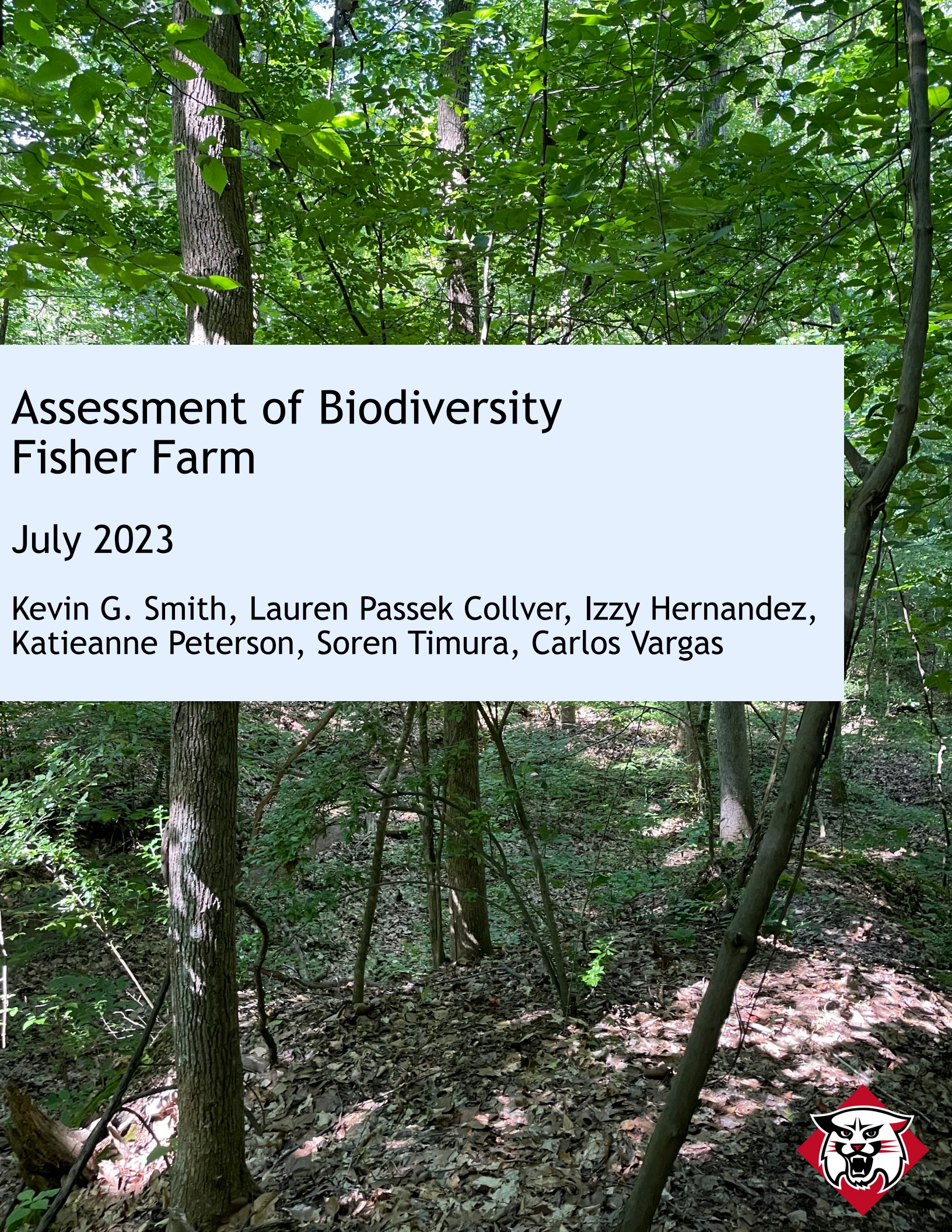

Assessment of Biodiversity
Fisher Farm

July 2023

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Executive Summary

In summer of 2023 Davidson College researchers began a biodiversity survey and assessment project as part of an ongoing relationship with Davidson Lands Conservancy and the Town of Davidson at Fisher Farm. The goal of these surveys was to provide data to inform management activities occurring at Fisher Farm. The focus area was a 20 acre forest plot, adjacent to the main parking lot at Fisher Farm. We split the forest into seven sections in order to obtain ample information about the patch.

We focused on documenting tree, shrub, and forest floor plant biodiversity to assess the current state of the habitat in this forest patch. Through data collection, analysis and interpretation, we focused on general biodiversity, tree abundance and size, light levels and forest floor coverage, and the presence of non-native species.

The forest patch has an impressive number of woody and herbaceous species. Unfortunately, this high species richness is undermined by an uneven distribution, as there are only a few species that dominate the forest at each respective level (forest floor, shrub, tree). There is potential, depending on the goals held for this forest patch, to increase biodiversity by balancing the distribution of these species through low-intensity burning, thinning, and/or herbicide use. Non-native species are found throughout the forest patch. The most prevalent ones, Autumn Olive and Japanese Honeysuckle, occur primarily around the edge of the forest patch at relatively low but variable densities. Eradication of these species is unlikely, but given their low densities management may be successful and should be based on stakeholder goals for the forest patch.

Overall, our findings indicate strong potential to support plant diversity and a diverse wildlife population in the forest patch at Fisher Farm. We suggest several management actions (forest stand improvement and low-intensity prescribed fire) that will reduce tree density and open the forest canopy to increase light levels on the forest floor and stimulate a more diverse and abundant herbaceous plant community. This in turn would support a more diverse wildlife population by providing a wider range of browse and habitat resources. The benefits of forest stand improvement and prescribed fire for biodiversity management are documented in published literature. Overall, we suggest that these management strategies will provide ecosystem benefits to wildlife as well as aesthetic benefits to visitors at Fisher Farm.

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Objectives and Scope of Report

In summer 2023, researchers from the Davidson College Biology and Environmental Studies Departments and Davidson Lands Conservancy (DLC) and the Town of Davidson developed a collaboration to assess biodiversity at Fisher Farm as part of DLC's Wildlife Enhancement Collaborative. The Davidson College team was led by Dr. Kevin G. Smith, a tenured biology professor and conservation scientist, and included one full-time research technician and four full-time student researchers in Biology and Environmental Studies. Conversations between Kevin Smith and DLC led to the development of plans to survey a 20 acre forest in the middle of Fisher Farm, with a specific focus on native biodiversity and to help develop plans to enhance biodiversity, wildlife habitat, aesthetics, and ecosystem health, in alignment with DLC's mission.

In this report, we summarize the work completed by our (the Davidson College) research group at Fisher Farm during June and July of 2023. Our goals for this work were to:

- Assess botanical (tree, understory, herbaceous) biodiversity, including potentially invasive species and value to wildlife
- Summarize our findings to describe the current conditions of the Fisher Farm forest plot as and to inform DLC's and the Town of Davidson's management decisions, and provide baseline data for comparison in future years, post-management
- Provide tentative recommendations for future management activities to be considered alongside those already under consideration by DLC and the Town of Davidson

It has been our pleasure to work with DLC and the Town of Davidson and to work at Fisher Farm. We hope that the information we provide in this report will be useful as you plan future management activities.

Site Location(s) and Description

Fisher Farm is a 200 acre publicly accessible park in Davidson, NC. The park is a popular location for recreational activities including walking, running, and biking. Fisher Farm is owned by the Town of Davidson and protected by a conservation easement held by Mecklenburg County. Davidson Lands Conservancy conducts stewardship and monitoring of the park in order to ensure the land is protected to the standards of the permanent conservation easement.

The Fisher Farm survey focused on a 20 acre mixed hardwood forest with a trail running through the center. This location was chosen because of its large size and relative lack of disturbance and management. It is immediately adjacent to the main parking area and is one of the first forested habitats visitors to the park will encounter. For our surveys, we divided the 20 acre plot into seven 100m x 5m sections spread out around the site to effectively assess the overall biodiversity, individual species present, density and cover, and physical topography, across the entire forest patch.

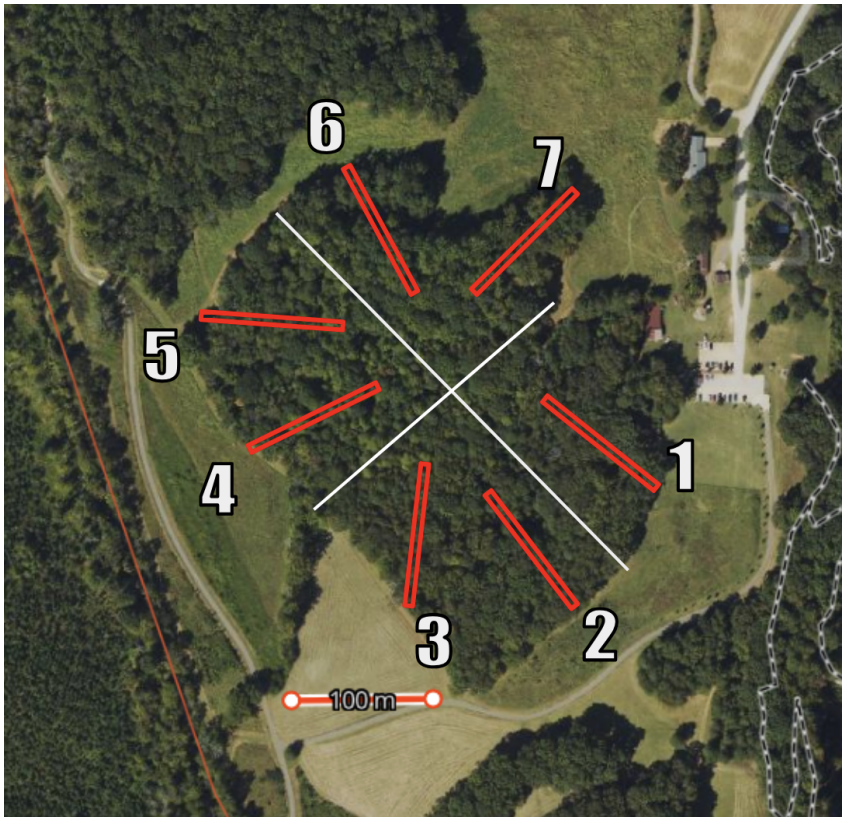


Fig 1. Map of Fisher Farm with locations of each section where a transect was conducted.

Methods

To present a comprehensive report of the biodiversity within Fisher Farm, we used three distinct methods to collect data on the diversity of the forest floor, midstory, and overstory.

1. Identification and diameter of trees occupying the overstory.
2. Identification and coverage data of plants occupying the mid story, commonly referred to as the “shrub layer.”
3. Identification and coverage data of plants occupying the forest floor.

For each survey, we established a 100 meter long and 5 meter wide transect using a reel tape. The species of every tree in the transect that was greater than thumb-width was identified and the diameter at breast height (DBH) was recorded. The presence of vines on trees was also documented. 25 square-meter plots were set up every 20 meters on the transect to conduct shrub level surveys. Within these subplots, we identified all species that were taller than 40 centimeters and less than thumb width and visually estimated the proportion of the plot area they occupied (referred to as maximum percent cover). For our forest floor level surveys, we set up 1 square-meter plots every 10 meters along the transect and did the same maximum percent cover estimations on species that were shorter than 40 centimeters. To ensure our data

reflected the ecosystem as accurately as possible, we also conducted rare species surveys where we recorded the presence of any plant species that fell within each transect but did not appear in any of our subplots.

Assessment of Biodiversity

Strengths

The forest patch has many strengths in terms of biodiversity and wildlife habitat. Overall, we observed high diversity among herbaceous plants and tree species. We documented 61 different species of trees and shrubs and 70 different species of herbaceous plants in the forest patch. For plants found on the forest floor, there is a 96% chance that any two random individuals in the surveyed plot will be different species, and there is a 93% chance that any two trees and shrubs will be different species. These numbers, calculated with the Simpson's Diversity Index, indicate a high level of biodiversity in this forest patch. The diversity of plant species is encouraging for the wildlife population at Fisher Farm, because "diversity begets diversity." Having many different types of plants helps ensure that resources are available for a similarly diverse array of species across all taxa.

The presence of large, mature trees, mainly oaks, in the forest patch is another strength. These trees provide valuable habitat, shade, and food to wildlife and people at Fisher Farm. Large trees also contribute greatly to the aesthetic and physical atmosphere of Fisher Farm and are valuable to the experience of visitors.

While there are non-native species present throughout Fisher Farm, the abundance and density of especially invasive species is only moderate compared to other areas in this region and even other parts of Fisher Farm. Invasive species that are present, such as Autumn Olive and Japanese Honeysuckle, do not exist as monocultures and so their control and management is possible. Additionally, many of these species provide habitat and forage for a wide array of wildlife, which may be considered in future management decisions.

An additional strength of the surveyed forest patch is the topographic heterogeneity of the site. The site consists of upland and bottomland, and the deep ravine that may have been caused by historical land clearing and/or unsustainable farming practices. This diversity of topography supports a high diversity of upland and lowland species and provides many different types of habitat in a relatively small section of land.

Overall, the forest patch has strong potential for providing value in terms of biodiversity, wildlife resources, and esthetic values for visitors to Fisher Farm.

Weaknesses

Although the forest patch has the above strengths, because it is not being actively managed for biodiversity and associated value we have identified some weaknesses.

For example, the forest is dominated by a small number of tree species in the midstory like Winged Elm (*Ulmus alata*), which occurs at nearly triple the abundance of the next most common species, and Green Ash *(Fraxinus pennsylvanica*). Other than Elms and Ashes, the latter of which are unlikely to survive, there are relatively few species available in the understory to maintain the present diversity of the tree canopy in the future. This suggests that tree biodiversity in the forest patch will decline over time in the absence of management.

Furthermore, the closed canopy of mature trees and high density of young trees in the mid and understory prevent sufficient sunlight from reaching the forest floor. As a result, herbaceous cover (e.g., forbs and wildflowers) is very low. Although many herbaceous species are present, they occur at very low abundance and provide few services or resources, limiting the biodiversity value of the forest patch.

Several invasive species are common in the forest patch, but they are not found in high densities meaning that they currently do not pose a severe threat to the biodiversity and can be managed. However, we did find high cover of invasive species concentrated in some spaces.

Tree and Shrub Diversity

In this section we summarize the most abundant tree and shrub species and discuss their implications for the biodiversity of the forest patch.

Tree diversity: The surveyed area is primarily a mixed hardwood forest. Winged elm (*Ulmus alata)* is the most abundant species, followed by Eastern Red Cedar (*Juniperus virginiana),* Sweetgum (*Liquidambar styraciflua*), Green Ash (*Fraxinus pennsylvanica),* and American Beech (*Fagus grandifolia*).

Tree size: A critical point of the tree diversity at Fisher Farm is that among the most abundant trees, Winged Elm and Green Ash appear almost exclusively as small to medium sized trees in the midstory. The diameter at breast height (DBH; *see Appendix A for more information)* of most Winged Elms and Green Ash are under 8 cm and 5 cm, respectively. Smaller trees of these species were also among the most abundant in the shrub level. A concern of this is that these species are taking up space in the midstory and understory that could otherwise be occupied by trees that live longer and provide more value for wildlife *(*Oaks, for example*)*. Further, the high density of ashes will eventually be susceptible to the Emerald Ash Borer, an invasive insect that kills adult ashes *(see Appendix B for more info)*.

In contrast to understory trees, canopy tree species provide a variety of ecosystem services including producing hard mast of nuts/acorns and providing habitat space for a variety of bird species. Hickories (*Carya)* and American Beech are trees that contribute to these services once

they are big enough to join the canopy. The most common canopy tree in this forest plot is White Oak (*Quercus alba*) which alongside other oak species contribute huge services to wildlife *(see Wildlife Value for more information).* Canopy trees such as Sweetgum *(Nyssa sylvatica)* and Tulip Poplar *(Liriodendron tulipifera)* are in high abundance, yet do not provide these same services, limiting their value to the surrounding ecosystem.

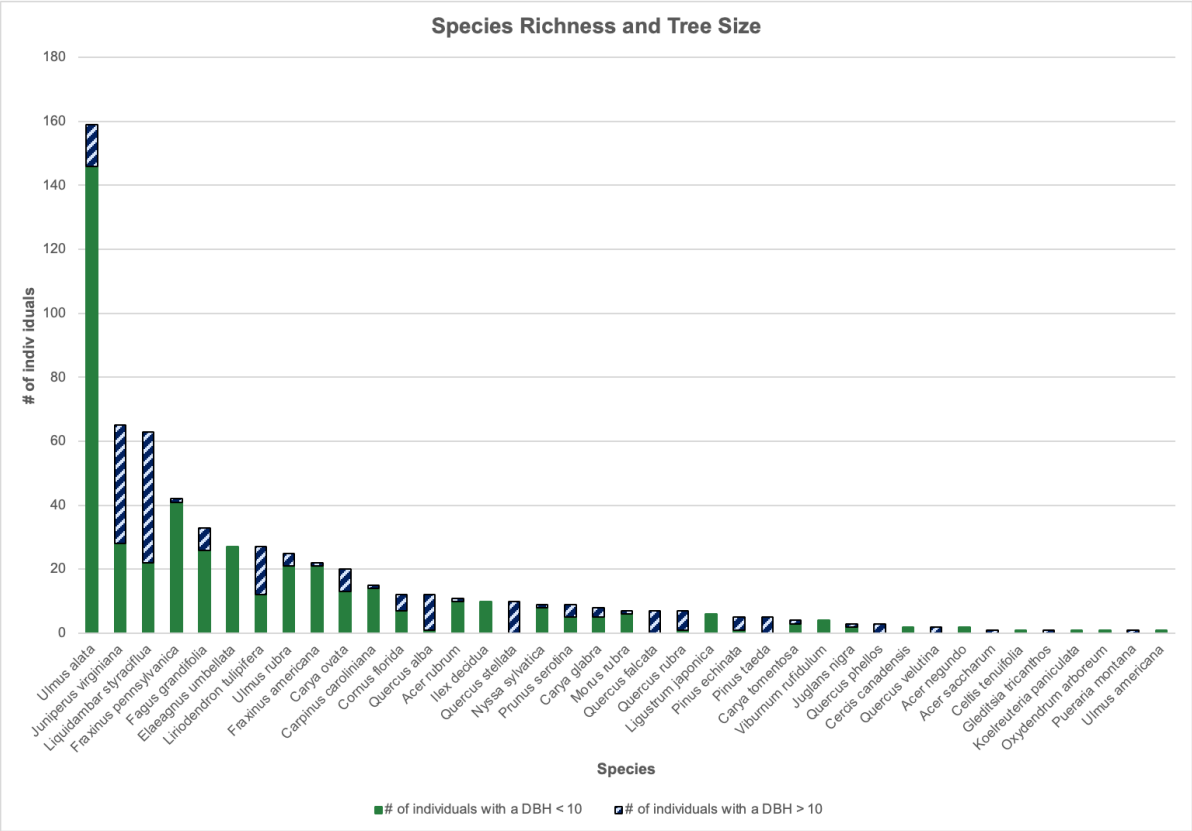


Fig 2. Species richness and tree size (DBH). This figure shows the dominance of small Winged Elm *(Ulmus alata)* in the forest patch. Winged Elm is drastically more abundant than the next most abundant species, and the vast majority of Winged Elm trees are smaller than 10cm in diameter.

Most abundant Shrub species: Besides Green Ash and Winged Elm, the most abundant species in the shrub level by coverage (*see Methods)* are Muscadine Grape (*Vitis rotundifolia)*, Autumn Olive (*Elaeagnus umbellata),* and Winter Honeysuckle (*Lonicera fragrantissima)* (*see Non-native Species for more info on Autumn Olive and Winter Honeysuckle*).

Light levels: Due to the dense overstory coverage, the amount of light reaching the forest floor is low. For light level readings we measured Photosynthetic Active Radiation (PAR), the light actively used by plants. Light levels were extremely low in the forest patch compared to the open field (100% light), with all sites having less than 5% available sunlight (Table 1). Reduced sunlight levels on the forest floor lead to suppressed understory growth, including saplings and young trees, herbaceous plants, and shrubs. In forested habitats, a minimum of 30% of available light should be able to reach the forest floor to allow for diverse and abundant plant communities to develop within the forest.

Table 1. Light level readings at Fisher Farm taken on July 25, 2023.

	Open field	Section 1	Sections 2-3	Sections 4-5	Sections 6-7
PAR µmol	1961	80.05	68.6	66.2	45.85
% of Available Sunlight	100%	4.08%	3.50%	3.40%	2.34%

Forest Floor Diversity

In this section we summarize the herbaceous cover on the forest floor, list the most common species, and discuss average percent coverage across the site. Many of these species are useful forage for wildlife and lend importance to the overall health of the ecosystem.

On average, 24% of the forest floor is covered by herbaceous plants and varies between sections of the forest. The most abundant species on the forest floor in order of coverage are Crossvine (*Bignonia capreolata)*, Virginia Creeper (*Parthenocissus quinquefolia)*, Muscadine Grape, and two non-native, invasive species; Greater Periwinkle (*Vinca major),* and Japanese Honeysuckle. It is interesting to note that all of these species have the growth form of woody vines, or lianas. This abundance of woody vines indicates that the only species of plants that can currently thrive in the shaded understory are species that can climb to higher sunlight levels. Other fairly common species found at the forest floor level included Green Ash, various grasses, and Eastern Redbud *(Cercis canadensis).* These species further demonstrate the dominance of young trees. Figure 3 presents an overall species richness distribution for the forest floor level. Figure 4 demonstrates the species richness excluding vines. Both of these figures show there is high diversity of species on the forest floor, yet there are a few species (mainly woody vines) dominating the system and most herbaceous species are very rare.

Table 2. Average forest floor percent coverage for the overall site and each section.

Location	**Average Forest Floor % Cover**
Whole Site	24.07%
Section 1	19.8%
Section 2	13.6%
Section 3	18.8%
Section 4	41%
Section 5	25.8%
Section 6	31.1%
Section 7	18.4%

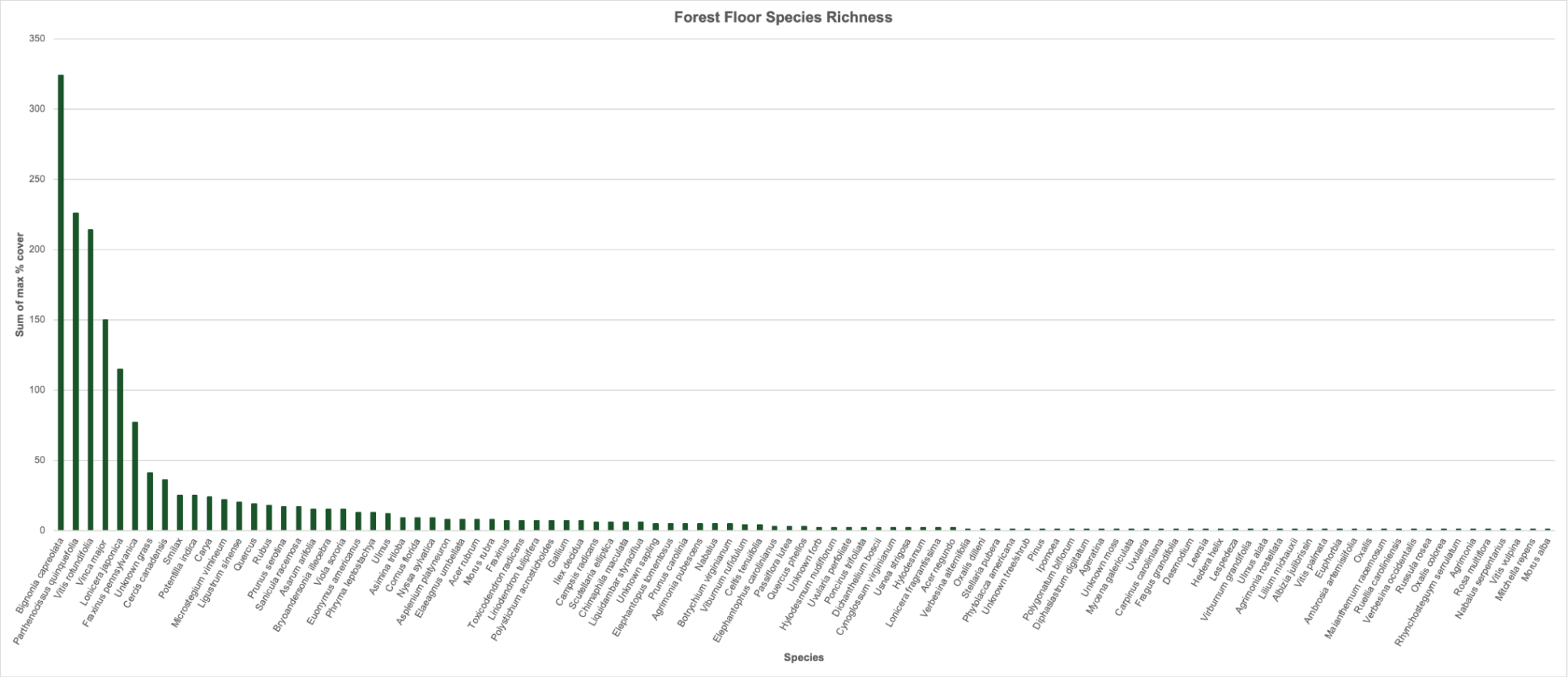


Fig 3. Species richness distribution at the forest floor level using sum of max percent cover

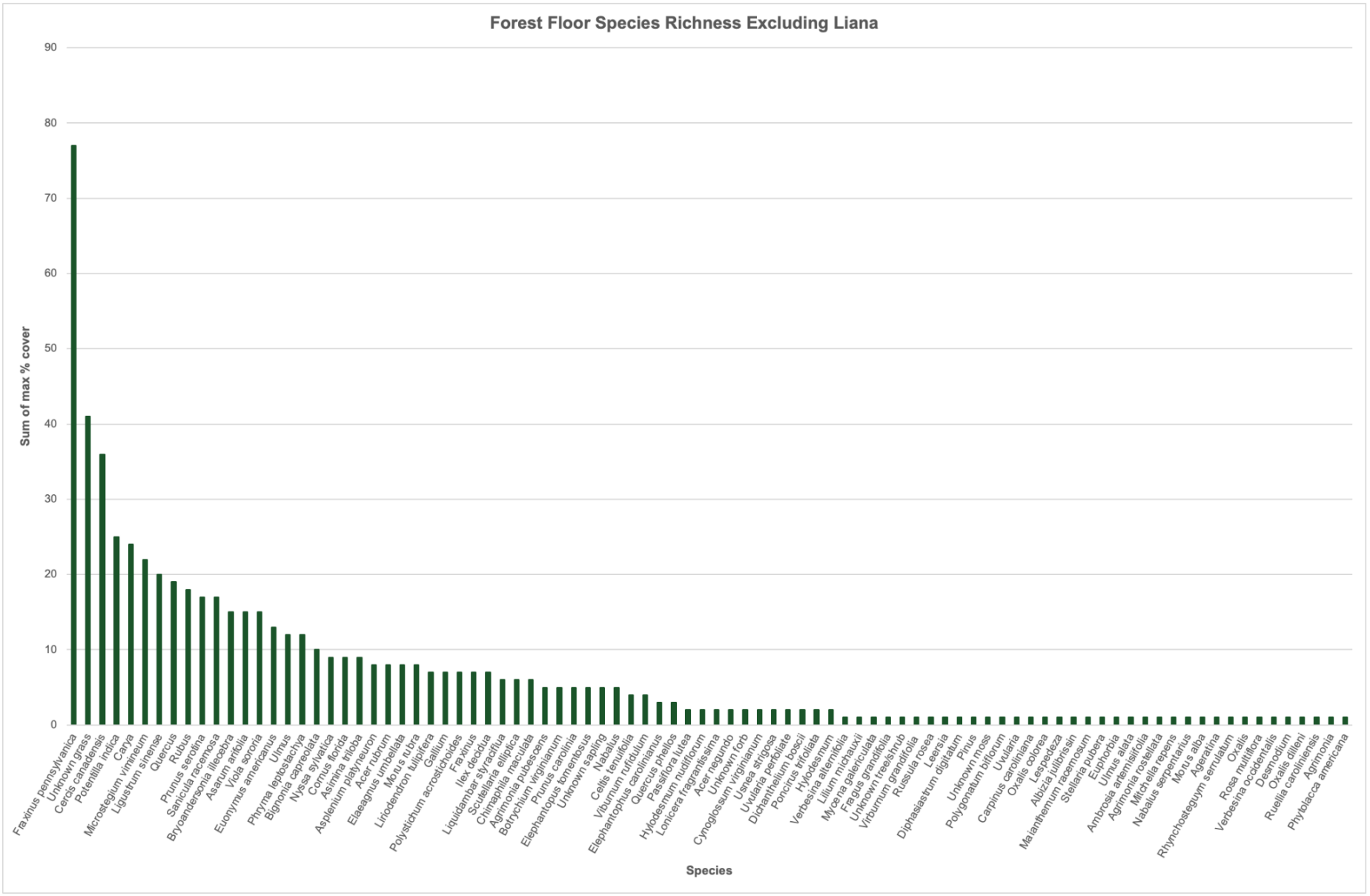


Fig 4. Species richness distribution using sum max percent cover for the forest floor level excluding vines.

Non-native Species

Non-native and invasive species have been a source of concern at Fisher Farm Park. For example, some management effort has already been applied to reducing the population of Autumn Olive at the park. Determining the threat posed by individual non-native species depends heavily on preferred outcomes and individual stakeholder values. As a result, different values may lead to differences in desired management strategies. This section is intended to provide information to assist in that determination in order to inform future management.

We documented a number of non-native species throughout the forest patch, some of which are considered invasive and many of which are naturalized in the area or very rare. While some may be the target of future management efforts depending on stakeholder goals, we did not document many cases of invasive species forming monocultures or obviously suppressing biodiversity. The two most abundant invasive species are discussed below (*see Appendix F for more information on other non-native species we documented).*

Autumn Olive was introduced to the Southeastern U.S. for erosion control and as forage for wildlife, and it produces fruits that are highly nutritious and even edible to people. It grows quickly in dense thickets and is known to outcompete native species through its resilience to disturbance and ability to fix nitrogen in poor soils. As with all thicket-forming shrubs, the plant will shade the forest floor and prevent growth. It is considered invasive for these reasons. **However, despite it being the fourth most abundant species at 7% cover (*see Figure 5 below)*, we did not find evidence of it outcompeting other species at the shrub level, such as small native hardwoods.** We also did not see many Autumn Olive thickets in the surveyed patch.

To further investigate whether Autumn Olive was impeding understory growth, we looked for an inverse relationship between Autumn Olive and forest floor plant cover. For Autumn Olive plants that were small enough to be counted in our shrub surveys, we did not find a significant decrease in herbaceous growth on the forest floor. This may be due to the closed canopy having a greater effect on light levels. This is supported by our observation that herbaceous growth decreased when Autumn Olive was large enough to be counted in the tree surveys (*see Figure 8 in Appendix F). For specific recommendations regarding Autumn Olive management, see the Recommendations section.*

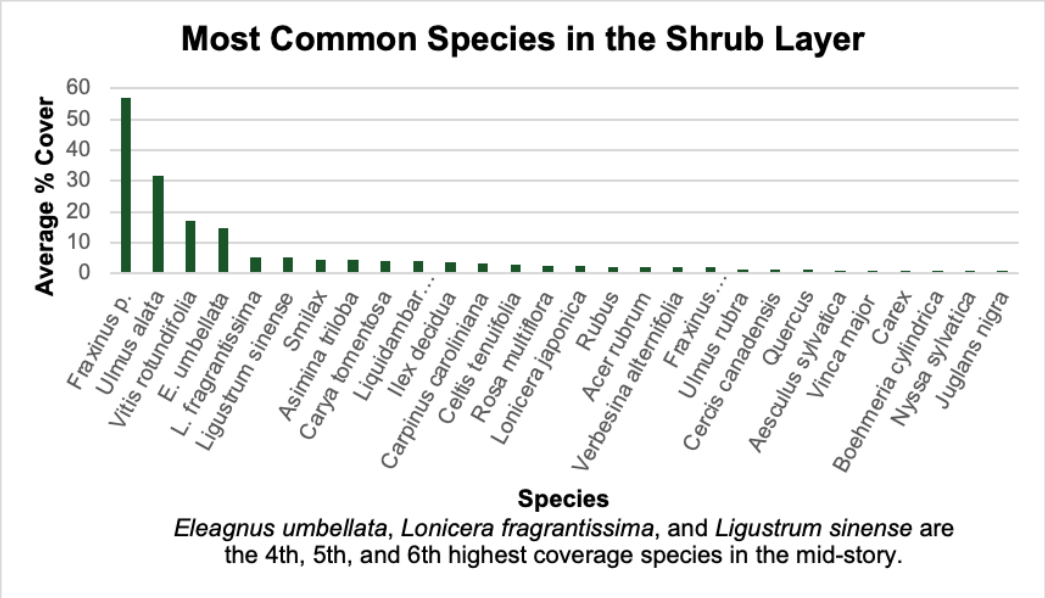


Fig 5. Most common species in the shrub layer

Japanese Honeysuckle is a woody vine that is also considered to be highly invasive. It outcompetes other species for nutrients, water, and sunlight. It is a common forage plant for deer, especially during the winter, and the flowers and berries are eaten by birds and rabbits. **Japanese Honeysuckle is widely present at Fisher Farm and makes up about 7% of all forest floor plants in the forest patch.** Important context while assessing the threat posed by this species is the presence of native vines in the same area. **11 out of the 14 vine species we identified were native, three of which were more abundant than Japanese Honeysuckle** (*see Appendix E Figure 7 for more information)*. Additionally, Japanese Honeysuckle was only the fifth most common of the eight vine species we found growing on trees.

It is worth noting that there are higher levels of invasive species on the outside edge of the forest patch, which we did not survey but did observe during our work. These species include Lesser Periwinkle (*Vinca minor*), Multiflora Rose, Japanese Honeysuckle, and others. Management of species on the outside edge is more likely to be easier than in the interior and would help prevent further ingress. Managing Japanese Honeysuckle is unlikely to be successful, though keeping some may be beneficial if providing forage for deer is an interest.

Wildlife Value

Elm, Cedar, and Sweetgum are the most common trees in the forest patch. These types of hardwoods provide valuable habitat and food for some small birds and insects. **However, they do not produce high protein hard mast such as acorns and nuts that are preferred by deer, large birds, and other small mammals.** Trees that do produce acorns and nuts include Oaks, Hickories, and Beech, all of which are relatively less abundant in the forest patch. While all trees provide resources for other species, the relative lack of mast-producing trees indicates a potential for improving the wildlife value of the forest stand, depending on which types of

wildlife are considered priorities. If a management goal is to support a higher number and a wider range of wildlife, then the forest could be managed to **increase the production of trees with high mast value** (*see Recommendations*).

Additionally, the low coverage of herbaceous growth on the forest floor caused by the low light levels is diminishing their utility to wildlife. Having abundant herbaceous growth provides important habitat for most species of birds and small mammals. Managing the forest stand to promote herbaceous growth would be useful if supporting these wildlife is a priority.

Table 3. Wildlife value of common trees found at Fisher Farm

Wildlife Value of Most Abundant Trees (Adapted from Harper, 2020)			
Species	**Relative Abundance (# of Individuals)**	**Mast Value**	**Wildlife Utilization**
Elm	29%	Low	- Deer (browse) - Birds, Squirrels (seeds & flowers)
Eastern Red Cedar	10%	Low/Medium	- Birds (berries & habitat)
Sweetgum	10%	Low	- Birds (seeds)
Ash	10%	Low/Medium	- Birds (seeds)
Oak	6%	High	- Acorns widely consumed
American Beech	5%	Medium/High	- Beechnuts widely consumed
Hickory	5%	Medium/High	- Squirrels, Bear (nuts)
Tulip Poplar	4%	Low	- Birds (cavity nesting)
American Hornbeam / Musclewood	2%	Low	- Minimal value to wildlife
Flowering Dogwood	2%	Medium	- Birds (drupes)

Stakeholder Survey

Our team is conducting ongoing surveys at Fisher Farm. We posted survey signs in July 2023 at Fisher Farm and are receiving responses from visitors. Our main goal for these surveys is to collect information from visitors about their use of the site, values held by the community about natural spaces and biodiversity, and perceptions of management practices. We can better understand and manage stakeholder values once the surveys are completed and analyzed. This may change some management recommendations down the road, but all recommendations listed below are based on our current knowledge.

Recommendations

Our surveys and assessments of the mixed hardwood forest patch at Fisher Farm show that there is high biodiversity but low evenness, meaning there are few very abundant species and many rare species. The biggest weaknesses are the abundance of young and small trees, low light levels into the forest, low forest floor coverage, and a lack of valuable wildlife trees in the canopy. Using the different management techniques that are outlined below, this habitat can become more diverse and robust to support a variety of species.

Forest Stand Density

The density of the forest stand is our primary concern for Fisher Farm. We suggest that management should focus on addressing the low sunlight levels in the understory and the high density of small trees throughout the forest patch, each of which portends the potential for decreased diversity.

If increasing herbaceous growth and promoting plant diversity in the forest patch is a goal for managers, we recommend decreasing the density of small trees, specifically Ash and Elm. We propose two possible approaches to achieving this goal:

- A low intensity burn would achieve two outcomes. First, it would help eliminate many small trees without harming mature trees, opening up the midstory. Second, fire would reduce leaf litter and promote germination of the seed bank, further promoting forest floor diversity.
- Manual killing of small trees can be accomplished by cutting stems and treating stumps with an herbicide, through the hack-and-squirt or cut-and-paint methods. This would provide some of the same benefits as a prescribed burn, but would not reduce leaf litter.

See Appendix B for specific information on Green Ash abundance.

If addressing the low sunlight levels is of interest, we recommend thinning some abundant mature trees such as Sweetgum and Tulip Poplar in order to increase light infiltration into the forest patch and result in increased herbaceous growth, if desired. Felling and/or killing these trees with relatively low wildlife value can also help support the wildlife population by reducing competition around high producing trees. Alternatively, killing a few large trees via hack and squirt and leaving the trees standing would provide the same benefits while also creating habitat for insects and cavity-nesting birds. Finally, thinning around large Oaks and some Hickory and

Beech individuals can allow their hard mast-producing canopies to spread out and become more productive.

If taking action such as described above, consideration should be given to the effects of increased sunlight levels on the shrub species. With canopy trees felled/thinned, there is a potential for an increase in the density of shrubs to the extent that the forest floor continues to be blocked from receiving sufficient levels of sunlight. This concern is primarily for particularly resilient species of shrubs - see Autumn Olive recommendations below.

Autumn Olive Management

We consider Autumn Olive to be a moderate threat to plant diversity in the forest patch at Fisher Farm. However, completely and permanently eradicating Autumn Olive is not an achievable goal due to the species' ability to both quickly resprout and become regularly reintroduced by birds who spread its seeds.

Determining the proper management approach of Autumn Olive depends on the desired management outcome. If maintaining overall biodiversity is the primary goal, then Autumn Olive does not need to be aggressively controlled but rather can be routinely managed in order to control its abundance. In contrast, if Autumn Olive is considered a threat solely because of its status as a non-native species (e.g. if an entirely native forest patch is desired), then more aggressive management may be considered. Alternatively, if managing specifically for wildlife value, Autumn Olive provides fruit for birds and small mammals and midstory habitat cover. As long as this species is prevented from forming dense thickets through standard management, it may not be a significant threat to biodiversity of the habitat.

If controlling Autumn Olive is a desired management goal, a combination of cutting and herbicide application (such as hack-and-squirt or cut-and-paint) would be required. One potential concern is that any removal utilizing machinery could cause damage to the forest floor and shrub communities and risk doing more harm than good, including creating disturbance that could promote the spread of other invasive species into the forest patch. Regardless of the preferred management outcome, a complete and permanent eradication of Autumn Olive is not possible or necessary for promoting a diverse forest stand that is supportive of both wildlife and people. Consistent management would be more practical and better suited for this.

Additional Findings - Farm Dump Sites

While surveying the forest patch, we found garbage and farming debris that could be an aesthetic concern. For aesthetic purposes as well as potential habitat enhancement, cleaning up the old equipment and debris could be beneficial.

Appendix

A. Tree Size by Species

The metric used in these surveys to record and assess tree size is Diameter at Breast Height (DBH). This is a measurement taken in centimeters and measured approximately 1.5 meters off of the ground.

- A tree with a DBH between 0 and 2 will be smaller than thumb-sized.
- A DBH between 5 and 10 will be about hand-width.
- Once trees reach 10cm in diameter, they are typically considered canopy trees.
- A tree with a DBH over 50 cm is one that will be difficult to wrap your arms around and is considered a significantly large tree.

In accordance with the DBH standards listed above, Figure 6 shows the tree size range of various species in both the canopy and understory for comparison between species. This further emphasizes the abundance of small Elms (*Ulmus*) and Ash (*Fraxinus)* as well as Oaks (*Quercus)* and Sweetgums *(Liquidambar)* as the larger trees occupying the canopy.

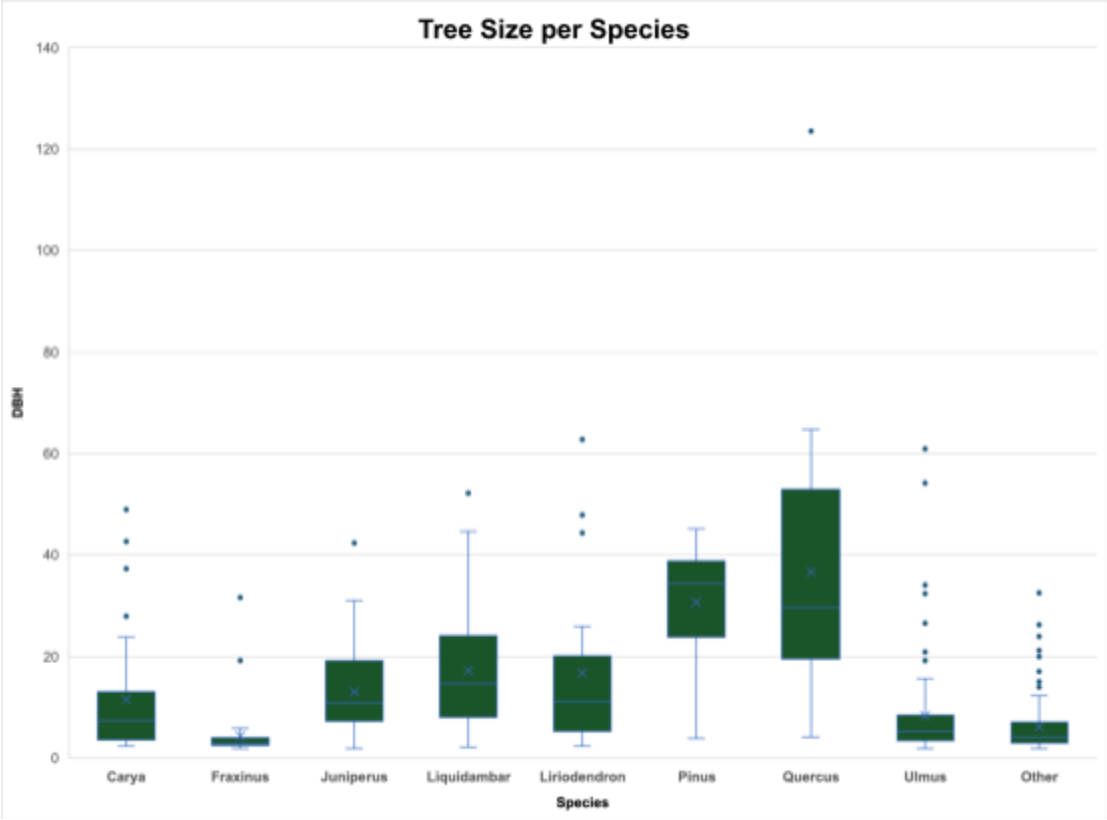


Fig 6. Comparison of tree size based on DBH between various species demonstrating Oaks, Sweetgums, and Tulip Poplar as some of the larger, canopy species.

B. Abundance of Green Ash

The dominance of Green Ash (*Fraxinus pennsylvanica*) is a cause for concern due to the threat of the Emerald Ash Borer (EAB). Survey sections 1 and 2 are the locations where Green Ash trees are the most abundant. In these two sections, Green Ash makes up about 65% of all plants in the shrub layer. It is highly likely that the majority of these trees will be affected by the EAB and die before reaching maturity, leaving sections of the survey plot without other tree species entering the future canopy. Unfortunately, there are very few resources or treatment options for protecting ash trees in a forest stand from EAB. One management option to address this concern would be to prioritize the diversity of small tree species by thinning the small Ash trees to allow other saplings to thrive more readily. Promoting tree diversity in these sections would be proactive to ensuring a healthy mature tree community in the future.

C. Shrub Cover

The metric to record shrub cover was a visual estimation of the amount of space a species took up within a 25 square-meter plot. The average shrub cover over the whole forest patch was 27.03%. Overall there was a wide range of coverage section to section. This information has implications if the overstory is to be thinned.

Table 4. Average percent cover at the shrub level for the overall site and each transect/section.

Location	**Average Shrub % Cover**
Whole Site	27.03%
Section 1	36.4%
Section 2	28.4%
Section 3	39.6%
Section 4	18.8%
Section 5	16.6%
Section 6	27.4%
Section 7	22%

D. Light Levels Methodology

We measured light levels using a Spot-On Quantum PAR light meter in “Scan” mode. The light measurements were taken on a sunny day around 1:00 pm. For the measurements taken inside of the forest patch, two readings were taken in each area and averaged together. The open field

light measurement was taken to get an understanding of what 100% sunlight is, this was taken at the field adjacent to the forest patch.

E. Further Information on Forest Floor Cover

To further emphasize the dominance of vines, see Figure 7, a species richness chart of just vines and their average percent cover across the entire forest plot site. There are 14 species of woody vines present in the area, with high coverage of Crossvine, Virginia Creeper, Muscadine, Greater Periwinkle, and Japanese Honeysuckle.

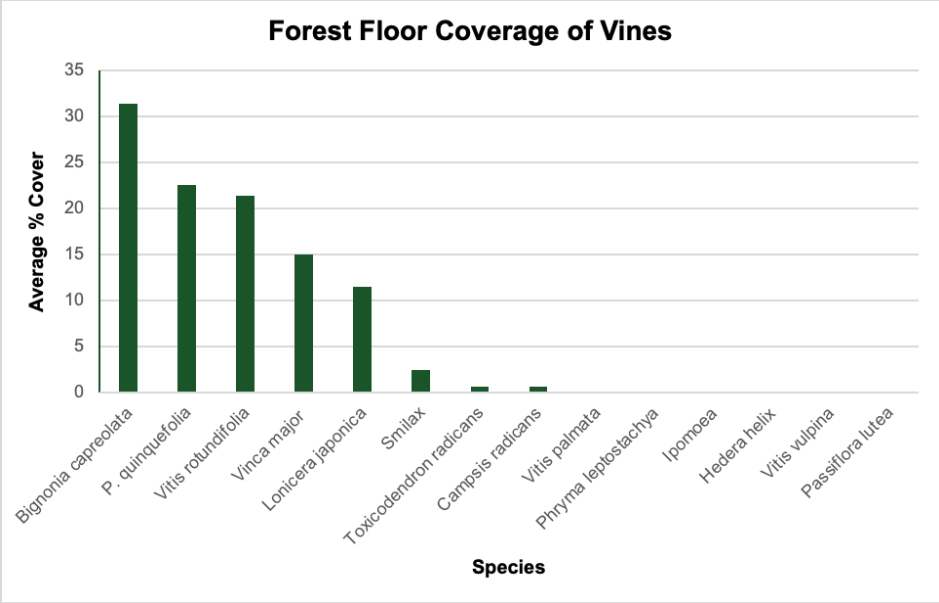


Fig 7. Species richness of woody vines at the Fisher Farm forest patch.

F. Further Information on Non-native Species

As discussed in the report, Autumn Olive is one of the more prominent species at Fisher Farm. We did see a negative correlation (Figure 8) between Autumn Olive presence at the shrub level and forest floor coverage in this area.

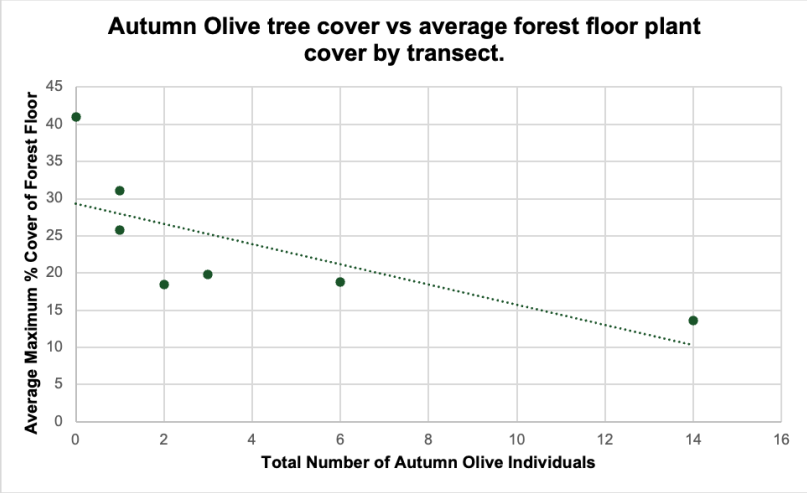


Fig 8. Autumn olive tree cover correlation to forest floor cover.

A detailed listing of all the non-native species recorded at the forest patch and in which sections can be found in Table 5. This emphasizes the low appearance of many of these species while others may be present at all sites. Further information on Winter Honeysuckle, Chinese Privet, Multiflora Rose, and Greater Periwinkle can be found below.

Table 5. All non-native species present in the forest patch and which sections the species were present in.

Species	**Section(s) Present**
Autumn Olive (*Elaeagnus umbellata*)	All
Chinese Privet (*Ligustrum sinense*)	1, 2, 3, 4, 5, 7
English Ivy (*Hedera helix*)	2
Flowering Viburnum (*Virburnum grandiflorum*)	6
Golden Raintree (*Koelreuteria paniculata*)	6
Greater Periwinkle (*Vinca major*)	6
Japanese Honeysuckle (*Lonicera japonica*)	All
Japanese Privet (*Ligustrum japonicum*)	3
Japanese Stiltgrass (*Microstegium vimineum*)	2, 3, 4
Mimosa/Silk Tree (*Albizia julibrissin*)	1
Mock Strawberry (*Potentilla indica*)	1, 2, 3, 4, 6
Multiflora Rose (*Rosa multiflora*)	2, 3, 4, 5, 7
Trifoliate Orange (*Poncirus trifoliata*)	1, 3
White Mulberry (*Morus alba*)	1, 4, 6, 7
Winter Honeysuckle (*Lonicera fragrantissima*)	2, 4, 6, 7

Winter Honeysuckle (*Lonicera fragrantissima*) is a flowering shrub honeysuckle native to China and introduced to the U.S. to be ornamental and wildlife habitat. It is considered invasive across the Southeastern U.S. and is easily spread by birds and other wildlife. It can easily invade forests and form dense thickets. It is a valuable plant for pollinators, birds, and small mammals. It is currently in four out of the seven sections.

Privets are considered highly invasive shrubs and small trees that form dense thickets and outcompete native plant species. Chinese Privet (*Ligustrum sinense*) was introduced in the 1800s as an ornamental plant and is now widespread across the Southeastern U.S.

Multiflora Rose (*Rosa multiflora*) is found throughout the Eastern U.S. and is considered an invasive plant and noxious weed. It can outcompete other species and poses a threat to native biodiversity. At Fisher Farm, Multiflora Rose is found in most sections of the study site but is not very common compared to other shrub species. It does not appear to be outcompeting other species or forming dense thickets.

Greater Periwinkle (*Vinca major*) is present in one dense patch within Section 6 of the forest plot. Greater periwinkle has a sum percentage of 15% on the forest floor, which is the greatest of any invasive species. Although greater periwinkle is currently isolated to section 6 there is a chance it may spread, actions to prevent the spread of it and allow for more biodiversity can be taken (see recommendations).

Other species: while there are other non-native species present, none are abundant enough to present as a threat to the integrity of the overall biodiversity.

G. Deer Forage

White-tailed deer is one of the main large wildlife species present at Fisher Farm. Many of the top forage species for deer are present in the forest patch. Virginia Creeper, Muscadine Grape, and Japanese Honeysuckle are the top three species present for deer forage at this site. These are also all within the top five forest floor herbaceous cover species, meaning that deer have a good amount of food resources within this forest patch site. While the abundance of woody vines is supporting the deer population, deer may eat up to 600 different species of plants and require a diverse population of plants to support all of their nutritional needs. Reference Figure 6 below for the full breakdown of top forage species and their abundance at the forest patch.

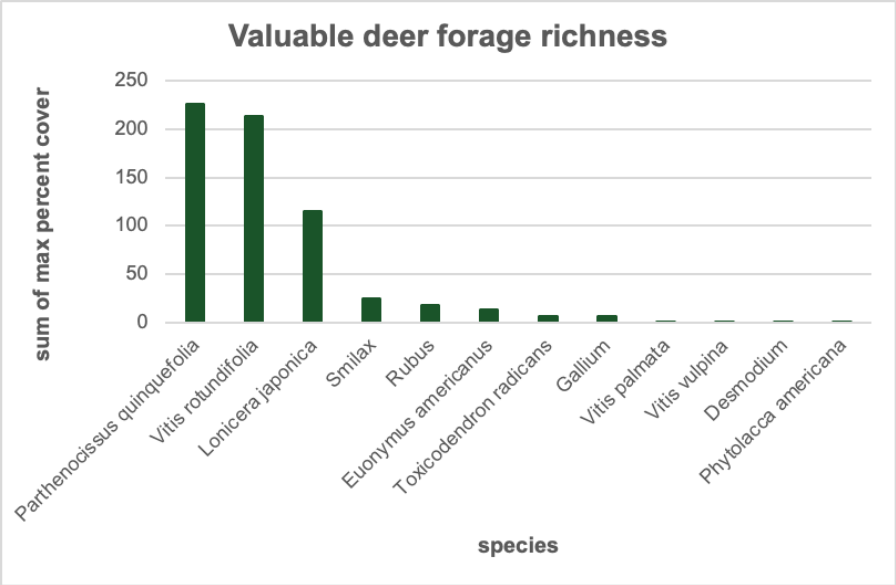
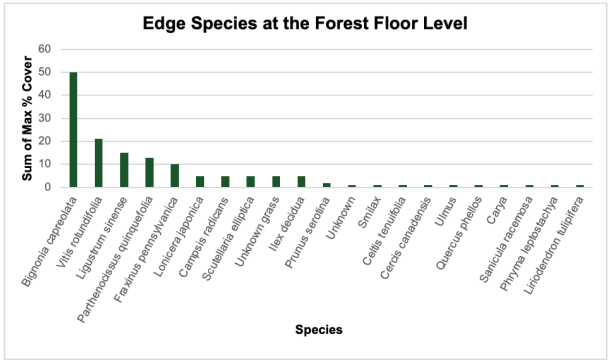
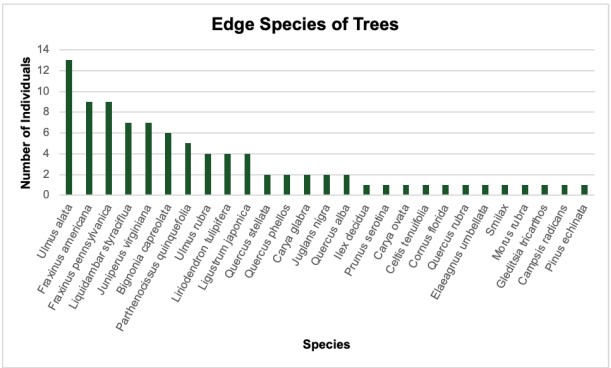


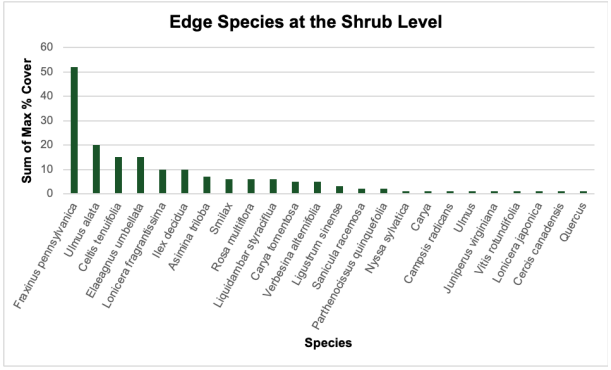
Fig 9. Valuable deer forage species and their sum of coverage at the Fisher Farm forest patch.

H. Edge Species

As expected with a patch of forest, there are significant differences between the species found in the edge of the forest and throughout the rest of the site. These figures show the abundance of species found within the first ten meters of each of our transects. Crossvine (forest floor), Green Ash (shrub), and Winged Elm (tree) abundance indicated at the edge is consistent with what we found within the forest.







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