Pinus resinosa*	Red Pine	46	9.5	US-N	3260.6	22.6
PNST	*Pinus strobus*	Eastern White Pine	74	9.6	PA-N	5356.3	37.2
PNSY	*Pinus sylvestris*	Scotch Pine	15	15.1	NN	2686.2	18.7
PODE	*Populus deltoides*	Eastern Cottonwood	2	0	PA-N	0.0	0.0
POTR	*Populus tremuloides*	Quaking Aspen	2	10	PA-N	157.1	1.1
PRPE	*Prunus subhirtella 'Pendula'*	Weeping Higan Cherry	1	14.3	NN	160.6	1.1
PRSA	*Prunus sargentii*	Sargent Cherry	2	9.4	NN	138.8	1.0
PRSE	*Prunus serotina*	Black Cherry	22	9	PA-N	1399.6	9.7
PSME	*Pseudotsuga menziesii*	Douglassfir	4	4.9	US-N	75.4	0.5
PYBR	*Pyris calleryana 'Bradford'*	Bradford Pear	8	4.7	NN	138.8	1.0
PYCO	*Pyrus communis*	Common Pear	1	10.5	NN	86.6	0.6
QUAL	*Quercus alba*	White Oak	17	27.1	PA-N	9805.7	68.1
QUFA	*Quercus robur 'Fastigiata'*	Upright English Oak	3	5.5	NN	71.3	0.5
QUPA	*Querus palustris*	Pin Oak	55	16.4	PA-N	11618.2	80.7
QUPR	*Querus prinus*	Chestnut Oak	1	28	US-N	615.8	4.3
QURO	*Quercus robur*	English Oak	1	13.4	NN	141.0	1.0
QURU	*Quercus rubra*	Northern Red Oak	29	14.2	PA-N	4592.7	31.9
ROPS	*Robinia pseudoacacia*	Black Locust	18	9.1	US-N	1170.7	8.1
SALB	*Salix alba*	White Willow	2	2.2	NN	7.6	0.1
SOAU	*Sorbus aucuparia*	European Mountainash	2	9.7	NN	147.8	1.0
SOJA	*Sophora japonica*	Japanese Pagodatree	1	22	NN	380.1	2.6
SYRE	*Syringa reticulata*	Japanese Tree Lilac	1	7.6	NN	45.4	0.3
TADI	*Taxodium distichum*	Common Baldcypress	2	9.6	US-N	144.8	1.0
THOC	*Thuja occidentalis*	American Arborvitae	3	8.5	US-N	170.2	1.2
TIAM	*Tilia americana*	American Linden	3	20.7	PA-N	1009.6	7.0
TICO	*Tilia cordata*	Littleleaf Linden	21	14.8	NN	3612.7	25.1

TSCA	*Tsuga canadensis*	Eastern Hemlock	59	6.7	PA-N	2080.1	14.4
ULAM	*Ulmus americana*	American Elm	4	18.1	PA-N	1029.2	7.1
ULCA	*Ulmus glabra 'Camperdownii'*	Camperdown Elm	1	14	NN	153.9	1.1
ULPA	*Ulmus parvifolia*	Chinese Elm (Lacebark Elm)	1	1.9	NN	2.8	0.0
ULRU	*Ulmus rubra*	Slippery Elm	2	18.1	PA-N	514.6	3.6
VIPR	*Viburnum prunifolium*	Blackhaw Viburnum	5	3	US-N	35.3	0.2
		Total	**1264**	**-**	**-**	**131625**	**914.1**