



Sanford Natural Area

Bio-Inventory Report

Submitted to
MSU Campus Natural Areas Classroom, Curriculum and Conservation
Committee Submitted August 2021 by Matthew Peña

Executive Summary and Recommendations

Sanford Natural Area is an excellent representation of a mature southern mesic forest. There is a high diversity of both woody and herbaceous species present, and it is one of the most species-rich natural areas on Michigan State University's campus. During this survey, we identified a total of 78 species: 65 native species, and 13 non-native. This natural area is characterized by its diverse and healthy mesic/upland sites while also having lots of area of quality wetlands within the forest. These wetlands, however, contain a much higher volume of invasive species than the upland areas, and they need to be controlled in order to maintain the health of the wetlands. The most notable of these invasive species is a dense colony of oriental bittersweet (*Celastrus orbiculatus*) present along the northern edge of the natural area. It has completely taken over the small area it currently inhabits, and needs to be taken care of soon before it continues to spread. Another threat to the health of the forest is the high amount of human interference observed within the natural area. There is plenty of evidence of people tampering with trees by spray painting them or carving into their bark. Additionally, there is some trash scattered across the forest floor and a large hole cut into the fence near one of the entrances.

Sanford has proven to be a very important natural area to Michigan State University in terms of biodiversity, leisure, teaching, and research. Its well-kept trails provide lots of opportunity for people to walk and enjoy the forest, and the high species richness allow for great opportunities for ecology-based professors to both teach and perform research. Its close relationship and service to the community opens up great opportunities for volunteerism, as

community service projects to remove invasive species could be done here. However, regardless if community service is integrated or not, invasive species management must be done here to preserve one of the most important and high-quality natural areas at Michigan State University.

Recommendations

1. Work to remove the invasive species, especially the oriental bittersweet patch.
2. Use volunteers and community service events to remove both invasive species and trash within the natural area.

Forest Inventory

Overstory

In total, we encountered 22 species of trees in the overstory (>4" dbh) at Sanford Natural Area; 14 of these were observed in our fixed-area plots and 8 of them were seen on our walking survey of the forest. The living overstory trees (>4" dbh) at Sanford had a total basal area of 136.6 ft² ac⁻¹ and a stem density of 121.5 trees per acre. Sugar maple (*Acer saccharum*) was by far the most important overstory tree species due to it having the highest relative dominance, relative density, and relative frequency of any species that we encountered within our plots (Table 1). The only other tree species that occurred somewhat frequently was American beech (*Fagus grandifolia*) which had the second highest relative dominance, density, and frequency. Each of the other species were all observed fairly sparsely. In descending order of importance, the remaining overstory tree species we found within our fixed-area plots are: red oak (*Quercus rubra*), basswood (*Tilia americana*), black maple (*Acer nigrum*), silver maple (*Acer saccharinum*), white oak (*Quercus alba*), sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), northern hackberry (*Celtis occidentalis*), bitternut hickory (*Carya cordiformis*), chinkapin oak (*Quercus muehlenbergii*), ironwood (*Ostrya virginiana*), and musclewood (*Carpinus caroliniana*). In addition to the overstory species we observed within our plots, we also observed 8 species in the overstory of Sanford during our walking survey of the forest: black locust (*Robinia pseudoacacia*), boxelder maple (*Acer negundo*), eastern cottonwood (*Populus deltoides*), eastern hemlock (*Tsuga canadensis*), green ash (*Fraxinus pennsylvanica*), shagbark hickory (*Carya ovata*), Siberian elm (*Ulmus pumila*), and white mulberry (*Morus alba*).

Table 1. Overstory Stand Composition. Relative dominance is the percentage of the total stand basal area made up by each species, relative density is the percentage of total individuals and relative frequency is the percentage of plots in which a species was found. Importance Value (IV) is a summary statistic that averages across relative dominance, density and frequency.

Species	Rel. Dominance	Rel. Density	Rel. Frequency	IV
American Beech	12.9	13.4	33.3	19.9
Basswood	2.6	3.0	14.8	6.8
Bitternut Hickory	0.1	0.6	3.7	1.5
Black Cherry	1.3	0.6	3.7	1.9
Black Maple	1.0	3.0	11.1	5.1

Chinkapin Oak	0.2	0.6	3.7	1.5
Ironwood	0.1	0.6	3.7	1.5
Musclewood	0.1	0.6	3.7	1.5
Northern Hackberry	1.0	0.6	3.7	1.8
Red Oak	7.3	2.4	14.8	8.2
Sassafras	4.3	1.2	3.7	3.1
Silver Maple	5.1	1.2	7.4	4.6
Sugar Maple	59.5	70.7	96.3	75.5
White Oak	4.5	1.2	7.4	4.4

Understory

Based on our inventory plots, we estimate that there are about 1370.4 trees per acre in the sapling layer (at least 4.5 feet tall and a dbh less than 4") at Sanford Natural Area. This understory class is overwhelmingly dominated by sugar maple saplings, as they have the highest relative density by a large margin, and were observed in 89% of our plots (Table 2). The next most abundant species was white ash (*Fraxinus americana*), although its relative density was only 12.2 - nothing significant compared to sugar maple's 74.3 relative density. Despite there being 16 total species observed in the understory, the remaining 14 species all have very low relative densities (black cherry has the highest with 2.9) as well as very low relative frequency rates (black cherry is also the highest here with it having appeared in 18.5% of our plots). These remaining 14 species are: American beech, American elm (*Ulmus americana*), amur honeysuckle (*Lonicera maackii*), bitternut hickory, black cherry, black maple, bladdernut (*Staphylea trifolia*), border privet (*Ligustrum obtusifolium*), ironwood, leatherwood (*Dirca palustris*), multiflora rose (*Rosa multiflora*), sassafras, spicebush (*Lindera benzoin*), and witch hazel (*Hamamelis virginiana*).

Table 2. Composition and size class distribution of the sapling layer in Sanford Natural Area. Relative density and relative frequency for each species are expressed as a percentage of the total number of saplings, whereas individuals within each sapling size class are expressed as trees per acre.

Species	Rel. Dens.	Rel. Freq.	1" TPA	2" TPA	3" TPA	4" TPA
American Beech	1.4	14.8	11.1	0	0	7.4
American Elm	0.3	3.7	3.7	0	0	0
Amur Honeysuckle	0.5	3.7	7.4	0	0	0
Bitternut Hickory	0.3	3.7	3.7	0	0	0
Black Cherry	2.9	18.5	37.0	0	3.7	0
Black Maple	0.8	3.7	0	7.4	3.7	0

Bladdernut	0.8	7.4	11.1	0	0	0
Border Privet	2.7	7.4	37.0	0	0	0
Ironwood	0.3	3.7	0	3.7	0	0
Leatherwood	0.5	3.74	7.4	0	0	0
Multiflora Rose	0.8	3.7	11.1	0	0	0
Sassafras	0.5	3.7	0	3.7	3.7	0
Spicebush	1.4	14.8	18.5	0	0	0
Sugar Maple	74.3	88.9	885.2	62.9	37.0	33.3
White Ash	12.2	40.7	144.4	22.2	0	0
Witch Hazel	0.3	3.7	3.7	0	0	0

Regeneration Layer

We observed 11 tree species regenerating in the seedling layer (<4.5 feet tall) at Sanford: American beech, basswood, bitternut hickory, black cherry, black maple, ironwood, northern hackberry, red oak, sassafras, sugar maple, and white ash. Sugar maple seedlings were overwhelmingly dominant as they were observed in 96.3% of our plots with an average coverage percentage of 53%. While each of the other species were observed with very low average coverage percentages, many still occurred somewhat frequently. White ash was regenerating in over half of our plots while bitternut hickory and black cherry were observed in roughly a quarter of our plots. American beech was also observed in a little under a quarter of our plots. The remaining species were all seen fairly sparsely throughout our plots.

Table 3. Coverage and relative frequency of tree species in the seedling layer. Coverage is an estimate of the ground area of the plot covered by that species and relative frequency is the percentage of plots in which that species was found.

Species	Average % Coverage	Rel. Frequency
American Beech	2.5	22.2
Basswood	2.5	11.1
Bitternut Hickory	2.5	25.9
Black Cherry	4.3	25.9
Black Maple	2.5	7.4
Ironwood	2.5	7.4
Northern Hackberry	2.5	3.7
Red Oak	2.5	3.7
Sassafras	2.5	3.7
Sugar Maple	53.2	96.3

White Ash	6.9	51.9
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Stand Condition, Snags, and Coarse Woody Debris

All of the inventoried overstory trees were assigned to one of three Risk Classes based on structural integrity and evidence of disease/pest issues: RC1 = very low probability of dying during the next 20 years, RC2 = moderate probability of dying over the next 20 years, and RC3 = high probability of dying over next 20 years. Of the total basal area of 136.6 ft² ac⁻¹, 87% (118.2 ft² ac⁻¹) was in Risk Class 1 trees, 9% (13 ft² ac⁻¹) was in Risk Class 2, and 4% (5.4 ft² ac⁻¹) was in Risk Class 3. On an individual tree basis, 91% (111.1 trees per acre) were in Risk Class 1, 6% (7.4 trees per acre) were in Risk Class 2, and 3% (3 trees per acre) were in Risk Class 3 in the total 121.5 trees per acre. In addition to living trees, we found 7.4 standing dead (snags) trees per acre, which account for 11.5 ft² ac⁻¹. We observed 10 standing dead trees, 1 in decay class 1, 1 in decay class 2, 3 in decay class 3, 1 in decay class 4, and 4 in decay class 5.

Across the woodlot, we found an average of 47.5 m³ ha⁻¹ of coarse woody debris (CWD). Coarse woody debris was distributed across the woodlot with 17 of 27 plots having at least one piece of CWD. We observed 4 logs in decay class 2, 16 logs in decay class 3, and 12 logs in decay class 4. We did not observe any pieces of CWD in decay classes 1 or 5.

Forest Inventory Summary and Conclusions

While Sanford Natural Area is heavily dominated by sugar maple, it also contains a great representation of northern hardwood species across all 3 layers of the forest. This can largely be attributed to the variability in forest cover type and the fairly pristine condition, as the wetlands provide habitat for species such as silver maple, while the high quality ecosystem allows for species such as leatherwood and green dragon (*Arisaema dracontium*). However, as with many of the other woodlots on MSU's campus, the future of this natural area's high diversity could be in question due to the heavy dominance of sugar maple. The understory is the area of most concern, as we calculated just over 1,000 trees per acre of sugar maple saplings.

Botanical Assessment

Overall we found 78 different species of vascular plants in Sanford Woodlot (Table 4). Of the 78 species, 65 were native and 13 were non-native. Many of the native species have high C values, indicating that Sanford Woodlot has high quality native habitats. The species list overall resulted in a Floristic Quality Index (FQI) of 36.2 for Sanford Woodlot. The FQI measures the botanical quality of a site from a biodiversity conservation perspective, an FQI score less than 20 indicates that the site is of insignificant value in terms of plant biodiversity, a score greater than 35 indicates an important site for plant biodiversity, and a score greater than 50 indicates a site with outstanding plant biodiversity value.

Table 4. Listing of all vascular plants identified to species in and around Sanford Natural Area in July, 2021.

Scientific Name	Family	Native?	C	Form	Duration	Common Name
<i>Acer negundo</i>	Sapindaceae	native	0	tree	perennial	box-elder
<i>Acer nigrum</i> ; <i>a. saccharum</i>	Sapindaceae	native	4	tree	perennial	black maple
<i>Acer saccharinum</i>	Sapindaceae	native	2	tree	perennial	silver maple
<i>Acer saccharum</i>	Sapindaceae	native	5	tree	perennial	sugar maple
<i>Actaea pachypoda</i>	Ranunculaceae	native	7	forb	perennial	dolls-eyes
<i>Allium tricoccum</i>	Alliaceae	native	5	forb	perennial	wild leek
<i>Arctium minus</i>	Asteraceae	non-native	0	forb	biennial	common burdock
<i>Arisaema dracontium</i>	Araceae	native	8	forb	perennial	green dragon
<i>Arisaema triphyllum</i>	Araceae	native	5	forb	perennial	jack-in-the-pulpit
<i>Asarum canadense</i>	Aristolochiaceae	native	5	forb	perennial	wild-ginger
<i>Berberis thunbergii</i>	Berberidaceae	non-native	0	shrub	perennial	japanese barberry
<i>Boehmeria cylindrica</i>	Urticaceae	native	5	forb	perennial	false nettle
<i>Carex albursina</i>	Cyperaceae	native	5	sedg e	perennial	sedge
<i>Carex grayi</i>	Cyperaceae	native	6	sedg e	perennial	sedge
<i>Carex plantaginea</i>	Cyperaceae	native	8	sedg e	perennial	sedge
<i>Carex platyphylla</i>	Cyperaceae	native	1 0	sedg e	perennial	broad-leaved sedge
<i>Carpinus caroliniana</i>	Betulaceae	native	6	tree	perennial	blue-beech
<i>Carya cordiformis</i>	Juglandaceae	native	5	tree	perennial	bitternut hickory
<i>Carya ovata</i>	Juglandaceae	native	5	tree	perennial	shagbark hickory
<i>Caulophyllum thalictroides</i>	Berberidaceae	native	5	forb	perennial	blue cohosh

<i>Celastrus orbiculatus</i>	Celastraceae	non-native	0	vine	perennial	Oriental bittersweet
<i>Celtis occidentalis</i>	Cannabaceae	native	5	tree	perennial	hackberry
<i>Circaea canadensis</i> ; <i>c. lutetiana</i>	Onagraceae	native	2	forb	perennial	enchanters-nightshade
<i>Cornus alternifolia</i>	Cornaceae	native	5	tree	perennial	alternate-leaved dogwood
<i>Deparia acrostichoides</i>	Athyriaceae	native	6	fern	perennial	silvery spleenwort
<i>Dioscorea villosa</i> ; <i>dioscorea villosa</i>	Dioscoreaceae	native	4	forb	perennial	wild yam
<i>Dirca palustris</i>	Thymelaeaceae	native	8	shrub	perennial	leatherwood
<i>Dryopteris carthusiana</i>	Dryopteridaceae	native	5	fern	perennial	spinulose woodfern
<i>Dryopteris goldiana</i>	Dryopteridaceae	native	1 0	fern	perennial	goldies woodfern
<i>Epipactis helleborine</i>	Orchidaceae	non-native	0	forb	perennial	helleborine
<i>Euonymus obovatus</i>	Celastraceae	native	5	shrub	perennial	running strawberry-bush
<i>Fagus grandifolia</i>	Fagaceae	native	6	tree	perennial	american beech
<i>Fraxinus americana</i>	Oleaceae	native	5	tree	perennial	white ash
<i>Fraxinus pennsylvanica</i>	Oleaceae	native	2	tree	perennial	red ash
<i>Geranium maculatum</i>	Geraniaceae	native	4	forb	perennial	wild geranium
<i>Hamamelis virginiana</i>	Hamamelidaceae	native	5	shrub	perennial	witch-hazel
<i>Hydrophyllum appendiculatum</i>	Boraginaceae	native	7	forb	biennial	great waterleaf
<i>Hydrophyllum canadense</i>	Boraginaceae	native	7	forb	perennial	canada waterleaf
<i>Laportea canadensis</i>	Urticaceae	native	4	forb	perennial	wood nettle

Ligustrum obtusifolium	Oleaceae	non-native	0	shrub	perennial	border privet
Lindera benzoin	Lauraceae	native	7	shrub	perennial	spicebush
Lonicera maackii	Caprifoliaceae	non-native	0	shrub	perennial	amur honeysuckle
Lysimachia nummularia	Myrsinaceae	non-native	0	forb	perennial	moneywort
Maianthemum racemosum; smilacina r.	Convallariaceae	native	5	forb	perennial	false spikenard
Menispermum canadense	Menispermaceae	native	5	vine	perennial	moonseed
Morus alba	Moraceae	non-native	0	tree	perennial	white mulberry
Ostrya virginiana	Betulaceae	native	5	tree	perennial	ironwood; hop-hornbeam
Parthenocissus quinquefolia	Vitaceae	native	5	vine	perennial	virginia creeper
Persicaria virginiana; polygonum v.	Polygonaceae	native	4	forb	perennial	jumpseed
Pilea pumila	Urticaceae	native	5	forb	annual	clearweed
Polystichum acrostichoides	Dryopteridaceae	native	6	fern	perennial	christmas fern
Populus deltoides	Salicaceae	native	1	tree	perennial	cottonwood
Prunus serotina	Rosaceae	native	2	tree	perennial	wild black cherry
Prunus virginiana	Rosaceae	native	2	shrub	perennial	choke cherry
Quercus alba	Fagaceae	native	5	tree	perennial	white oak
Quercus muehlenbergii	Fagaceae	native	5	tree	perennial	chinquapin oak
Quercus rubra	Fagaceae	native	5	tree	perennial	red oak
Ranunculus hispidus	Ranunculaceae	native	5	forb	perennial	swamp buttercup
Ribes cynosbati	Grossulariaceae	native	4	shrub	perennial	prickly or wild gooseberry
Robinia pseudoacacia	Fabaceae	non-native	0	tree	perennial	black locust

Rosa multiflora	Rosaceae	non-native	0	shrub	perennial	multiflora rose
Sambucus racemosa	Adoxaceae	native	3	shrub	perennial	red-berried elder
Sanguinaria canadensis	Papaveraceae	native	5	forb	perennial	bloodroot
Sassafras albidum	Lauraceae	native	5	tree	perennial	sassafras
Smilax hispida; s. tamnoides	Smilacaceae	native	5	vine	perennial	bristly greenbrier
Solanum dulcamara	Solanaceae	non-native	0	vine	perennial	bittersweet nightshade
Solidago caesia	Asteraceae	native	6	forb	perennial	bluestem goldenrod
Solidago flexicaulis	Asteraceae	native	6	forb	perennial	zigzag goldenrod
Staphylea trifolia	Staphyleaceae	native	9	shrub	perennial	bladdernut
Taxus cuspidata	Taxaceae	non-native	0	tree	perennial	japanese yew
Tilia americana	Malvaceae	native	5	tree	perennial	basswood
Toxicodendron radicans	Anacardiaceae	native	2	vine	perennial	poison-ivy
Tsuga canadensis	Pinaceae	native	5	tree	perennial	hemlock
Ulmus americana	Ulmaceae	native	1	tree	perennial	american elm
Ulmus pumila	Ulmaceae	non-native	0	tree	perennial	siberian elm
Uvularia sessilifolia	Convallariaceae	native	5	forb	perennial	merrybells
Viburnum trilobum; v. opulus	Adoxaceae	native	5	shrub	perennial	american highbush-cranberry
Vitis riparia	Vitaceae	native	3	vine	perennial	river-bank grape

Invasive Species

Throughout Sanford Natural Area, we observed 13 non-native species in varying levels of invasiveness. Most of these species were not observed in high enough frequency to be problematic at the given moment, however oriental bittersweet (*Celastrus orbiculatus*) poses a serious threat to the natural area. It has completely taken over an area of forest along the Red Cedar River and will continue to spread if not taken care of soon. Border privet (*Ligustrum obtusifolium*) is another species that was observed fairly frequently, and while its threat to the

natural area is not nearly as much as oriental bittersweet's at the moment, natural area managers should keep an eye out for this species.

Figure 1. Image of oriental bittersweet (*Celastrus orbiculatus*) invasion and dominance, as it has fully taken over the tree in the image while forming a dense thicket beneath it and beyond.



Human Impacts

Trash, Structures or Other Human Disturbance

Given that this forest is surrounded by dorm halls and apartment buildings, there is lots of evidence of human activity within this forest. This includes evidence of people spray painting and carving into trees, creations of artificial dirt mounds, damage to the fence, and trash.

Figure 2. Examples of human activity at Sanford Natural Area: Spray paint and carving in a tree (top left), artificial dirt mounds (top right), a hole cut in the fence (bottom left), and trash (bottom right).



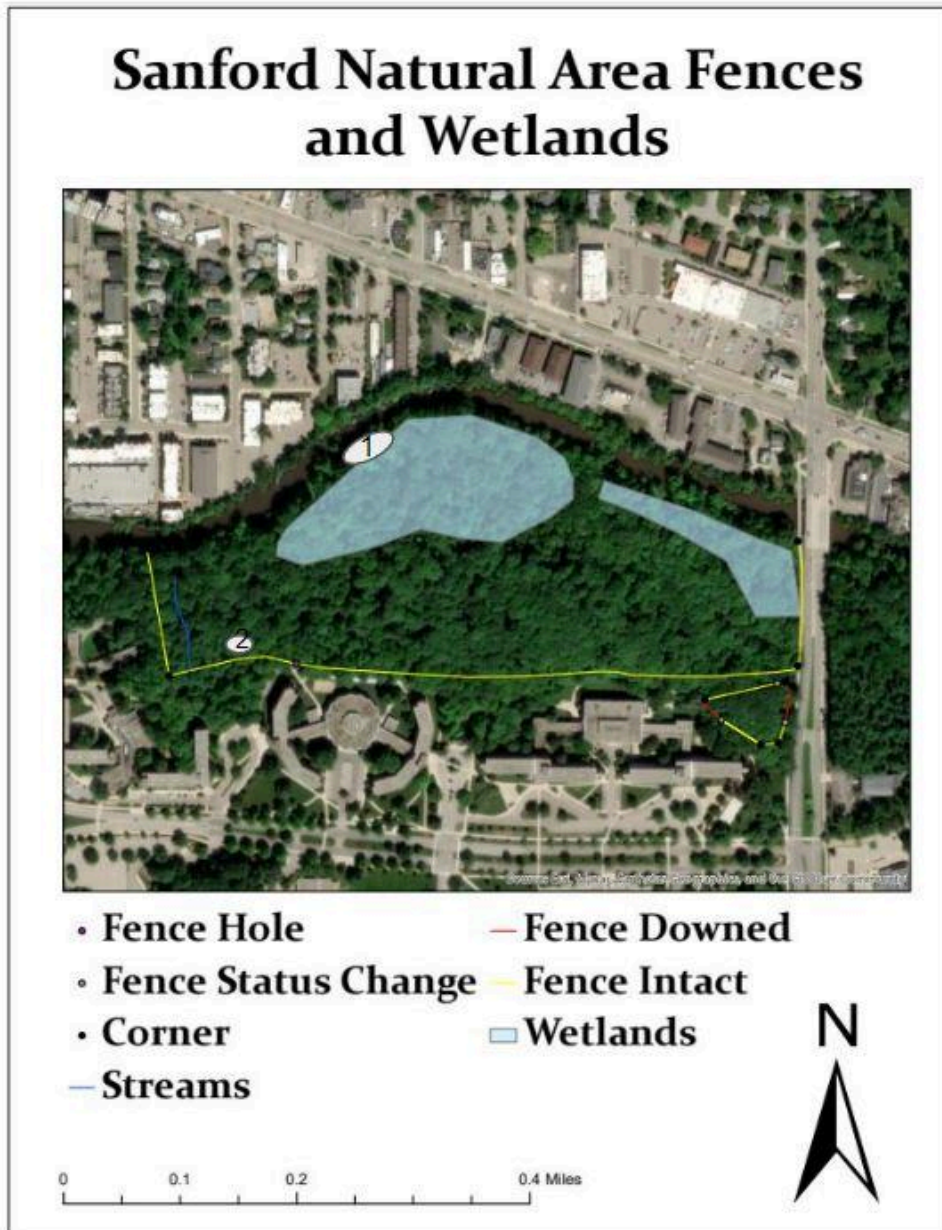
Boundary Issues

The majority of issues with the fence at Sanford Natural Area deal with the separated pocket of forest on the southeast side of the natural area. This section has many areas that are in need of new fences, as much of the fence has been toppled. In regards to the fence surrounding the main forest of the natural area, there is a small section on the western fence where the fence has been downed, and there is also a hole that someone cut along the southern fence.

Water Features

Much of Sanford Natural Area is a lower wetland that seasonally floods, as nearly the entire northern half of the natural area consists of this forest cover type. These wetlands are very important to the natural area as they have been observed to provide habitat for both wildlife species and unique plant species that don't grow in more upland forests that are common in the area.

Figure 3. Map of fence statuses, wetlands, and other important features identified within Sanford Natural Area.



1. Location of oriental bittersweet invasion front
2. Location of the two artificial mounds of dirt