



Evaluation of Ecosystem Response to Silvicultural Treatments in Upland Hardwood Forests in Northern Mississippi, United States

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INTRODUCTION

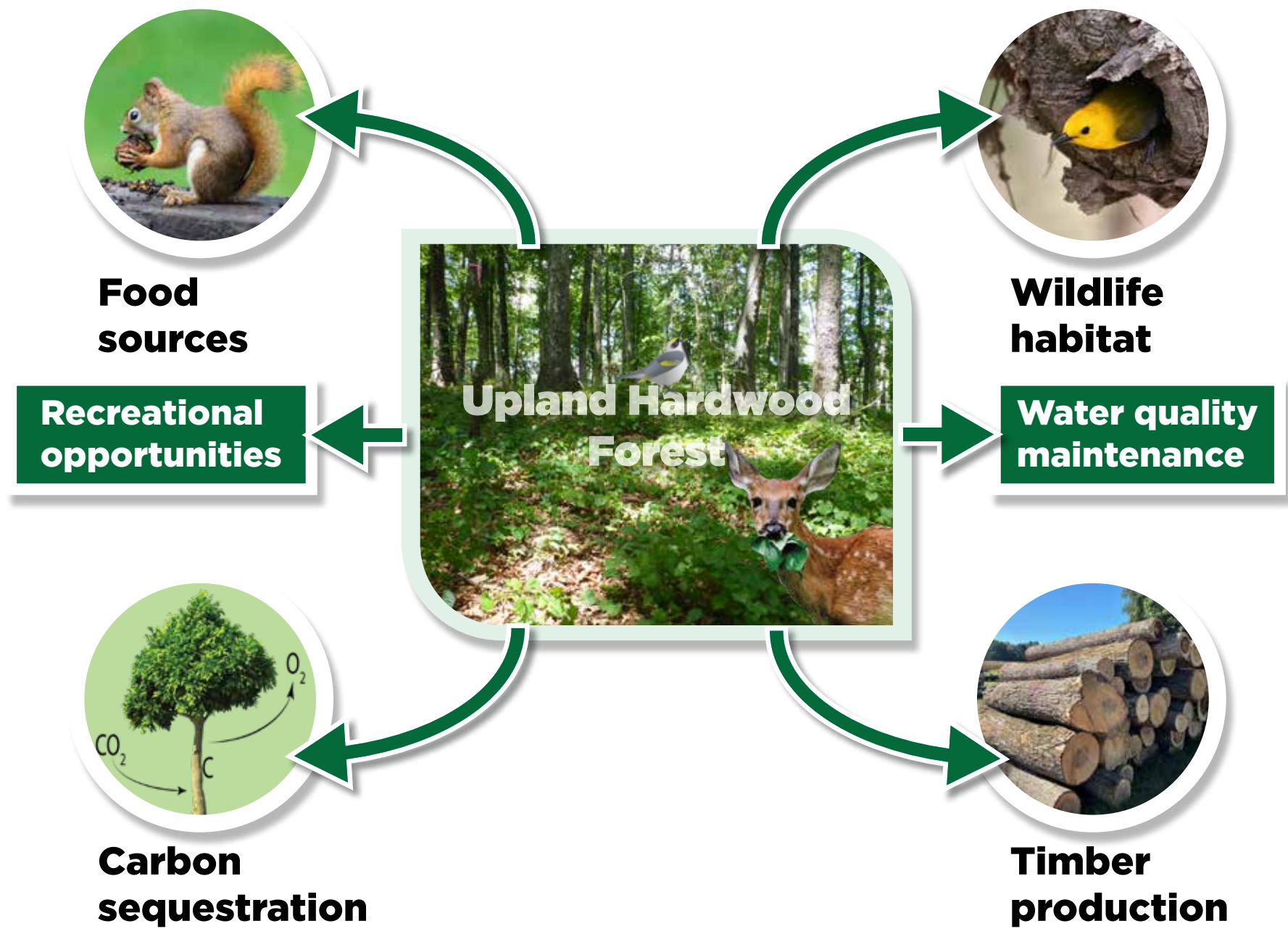


Figure 1. Ecologically diverse nature and vital ecosystem services of upland hardwood forest

- Many upland hardwood forests (UHF) are in degraded or poor condition, and successfully regenerating oak in these forests can be challenging.

Objective

- Investigate the response of forest ecosystems to different silvicultural treatments by assessing residual tree growth, seedling recruitment and diversity, and above-ground carbon storage in UHF.

MATERIALS AND METHODS

- The study is conducted at Spirit Hills Farm (SHF) in Tate County, Mississippi, which spans ~526 hectares, with 234 hectares of hardwood or mixed hardwood forest.

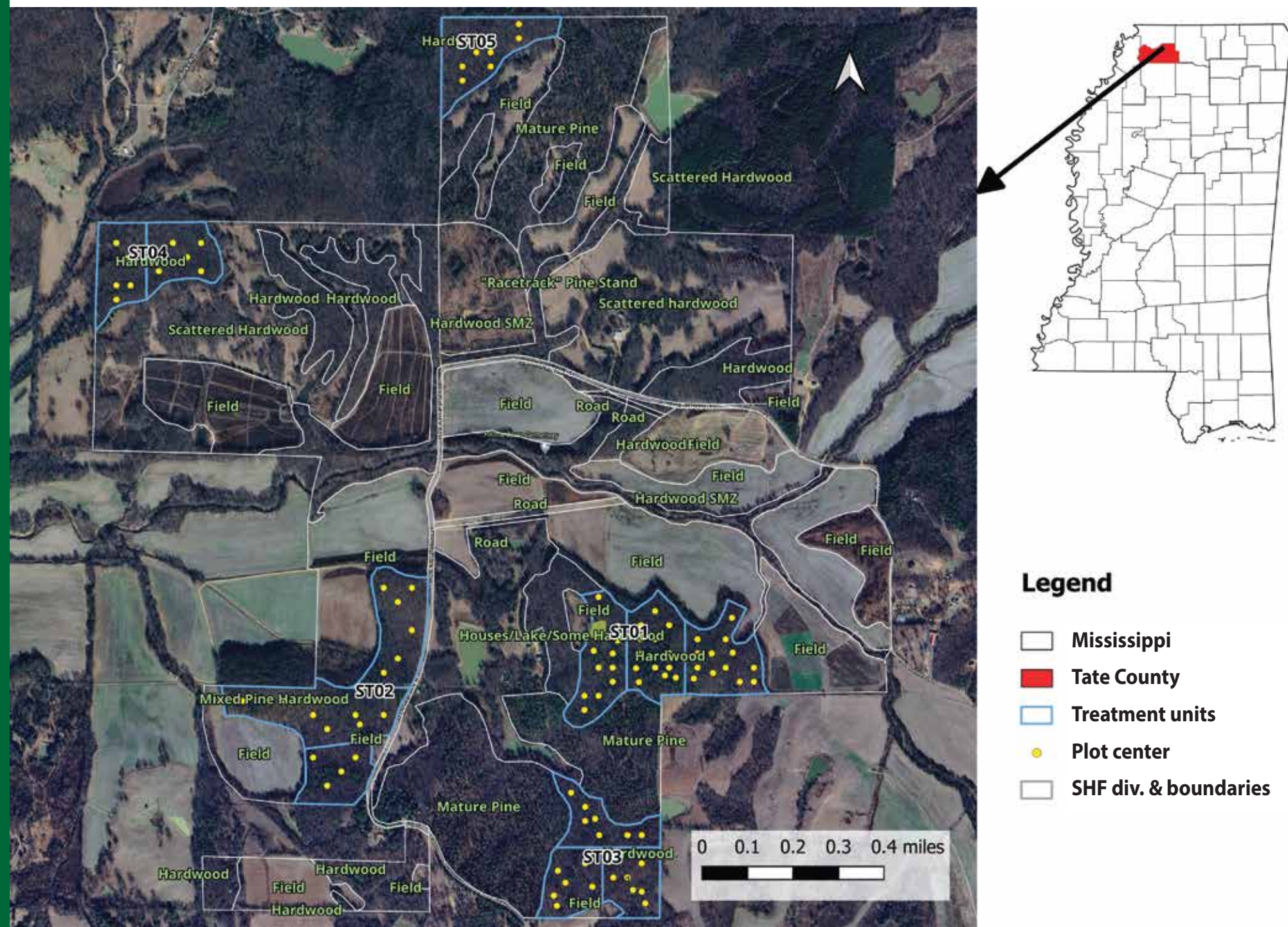


Figure 2. Map of the study area

Experimental Design and Plot Layout

- We used a randomized block design with three silvicultural treatments and four replicates:
T1: hack and squirt + overstory removal to residual basal area of ~11 m²/ha (~50 ft²/ac)
T2: hack and squirt + overstory removal to residual basal area of ~7 m²/ha (~30 ft²/ac)
T3: no treatment (control) (Figures 3 and 4).
- Hack and squirt is used to remove non-oak species under 20 cm (8 in.) in diameter.

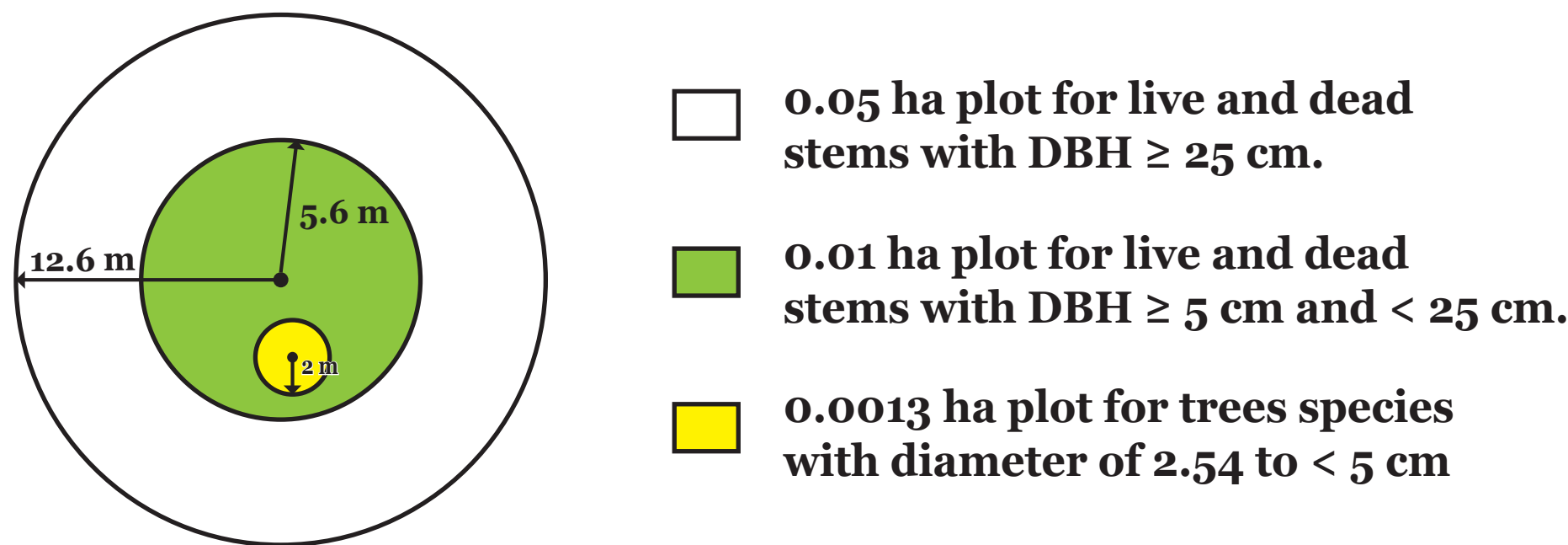


Figure 3. Nested plot design

- Plots of 0.05 ha, 0.01 ha, and 0.0013 ha were established to measure large, medium, and small diameters, respectively. The 0.0013 ha plots were located 4 m from the center of the 0.05 ha plot at a 180° angle.

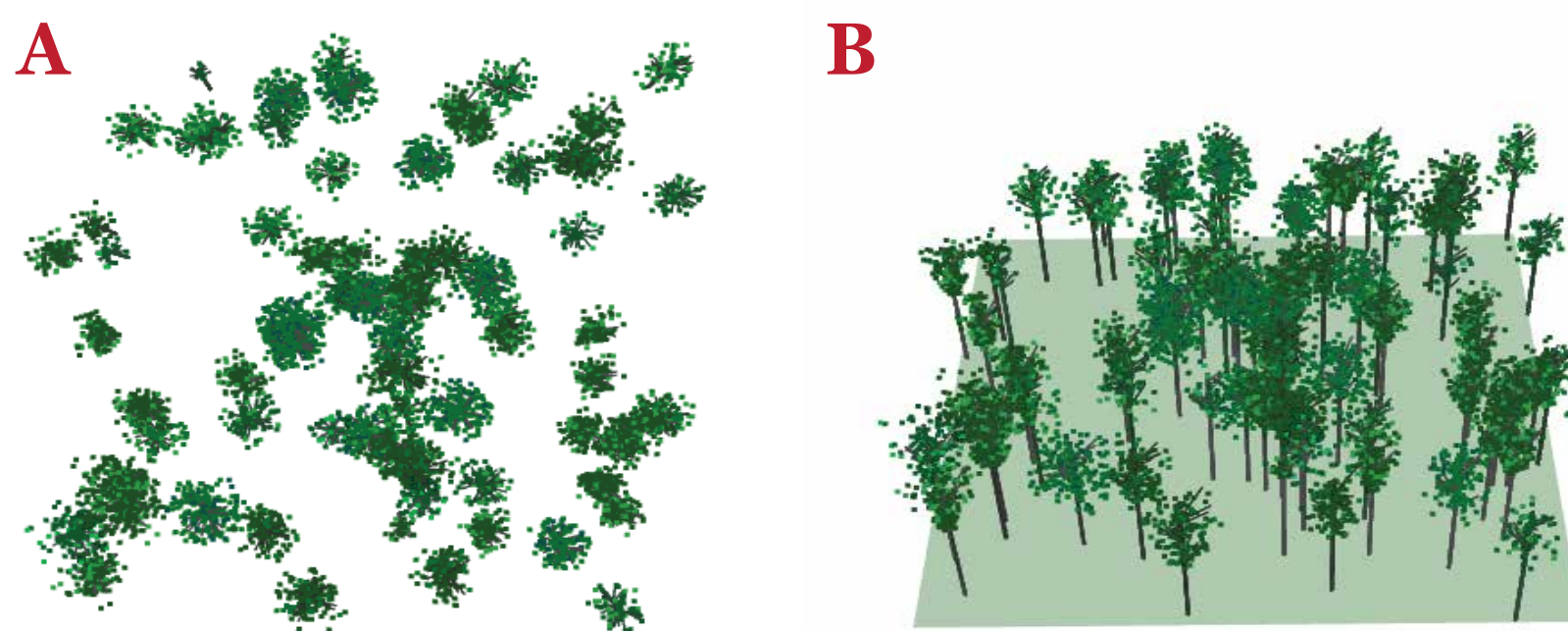


Figure 4. T1 - Overstory removal to ~11 m²/ha (A - overhead view and B - perspective view)

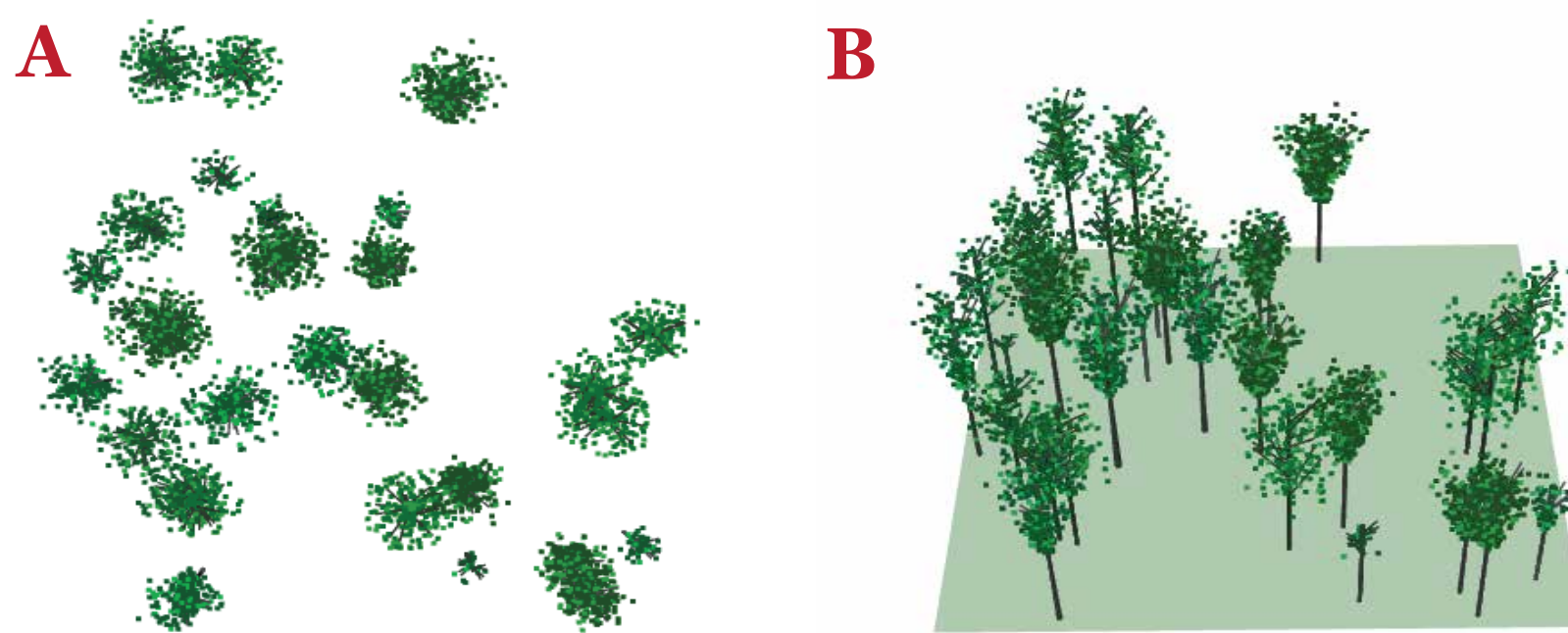


Figure 4. T2 - Overstory removal to ~7 m²/ha (A - overhead view and B - perspective view)

- In these plots, tree species were inventoried, total vegetation cover, biodiversity indices of woody species, and above-ground carbon were measured and quantified.

PRELIMINARY RESULTS

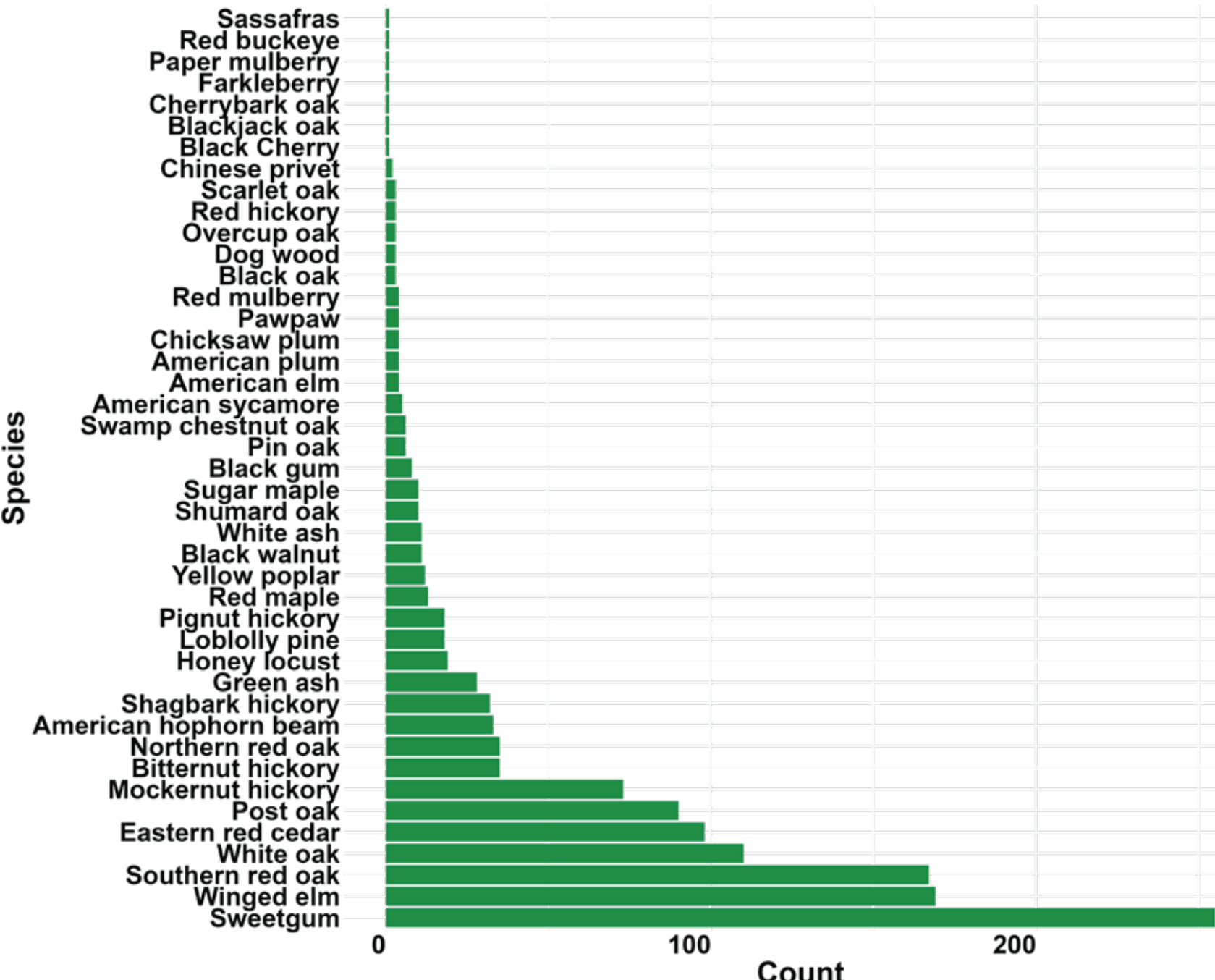


Figure 5. Species composition in the study area

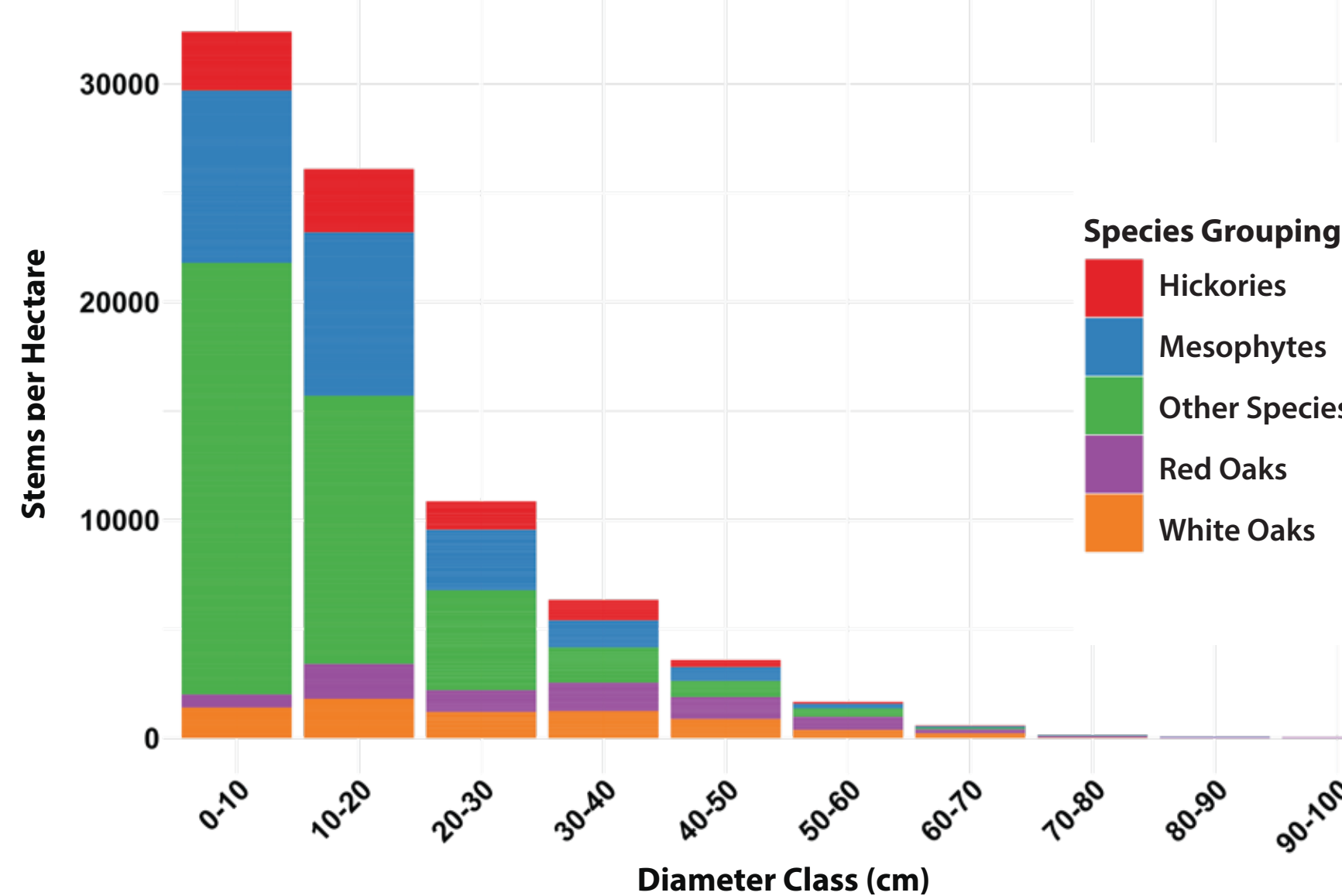


Figure 6. Pre-treatment distribution of stems per hectare by diameter class and species groupings

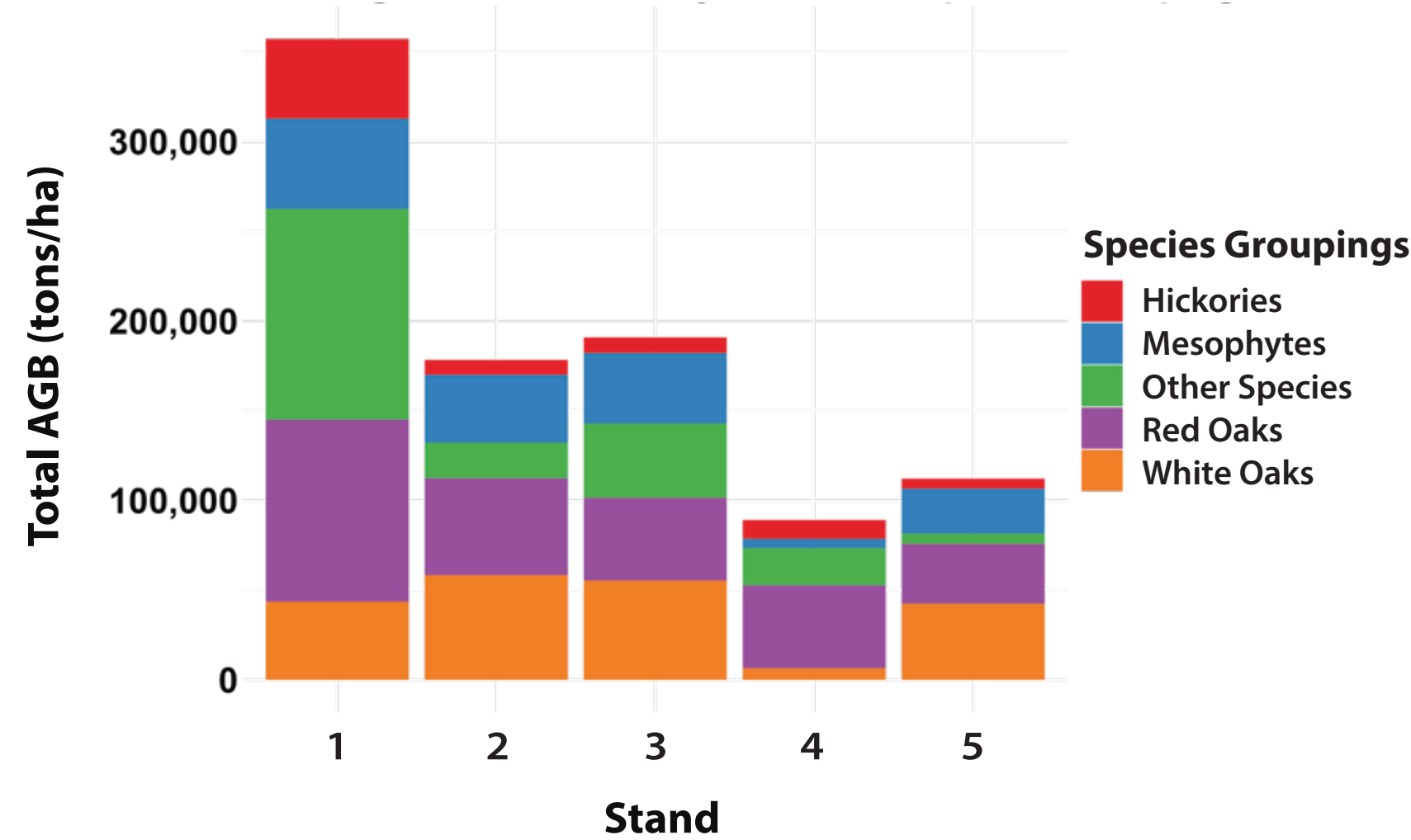


Figure 7. Estimated above ground biomass by species groupings

Biodiversity indices within stands

Table 1. Shannon and Simpson indices

Stand	Shannon	Simpson
1	2.802	0.912
2	2.601	0.903
3	2.640	0.897
4	2.369	0.873
5	2.252	0.860

DISCUSSION

- The historically dominant species, such as oaks and hickories, are declining in proportion within the smaller diameter classes (figure 6).
- This suggests a lack of recruitment of the historic species into the overstory, posing a threat to the current levels of larger trees that dominate the above ground biomass (Figure 7).
- Without intervention, the forest composition and structure are likely to shift away from its current state.

EXPECTED OUTCOME

- We expect to identify the most effective silvicultural treatments for UHF regeneration, while deepening our understanding of other ecosystem responses, such as pollinator communities and soil health.
- Our findings will guide sustainable management strategies for upland oak forests in northern Mississippi.
- The study will serve as a valuable demonstration site for upland oak silviculture, supporting regional and national outreach and education efforts.

Acknowledgement

- Dean's Office, College of Forestry, Mississippi State University (MSU) and Forest & Wildlife Research Center.
- National Institute for Food & Agriculture, U.S. Dept. of Agriculture, McIntire Stennis project under accession 1019117.
- Sheryl Bowen and Hearne Foster (Spirit Hill Farm).
- School of Environment, College of Agriculture, Human, and Natural Resource Sciences and College of Arts and Sciences, Washington State University.