Woodland Monitoring 2026

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Introduction

Woodlands were one of the most abundant ecosystem types present in Missouri prior to European settlement (Beerling and Osborne 2006). Today, woodlands are much less common throughout the state, as many have succeeded into forests due to fire suppression and lack of management. Though many different definitions of a woodland exist, they are typically classified as having 2-3 vegetation layers, 30-90% canopy closure, and a historical fire regime of low intensity fires every 3-5 years (Smith, 2004). Woodlands typically have less canopy cover and more understory dominance than a forest, but more canopy coverage and less understory dominance than a savanna (Smith, 2004).

Litzsinger Road Ecology Center (LREC) is a 39 acre restoration and education site in Ladue, Missouri that contains 14 acres of bottomland woodland habitat in the Deer Creek watershed. This woodland area is prone to disturbances from flooding and continuous input of invasive plant species from upstream sources. Due to the bottomland nature of this site, this property has a history of fire suppression prior to current management.

The LREC woodland understory was last monitored by LREC staff in 2006. The overstory was monitored separately in 2011. Since this time period, the area has undergone extensive treatment for invasive species such as *Euonymus fortunei* (wintercreeper) using foliar herbicide spray and *Lonicera mackii* (bush honeysuckle) using cut stump treatment. Additionally, each woodland unit is now burned on a three year rotation. Tree planting, plug planting, and broadcast seeding have also been used in restoration practices at LREC since the 1990s. Monitoring the plant community composition within LREC woodlands informs restoration coordinators of the effectiveness of these treatments, detects early plant invasions, and creates better understanding of ecological changes over time.

Research Questions

This study aims to better understand the following questions:

- What are the dominant species in each strata (overstory, midstory, understory) in the LREC woodlands?
- How does the species composition today compare to historical monitoring records?
- What is the average canopy cover percentage in the woodlands?

Methods

Plot Design

The woodlands were sampled using a nested plot design to incorporate the overstory, midstory, and understory. Seven plots were distributed evenly throughout both north woods (1 plot) and south woods (6 plots) units. Plots were located using an existing 15 meter x 15 meter grid system of permanent pins and rebar. One plot was located in every other row (row 22 was skipped due to time limitations). Plots were intentionally spaced out within each row to cover a wider diversity of areas. Many of the permanent pins were missing, which limited the areas

available for monitoring. The centerpoint of each plot is located 5 meters north of the corresponding pin.

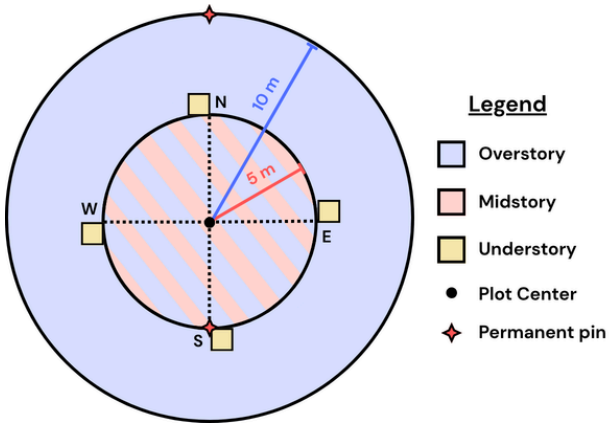


Figure 1. Woodland monitoring nested plot design

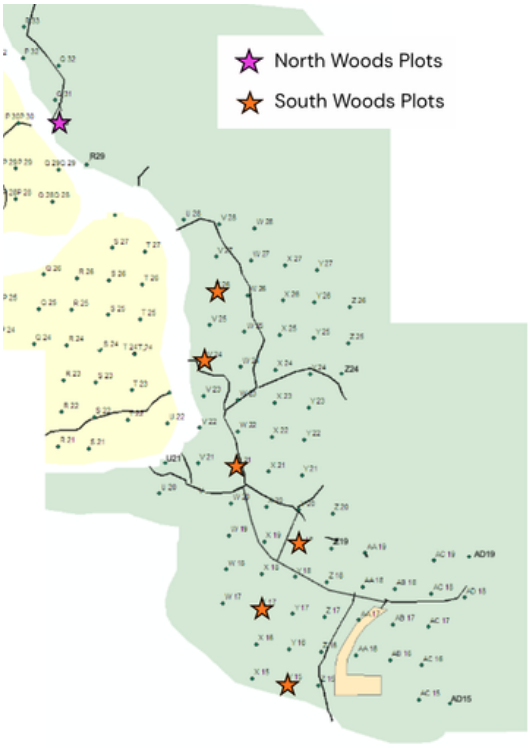


Figure 2. Map of woodland plot locations

Overstory

Species composition, canopy coverage, and size of overstory trees influence the community composition of both the midstory and understory in a woodland (Dey and Kabrick, 2015). Species and DBH are documented for all stems >10 cm DBH located within a 10m radius of the plot center. DBH and decay class (R = recent, B = broken, P = punky and rotten, D = down) are recorded for any snags or downed trees >10 cm DBH present.

Midstory

The midstory is one part of the multi-layered community structure in a woodland. Density and species composition of the midstory can impact diversity of the understory and a woodland's ability to recruit new overstory trees (Dey and Kabrick, 2015). DBH (cm) and stem count are recorded for all stems >1 meter tall and < 10 cm DBH located within 5 m radius of the plot center. If multiple stems are present on a plant, record the DBH of the largest stem only. All stems > 1 meter tall are included in the stem count. The midstory also includes secondary stems of overstory trees if they meet the size criteria specified above.

Understory

The species composition and vegetation abundance in the understory is significantly

impacted by the community structure above (Dey and Kabrick, 2015). More heliophilic (sun-loving) plants are less likely to occur in areas with high canopy coverage, and vice versa.

Four 0.25 square meter understory plots are located within each woodland plot, each 5 meters away from the centerpoint in each cardinal direction. All plots should be oriented to the left of the 5 meter point. If there is a major obstruction or the plot falls on a trail, the plot may be oriented to the right instead.

All plant species rooted within the understory plot are recorded, as well as their cover class (**1**: <1%; **2**: 1-5%; **3**: 5-25%; **4**: 25-50%; **5**: >50%). Total vegetation percent and ground cover type percentages (bareground, leaf litter, rock, downed woody debris, and non-vascular) are also recorded.

Canopy Coverage

A concave densiometer is used in each plot to measure the amount of light penetrating through the tree canopy. Densiometer measurements are recorded in the same location as each understory plot, with the viewer facing away from the plot center and holding the densiometer at chest height. A densiometer is used by dividing each square into four quadrants and counting the number of quadrants that reflect canopy, not sky. There are 96 quadrants in total.

Results

Overstory

The North Woods overstory contains *Juglans nigra* (30.8%), *Quercus macrocarpa* (23.1%), *Liquidambar styraciflua* (15.4%), *Quercus shumardii* (15.4%), *Liriodendron tulipifera* (7.7%), and *Platanus occidentalis* (7.7%) (Figure 2). The mean Coefficient of Conservatism (C-value) of the north woods overstory species is 4.83. The South Woods overstory is composed of *Celtis occidentalis* (30.8%), *Ulmus americana* (18.5%), and *Acer negundo* (16.9%), *Acer saccharinum* (12.3%), *Aesculus glabra* (10.8%), *Fraxinus pennsylvanica* (4.6%), *Asimina triloba* (3.1%), *Prunus serotina* (1.5%), and *Carya cordiformis* (1.5%) (Figure 3). The C-value of these species averages to be 3.22.

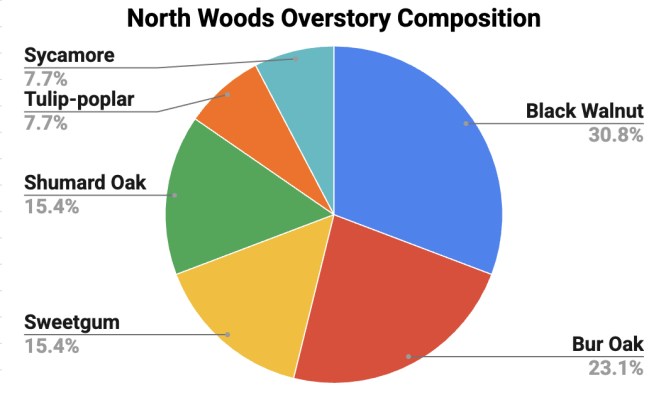


Figure 2. North Woods Overstory Composition.

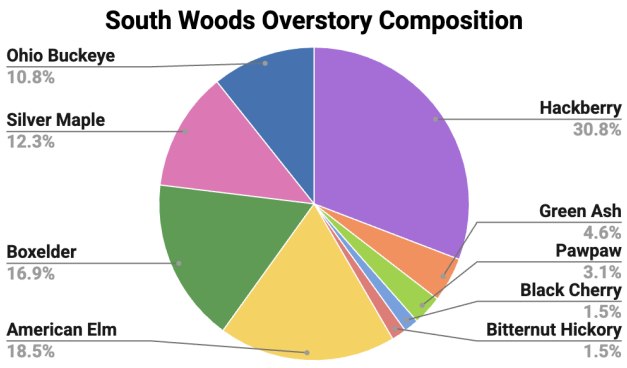


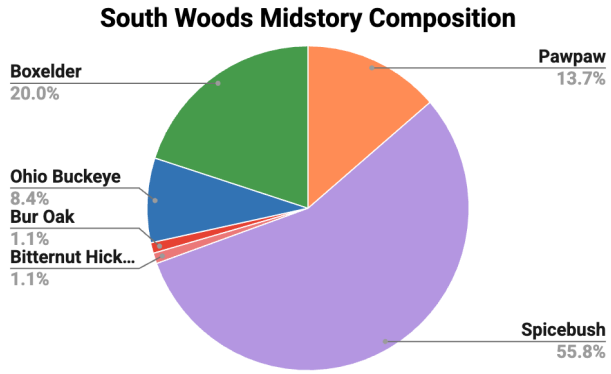
Figure 3. South Woods Overstory Composition.

Midstory

The most abundant species in the South Woods midstory were *Lindera benzoin* (55.8%), *Acer negundo* (20%), and *Asimina triloba* (13.7%) (Figure 4). The North Woods midstory

contained *Celtis occidentalis* (40%), *Platanus occidentalis* (20%), *Aesculus glabra* (20%), and *Quercus velutina* (20%) (Figure 5).

The North Woods midstory plot contained 258 stems per acre (SPA). SPA was calculated by multiplying the number of stems in each plot by an expansion factor of 51.53918. The South Woods midstory contained an average of 816 SPA (SD = 382.12). The maximum stem density recorded in the South Woods was 1340 SPA in plot Y19. The lowest stem density recorded was 361 SPA in plot V26.



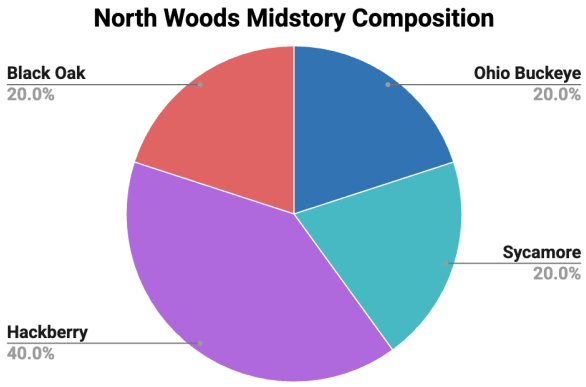


Figure 4. South Woods Midstory Composition

Figure 5. North Woods Midstory Composition

Understory

Across both woodland unit understories, a total of 52 unique taxa were observed (see appendix). Forty-three of these were native taxa. The mean C-value of all understory plants is 3.41 and the mean Floristic Quality Index (FQI) is 7.36. FQI was 9.85 in the north woods and 6.94 in the south woods.

Canopy Cover

The mean canopy cover across all woodland units was 87.54%. The north woods had slightly higher average canopy coverage (90.36%) than the south woods (87.07%).

Discussion

Overstory

The overstory composition varied significantly between the North and South woods units. The most abundant species in the North Woods unit were *Juglans nigra*, *Quercus macrocarpa, Liquidambar styraciflua*, and *Quercus shumardii*. Meanwhile, the South Woods area was dominated by *Celtis occidentalis*, *Ulmus americana*, and *Acer negundo*.

The North Woods contain more conservative overstory tree species than the South Woods. The *Quercus* species present in this area were planted, likely increasing the average C-value. The South Woods contain more diverse species count but lower average C-value. There were also more plots surveyed in the South Woods than the North Woods due to space. More plots in the North Woods are necessary for adequate comparisons.

Midstory

Midstory composition and density varied significantly between both woodland units and

individual plots. The average midstory density in the North Woods (258 SPA) was significantly lower than the average in the south woods (816 SPA). Even within the south woods, midstory density varied significantly by individual plot (SD = 382.12). Plots with the highest SPA density typically contained high abundance of *Asimina triloba* and/or *Lindera benzoin*.

This midstory is largely free of invasive woody shrubs such as *Lonicera mackii* that are often prevalent in Missouri woodlands and occasionally found in the woodland understory. This indicates that current management practices are effective at keeping these species at bay.

Understory

Of the 52 taxa observed in the understory, 82.69% were native. C-value was relatively consistent between woodland units (North Woods mean C-value = 3.42; South woods mean C-value = 3.41). However, FQI was greater in the north woods (FQI = 9.85) than the south woods (FQI = 6.94).

The south woods FQI has increased from 5.32 to 6.94 since the most recent survey in 2006. This indicates the success of management practices including prescribed burning, introduction of native species, invasive shrub removal, and foliar spraying of *Euonymus fortunei* over the past 20 years. Although *Euonymus fortunei* is still one of the most abundant taxa in the woodlands, it is less dominant than it was in previous surveys. The north woods plots surveyed in this study were not included in the 2006 survey and thus cannot be compared.

Canopy Cover

Woodland ecosystems are typically classified as having 30-90% canopy coverage (Nelson, 2004). The LREC woodlands average canopy coverage (87.4%) falls at the high end of this range. This site may be more productive than other woodland ecosystems due to propagule and nutrient input from the creek, leading to higher canopy coverage. Tree seedlings have also been planted in the woodlands for restoration, which may influence the canopy cover. Some sources note that understory vegetation can begin to resemble that of a forest at 80% canopy coverage or above (Dey and Kabrick, 2015). Because the current canopy coverage exceeds this range, additional canopy thinning may need to occur if restoration coordinators want to favor more heliophitic vegetation in the understory.

References

Beerling, D.J. and Osborne, C.P. (2006) The origin of the savanna biome, Global Change Biology, 12, 2023-2031. doi.10.1111/j.1365-2486.2006.01239.x

Dey, D. C., Kabrick, J. M. (2015). Restoration of midwestern oak woodlands and savannas. In: Stanturf, JA, ed. Restoration of boreal and temperate forests, 2nd edition. Boca Raton, FL: CRC Press: 401-428. Chapter 20., 401-428.

Nelson, P. W. (2004). Classification and characterization of savannas and woodlands in Missouri. In Proceedings of SRM 2002: savanna/woodland symposium (pp. 9-25).

Appendix

Understory Species Observed

Species	# of Occurances	C-Value
Euonymus fortunei	24	*
Laportea canadensis	16	4
Ageratina altissima	14	2
Verbesina alternifolia	11	4
Elymus macgregorii	9	6
Chasmanthium latifolium	8	4
Persicaria virginiana	8	1
Carex blanda	6	2
Parthenocissus quinquefolia	6	3
Lonicera mackii	5	*
Diarrhena obovata	5	6
Fraxinus pennsylvanica	5	2
Glechoma hederacea	4	*
Celtis occidentalis	4	3
Viola striata	4	3
Elymus villosus	4	4
Unknown	4	*
Acer negundo	3	1
Festuca subverticillata	3	4
Boehmeria cylindrica	3	4
Carex grisea	2	4
Asarum reflexum	2	6
Solidago gigantea	2	3
Toxicodendron radicans	2	1
Fraxinus americana	2	4
Lindera benzoin	2	5
Smilax hispida	2	3
Cinna arundinacea	2	7
Asimina triloba	2	5
Symphyotrichum lanceolatum	2	3
Desmodium perplexum	1	3
Sanicula canadensis	1	3
Solidago altissima	1	1
Muhlenbergia schreberi	1	0

Campanulastrum americanum	1	4
Acer saccharinum	1	2
Taraxicum officinale	1	*
Cercea canadensis	1	3
Packera obovata	1	4
Ampelopsis grandulosa	1	*
Amphicarpaea bracteata	1	4
Phytolacca americana	1	2
Polygonatum bifolium	1	4
Carex leavenworthii	1	3
Rudbeckia laciniata	1	4
Carex aggregata	1	4
Carex davisii	1	3
Persicaria longiseta	1	*
Juncus tenuis	1	0
Ficaria verna	1	*
Quercus rubra	1	5
Arnoglossum atriplicifolium	1	4