



THE EFFECTS OF INVASIVE SPECIES AND HABITAT MANAGEMENT ON NATIVE TREE RECRUITMENT

Hannah Carpenter
Missouri Botanical Garden REU Program
University of Nebraska-Omaha

Danelle Haake
Missouri Botanical Garden
Litzsinger Road Ecology Center

Invasive Species

- Impacts
 - Decreasing native populations
 - Modifying community composition
 - Displacing rare/sensitive species
- Expensive to manage
- Management Protects
 - Native biodiversity
 - Normal ecosystem functions



Photo: <http://www.slideshare.net/fsmrd/invasive-species-taskforce-of-pohnpei>

Invasive Species in this Study

- Examined to determine impact on native tree recruitment

1) *Lonicera maackii*

2) *Euonymus fortunei*



Photo: <http://flowerwild.info/honeysuckle-wildflower/>



Lonicera maackii (Bush honeysuckle)

- Native to east-central Asia, brought to U.S. in 1898
- Deciduous shrub; can reach 20 feet in height
- A top 5 most invasive specie in Midwest
- Effects
 - Decreases light availability
 - Depletes soil of moisture and nutrients

Photo: <http://extension.entm.purdue.edu/CAPS/pestInfo/asianBushHoneysuckle.htm>



Photo: <http://www.invasive.org/weedcd/images/1536x1024/1237033.jpg>

Euonymus fortunei (Wintercreeper)

- Native to East-central Asia and brought to U.S. in 1907
- Evergreen perennial with broad, leathery, green leaves
- Tolerates shade well; grows in many soil environments
- Effects:
 - Decreases light
 - Uses positive plant-soil feedback



Photos: http://commons.wikimedia.org/wiki/File:Euonymus_Fortunei_Fruit.jpg, <http://extension.entm.purdue.edu/CAPS/pestInfo/purpleWinterCreeper.htm>

Study Overview

■ Purpose

- Observe natural regeneration of riparian woodland areas with different invasive species management histories

■ Hypothesis

- Locations with less *Lonicera maackii* and *Euonymus fortunei* will produce a habitat with greater species diversity and density in native tree recruitment

■ Implications

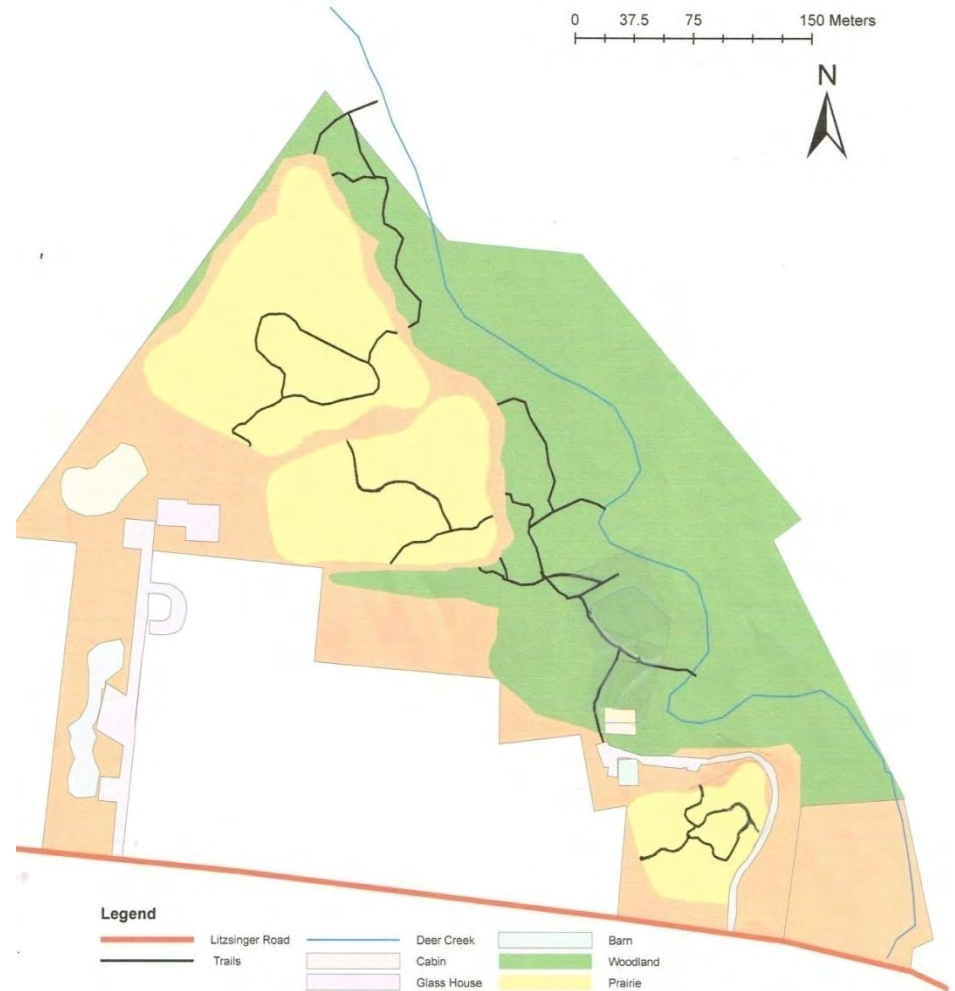
- Inform management decisions regarding invasive species treatment within a riparian forest at Litzsinger Road Ecology Center (LREC)



Photos: <http://www.thedirtbum.com/wp-content/uploads/2011-05-22-Bush-Honeysuckle.jpg>, <http://extension.entm.purdue.edu/CAPS/pestInfo/purpleWinterCreeper.htm>

Study Site: Litzsinger Road Ecology Center

- 34-acre center for ecological education and research
- 10 miles west of downtown St. Louis
- Variety of habitats
 - Bottomland forest
 - Tall grass prairie restoration
 - Urban creek
- Limited logging and land clearing
- Strong storms



Invasive Species Removal Within LREC

- Focused on removal of *Lonicera maackii* and *Euonymus fortunei* to restore herbaceous layer



- Treatments
 - Hand pulling
 - Cutting
 - Herbicide paint
 - Herbicide spray
 - Prescribed burns

Photo: <http://wolvesonceroamed.com/2012/04/13/battle-of-the-invasives-2/>

Four Locations



- 1) North Woods
 - Highly managed since 2001
 - Prescribed burns 2007 & 2012
- 2) South Woods
 - Moderate management against bush honeysuckle since 2003
- 3) Mulch Pile
 - Cleared bush honeysuckle 2010
 - Wintercreeper sprayed 2010
 - Highly managed since 2010
- 4) East Woods
 - Unmanaged (control)


Measurements Within Each Location



- 12 plots randomly selected (total 48 plots)
- Canopy density measured with Spherical Concave Forest Densiometer
- Noted presence of invasive species and adult trees in the canopy
- Tree saplings
 - Identified & measured within 3 meter radius
 - Trees above 1 meter in height and below 4.5cm DBH counted
- Tree seedlings
 - Identified & measured within 1 meter radius
 - Trees below 1 meter in height counted and placed in size classes

North Woods

Deer Creek

 = Individual Plot

South Woods

East Woods

Mulch Pile Woods

METHODS

Data Analysis



- Microsoft Excel 2007
- Minitab 16
- Species richness (Menhinick's Index)

$$D = s/\sqrt{N}$$



- Species diversity (Shannon Index)

$$H = \sum (p_1) |\ln p_1|$$

Photos: <http://www.newhorizons.com/LocalWeb/QA/Doha/Microsoft-Excel.aspx>, <https://store.technologypartnerz.com/minitab-16-statistical-software>

Canopy Density

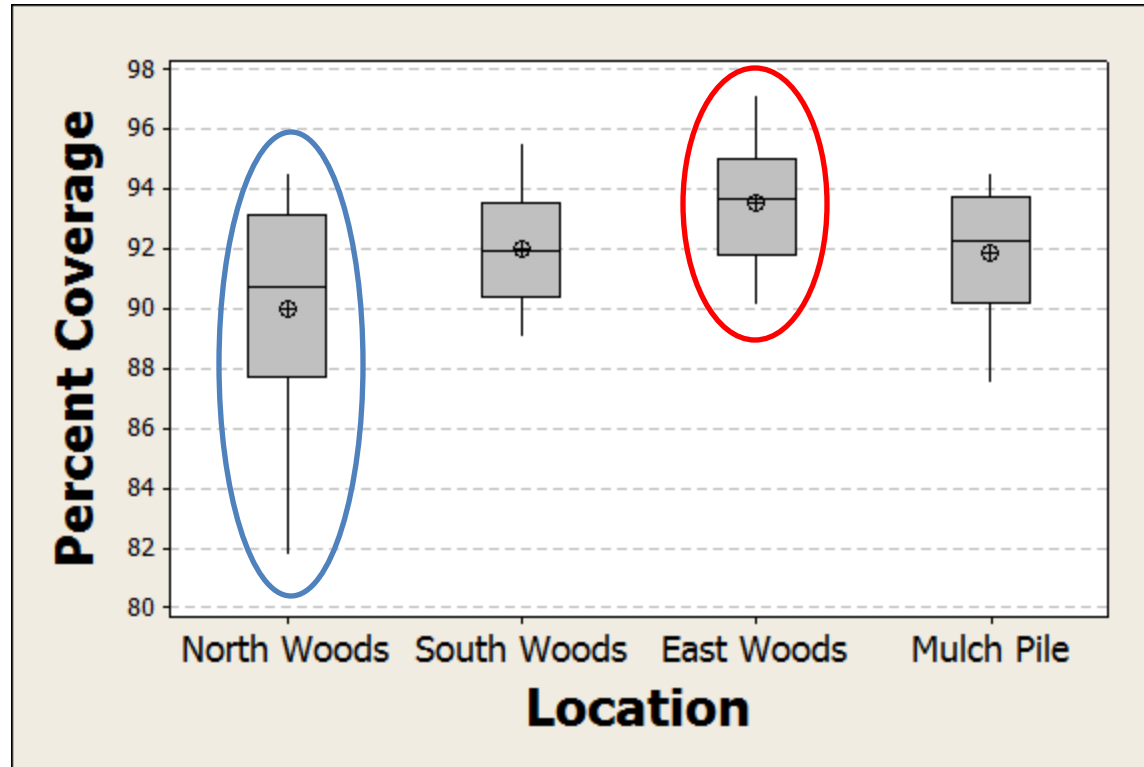


Figure 1. Box plot analysis of canopy density in the four woodland locations at LREC.

Seedling and Sapling Count

Species	Seedlings				Saplings			
	NW	SW	EW	MP	NW	SW	EW	MP
<i>Acer negundo</i>	37 (45.7%)	23 (45.1%)	2 (50%)	81 (57.0%)	10 (31.3%)	5 (25%)	1 (12.5%)	
<i>Aesculus glabra</i>	2 (2.5%)	3 (5.9%)	2 (50%)	3 (2.1%)		14 (70%)	7 (87.5%)	22 (71.0%)
<i>Carya cordiformis</i>	4 (4.9%)	2 (3.9%)						1 (3.2%)
<i>Celtis occidentalis</i>	14 (17.3%)	1 (2.0%)		42 (29.6%)	2 (6.3%)	1 (5%)		
<i>Cercis canadensis</i>	1 (1.2%)			4 (2.8%)				2 (6.5%)
<i>Cornus racemosa</i>	3 (3.7%)				6 (18.8%)			
<i>Fraxinus sp.</i>	18 (22.2%)	19 (37.3%)		1 (0.7%)	10 (31.3%)			1 (3.2%)
<i>Prunus serotina</i>		1 (2.0%)		2 (1.4%)				
<i>Quercus sp.</i>								2 (6.5%)
<i>Sassafras albidum</i>	2 (2.5%)			3 (2.1%)	3 (9.4%)			2 (6.5%)
<i>Staphylea trifolia</i>				6 (4.2%)				1 (3.2%)
<i>Ulmus sp.</i>		2 (3.9%)			1 (3.1%)			
TOTAL	81	51	4	142	32	20	8	31

Table 1. Number of seedling and sapling individuals of each species in all woodland locations at LREC. Percent composition is shown in parentheses.

Species Richness

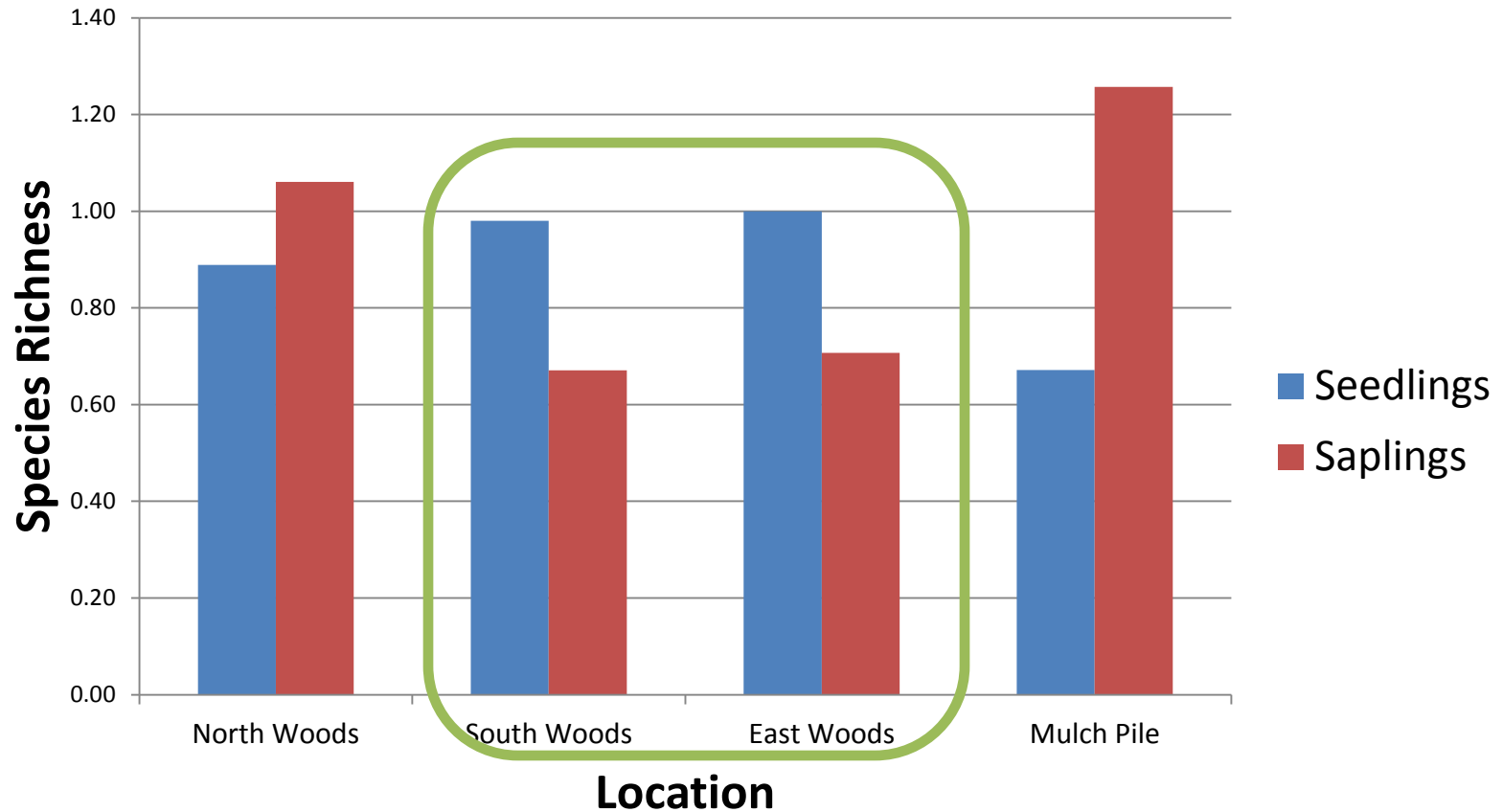


Figure 2. Species richness for each of the woodland locations at LREC. Species Richness was calculated using Menhinicks's Index.

Species Diversity

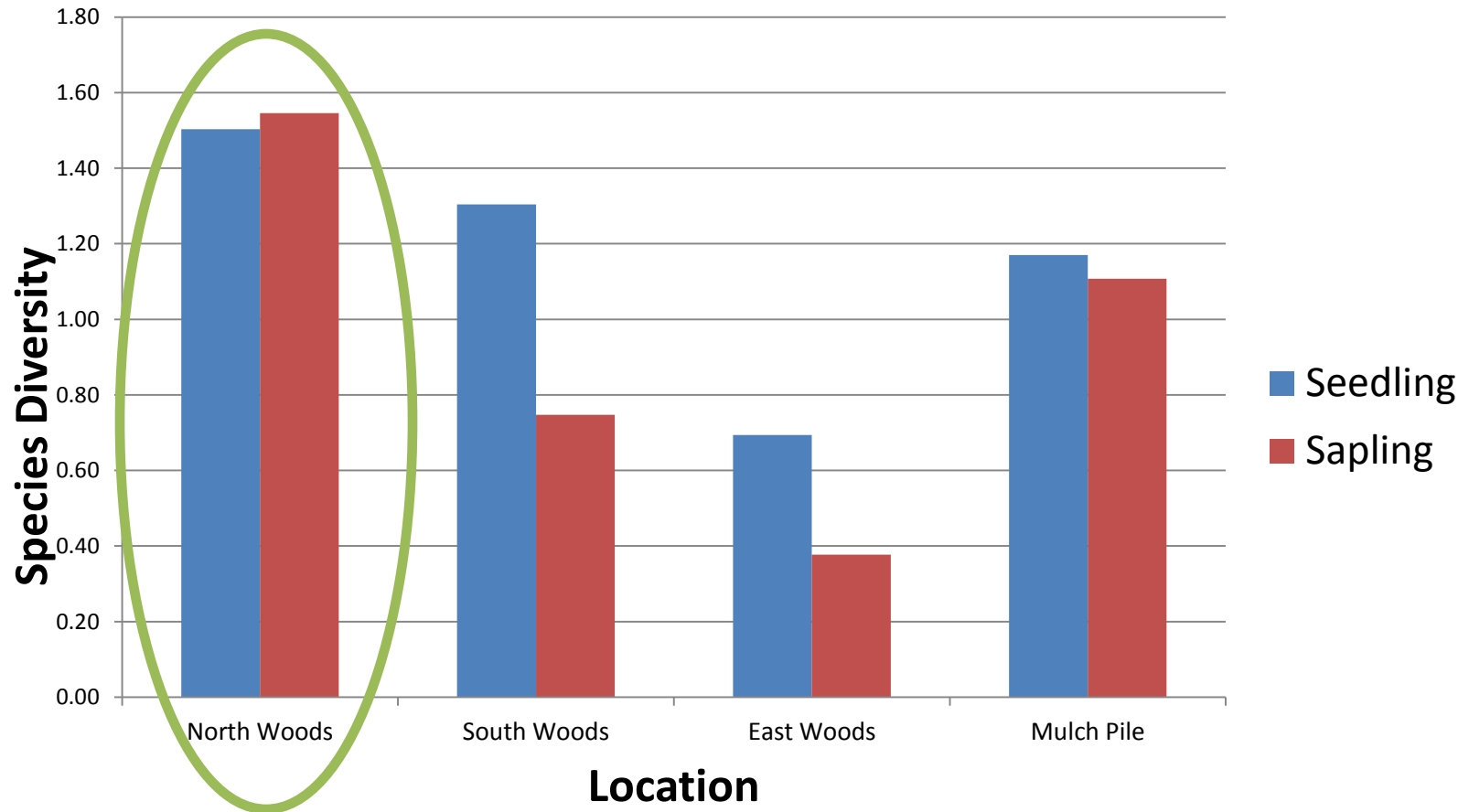


Figure 3. Analysis of species diversity for each of the woodland locations at LREC. Species diversity was calculated using the Shannon Index.

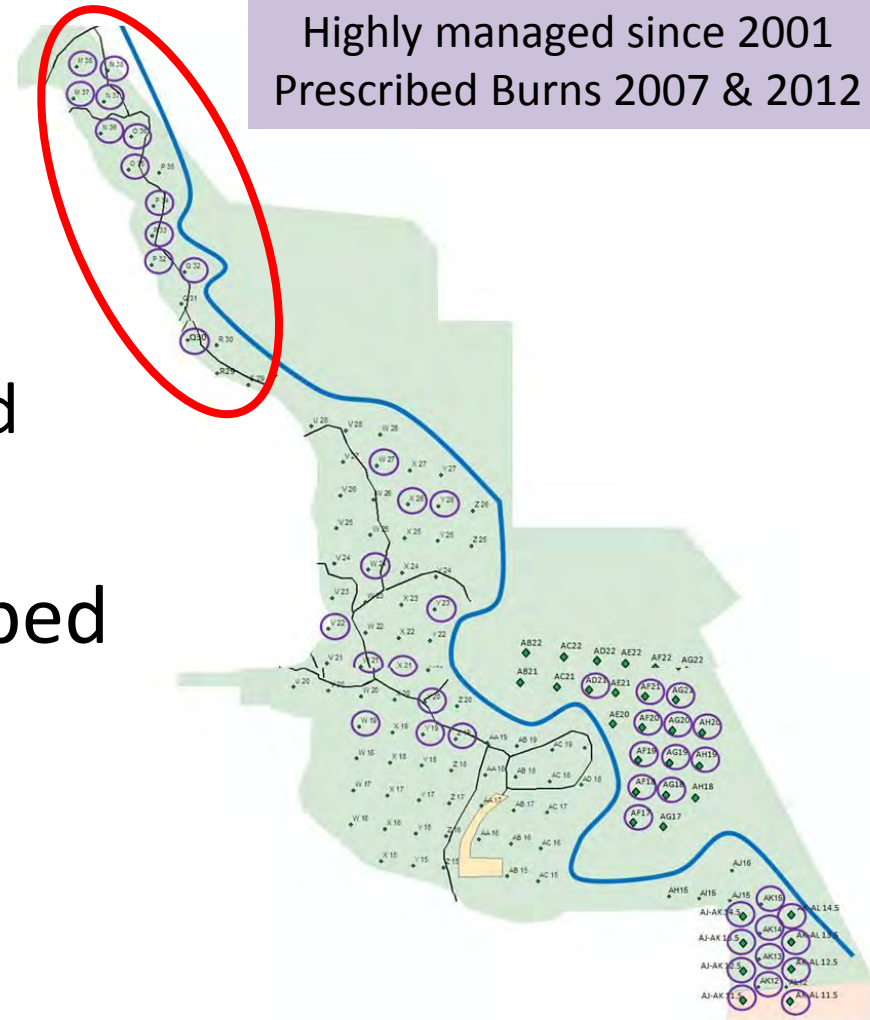
Associated Factors



- Invasive species management
- Canopy density/light levels
- Deer Browsing
- Soil composition
- Elevation/flood frequency
- Other Wildlife

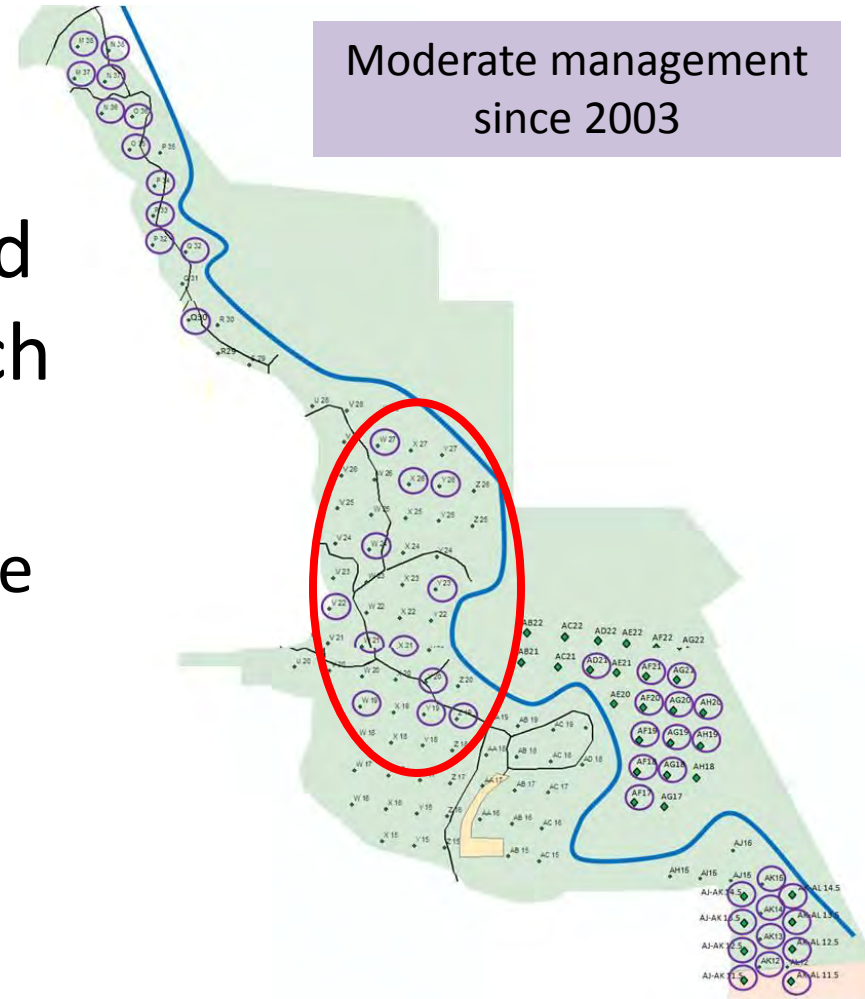
North Woods

- Lower canopy density and increased light
 - May contribute to greater abundance of seedlings and saplings
- Only location with prescribed burns
- High diversity and species richness



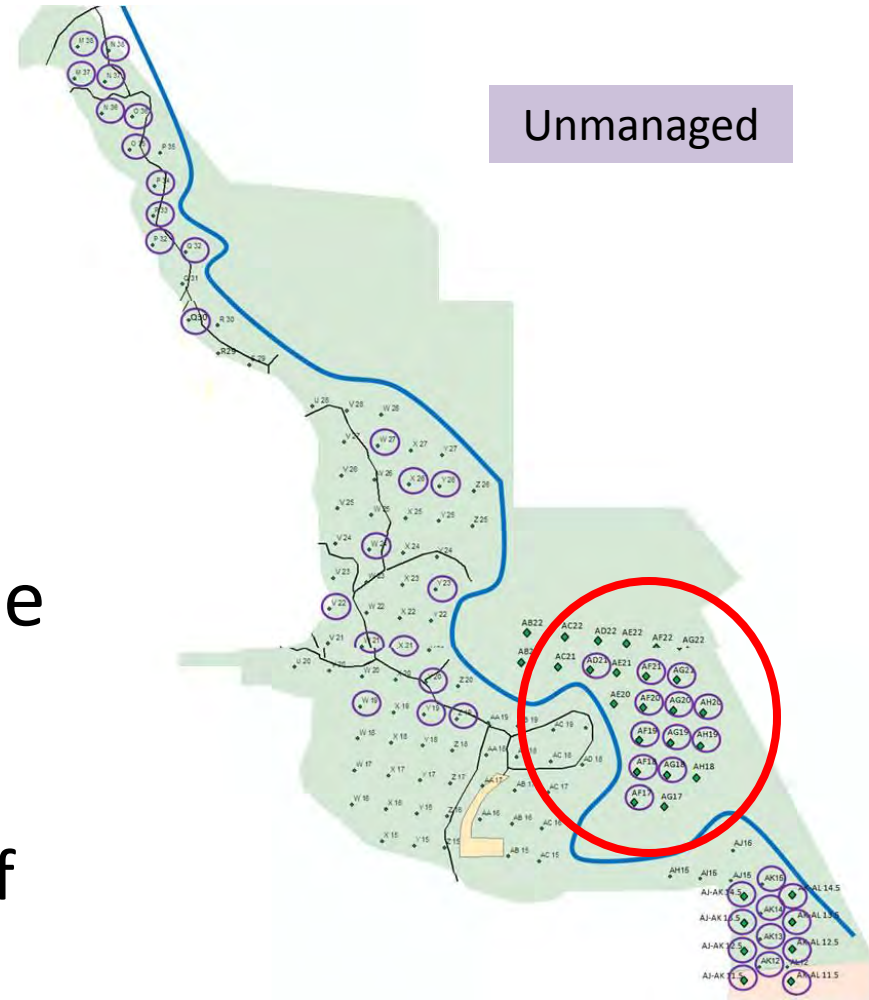
South Woods

- Lower in diversity and species richness compared to North Woods and Mulch Pile Woods
 - Likely due to less aggressive management which could explain fewer individual seedlings and saplings



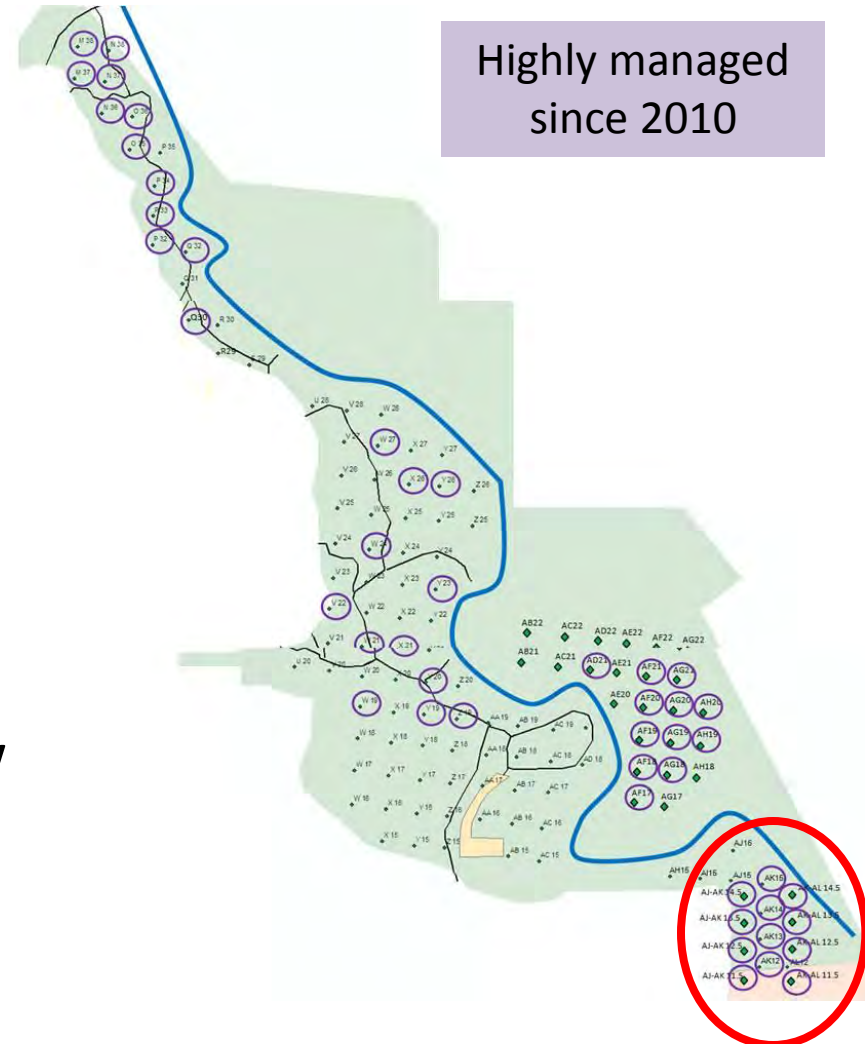
East Woods

- Lowest abundance of native tree seedling and saplings
- Highest canopy density
 - Attributed to abundance of *Lonicera maackii*
- Less populated and diverse by nearly every measure
 - Likely due to presence of invasive species and lack of management



Mulch Pile Woods

- Greatest percent composition of seedlings
 - Native tree seedlings responding well to environment
 - Enough time since invasive treatment for trees to grow in adjusted environment



Management Suggestion

- To achieve more diverse and species rich locations, LREC management could focus on the South Woods & East Woods
- Increased management may enhance native tree recruitment within LREC



Acknowledgements



- National Science Foundation
- Mentor: Danelle Haake
- Missouri Botanical Garden Staff
 - Dr. Iván Jiménez
 - Dr. David Bogler
- Litzsinger Road Ecology Center Staff
 - Dr. Bob Coulter
 - Mary Voges
 - Deanna English
 - Anne Wamser
- Justin Zweck