# Mushroom Abundance and Diversity in Deciduous and Coniferous Forests at Stinchfield Woods

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EAS 509: Ecology Independent Project Presentation
November 18, 2021

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# More than just a fungi

Fungi play a key role in the health, resiliency, and regeneration of forests, much of which is still being explored.

Fungi are known to have a mutualistic relationship with plants as they help to transfer soil nutrients and benefit from resources like water from plant roots. Having an abundance of fungi present might be critical to a strong, resilient ecosystem (Taylor et al. 2000).

While forests may not have high biodiversity of tree and herbaceous species, as characteristic of a conifer plantation, they may support a high diversity of fungal species (Halme et al. 2017). This can impact how we manage forests.

There is scientific and TEK evidence that climate change is contributing to a distinct change in mushroom abundance (Kotowski et al. 2021). This can be a helpful indicator in the effects of climate change in forests.

image: Flaticon.com

# Foundations

**Fungi can be used as an indicator species for plant productivity and success, pollution, and climate change (Tornberg, K., Bååth, E., & Olsson, S. 2003)** To what degree can we measure ecosystem health and resiliency based on the mushrooms found?

**Research by Varenius (2017) suggests that intensive timber harvesting can harm fungal communities, which in turn leads to less resilient forests due to the loss of fungi ecosystem services.** With wild fire ravaging much of the Western US and forest management being so costly, this could have huge impacts on the field and in climate change.

**Mushroom presence varies based on forest type, soil, and moisture conditions (Abrego, N., & Salcedo, I. 2011).** How do these elements influence abundance and diversity? As conifers lead to soil acidification (Hornung, M. 1985), what will we find in coniferous forests compared to deciduous forests?

# Research Questions

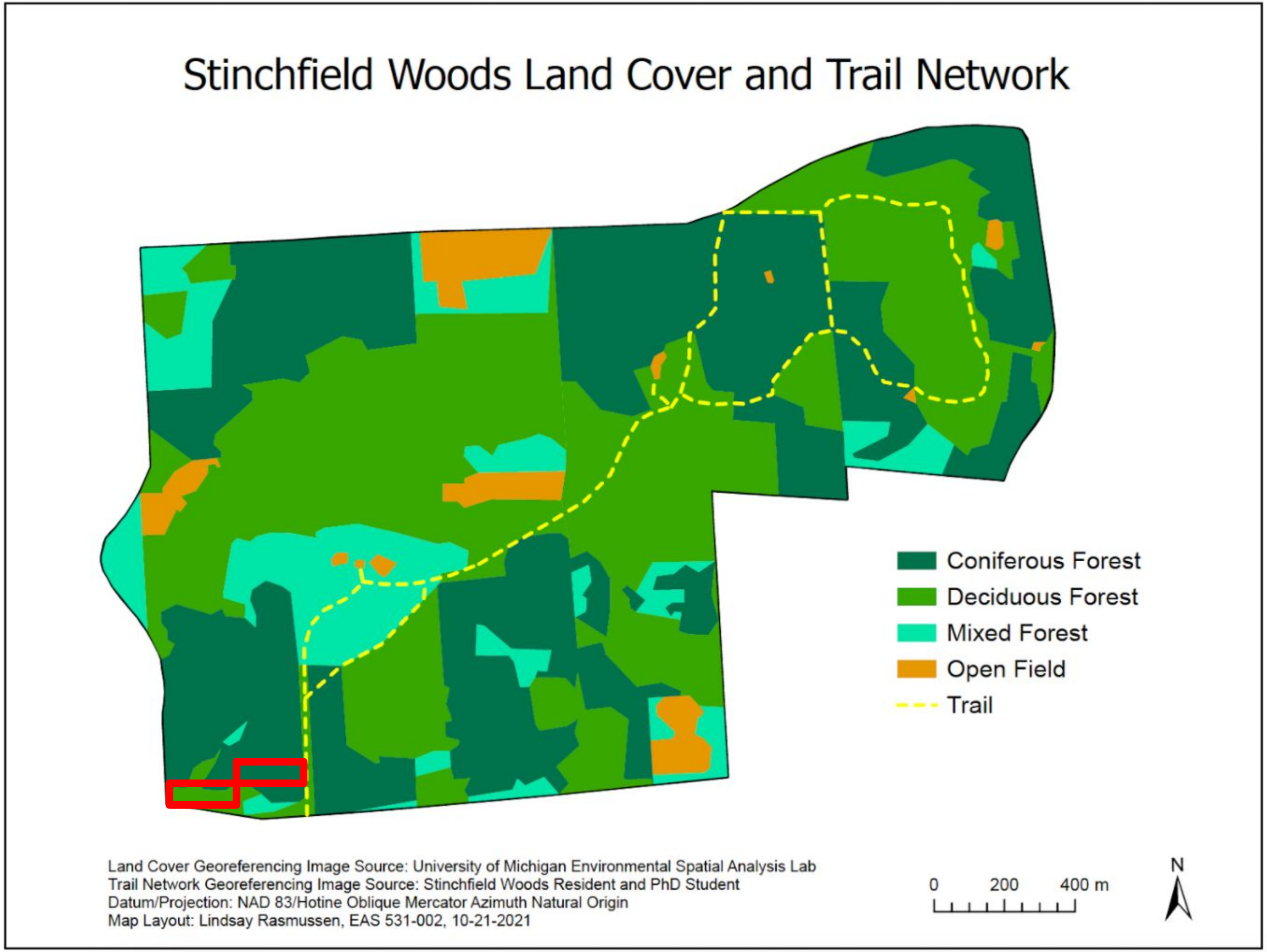
How does the forest type affect the diversity and abundance of mushrooms growing in a forest? Will we find more variety or abundance of mushrooms in different forest types? What might be the reason for the differences?

# Hypothesis

**If** mushrooms prefer acidic soils, **then** we will find a higher abundance and diversity of mushrooms in coniferous forests than in deciduous forests.

# History of Stinchfield Woods

- Topography reflects Michigan’s glaciation in Kames, Moraines, Outwash Plains
- No surface water present, soils are well drained
- Elevation ranges between 880’ above sea level and 1,058’ above sea level
- Owned by UMich SEAS, open to the public and used extensively for research
- 777 acres
- 281 acres of Native Hardwoods (Oak, Hickory, Cherry, Maple)
- 372 acres of Conifer Plantation


Stinchfield Woods Land Cover and Trail Network
Coniferous Forest
Deciduous Forest
Mixed Forest
Open Field
Trail
Land Cover Georeferencing Image Source: University of Michigan Environmental Spatial Analysis Lab
Trail Network Georeferencing Image Source: Stinchfield Woods Resident and PhD Student
Datum/Projection: NAD 83/Hotine Oblique Mercator Azimuth Natural Origin
Map Layout: Lindsay Rasmussen, EAS 531-002, 10-21-2021
0
200
400 m
N

# Site Observations: Stinchfield Woods

Data Collected: November 4, 2021, 43℉ cloudy (with some snow)

## Coniferous Site

- Pine plantation
- Dense canopy cover (~90%)
- Limited understory (~5-10%)
- Limited shrub layer (~25%)
- Limited Coarse Woody Debris
- Signs of deer and racoon activity

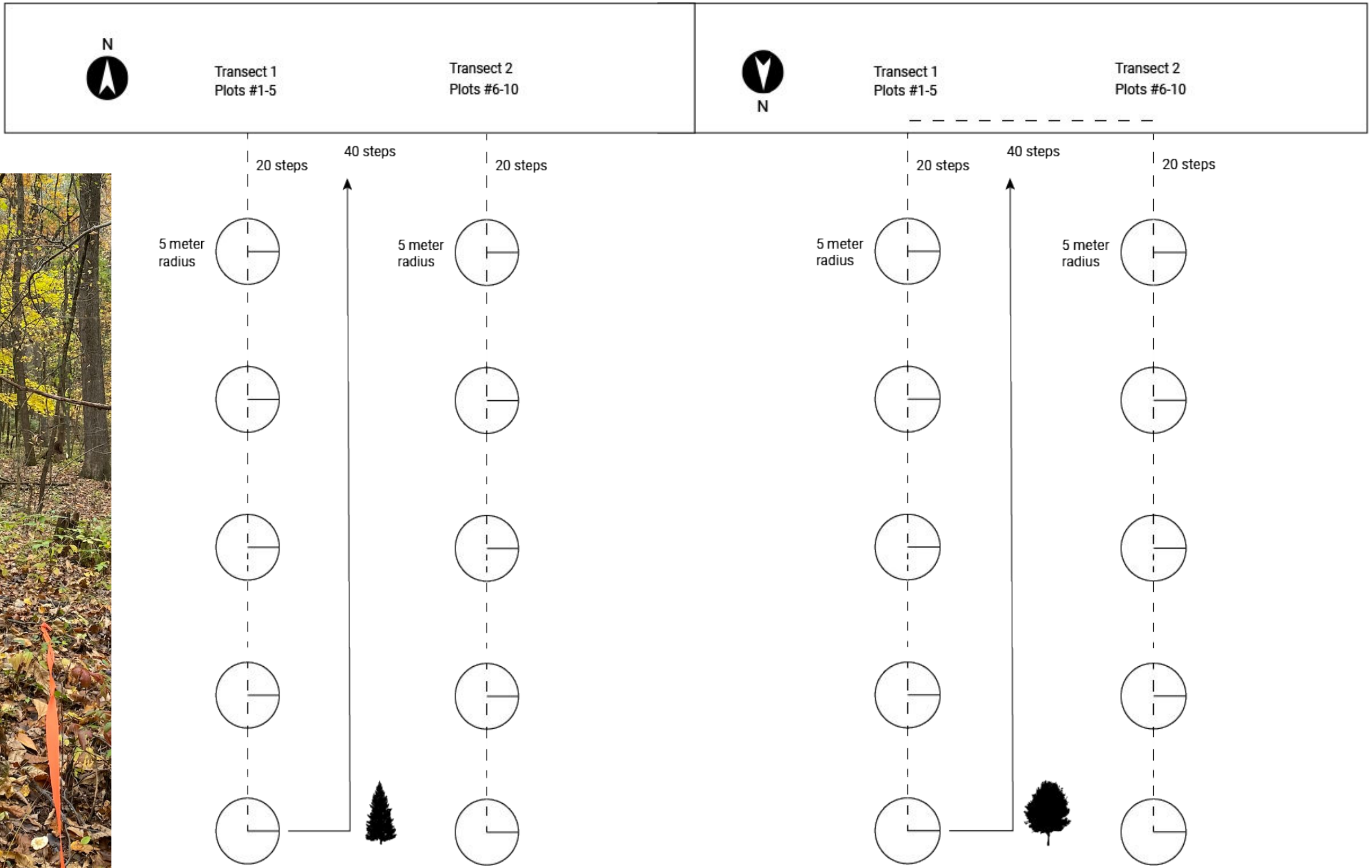
## Deciduous Site

- Hardwoods: Maple, Cherry, Hickory, & Oak
- Dense canopy cover (~75%)
- Medium understory (~50%)
- Limited shrub layer (~15%)
- Average Coarse Woody Debris
- Signs of deer and racoon activity

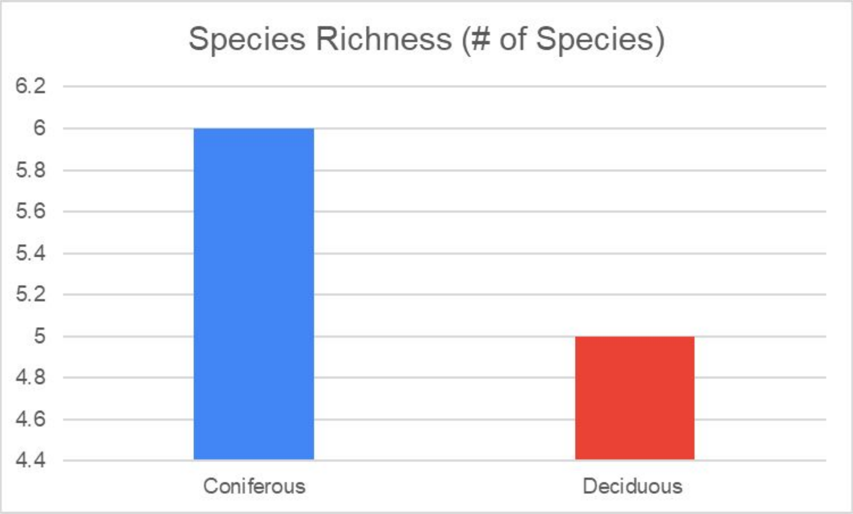
# Methods

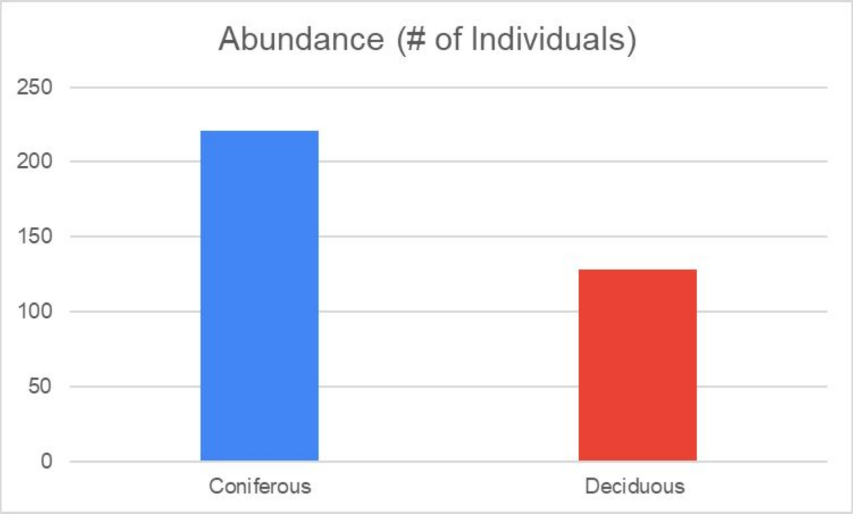
- 2 transects in each forest type, starting off of a trail
- 5 plots in each transect (total of 10 plots per forest)
- At each plot, we set a stake in the center and recorded the mushroom type found within a 5-meter radius
- We limited ourselves to 3-minutes at each plot for consistency
- We counted a mushroom as an individual if the centers of the mushrooms were further than 3-centimeters apart

# Methods


N
Transect 1
Plots #1-5
Transect 2
Plots #6-10
20 steps
40 steps
20 steps
5 meter radius
5 meter radius
N
Transect 1
Plots #1-5
Transect 2
Plots #6-10
20 steps
40 steps
20 steps
5 meter radius
5 meter radius

# Results




| | Coniferous | Deciduous |
|---|---|---|
| **Diversity Index** | 0.228353824 | 1.089636796 |
| **Evenness** | 0.127446696 | 0.677029407 |

# Results

Species Richness (# of Species)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
8
9
10
Number of Plots Sampled
Coniferous
Deciduous

# Discussion

**If** mushrooms prefer acidic soils, **then** we will find a higher abundance and diversity of mushrooms in coniferous forests than in deciduous forests.

- Partially supported
  - Coniferous showed higher abundance and species richness, but lower diversity
- Environmental conditions
  - Coniferous and abundance - Acidic soil, higher canopy coverage
  - Deciduous and diversity - Variety of substrate and tree species
- Future research is needed!

# Discussion - Limitations

- Time of year
  - Decaying
- Time constraint
  - Sample size and time spent at each plot
- Anthropogenic influences
  - Litter, holes, foraging
- Identification skills
  - Category vs. species

# Future Experiments

- Data collection in mid-october to ensure greater level of identification, diversity of samples, and relative abundance of mushrooms
- Sampling the same transects at different dates to get a better understanding of how the same locations can change over time
- Adding a third transect and/or adding 5 more plots per transect to see if trends remain consistent along a particular direction
- Choosing transects in different locations within the site to see if abundance and diversity trends remain consistent among forest types

# Implications and Future Questions

1. Ecosystems Services
    a. Simard (2012) - the mycorrhizal network plays a key role in many ecosystem services and community health
    b. Does the mycorrhizal network connect between different forest types?

2. Forest Management
    a. Stamets, 2005 - fungi can be a critical resource in forest management, “mycoforestry”
    b. What role might fungi play in forest management alternatives to clear cutting?

3. Climate Change
    a. Clemmensen et al. (2015) & Błońska et al. (2017)- fungi play a critical role in the sequestration of carbon
    b. How can fungi’s ability to sequester carbon impact climate change?

# Thank you for listening!

## Questions?

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