# Modeling of Silvicultural Treatments: Impacts on Oak Regeneration and Carbon Sequestration

Kelechi Ibeh[1], Austin Himes[1], and Allyson Beall King[1]

[1]School of Environment, Washington State University

Contact me

## INTRODUCTION 1

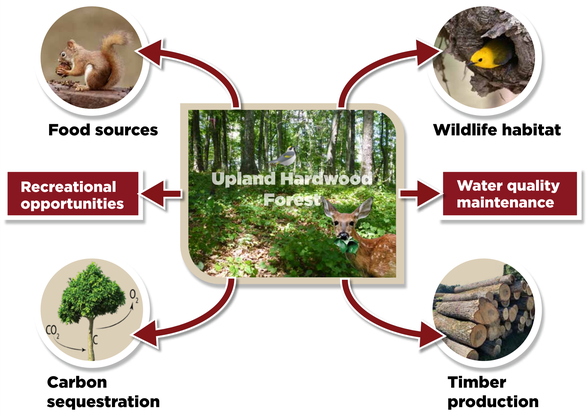


**Figure 1. Ecological diversity and ecosystem functions of upland hardwood forests (Ibeh et al., 2024)**

### Problem:

Oak-dominated upland hardwood forests are under threat due to mesophication, deer browsing, and competition from shade-tolerant species leading to oak regeneration and recruitment crises.

### Gap:

Silvicultural strategies exist, but long-term impacts on oak recruitment and carbon sequestration are poorly understood.

### Objective:

Apply system dynamics modeling to estimate how thinning treatments influence oak regeneration and carbon storage across time.

## RESEARCH PROCEDURE 2

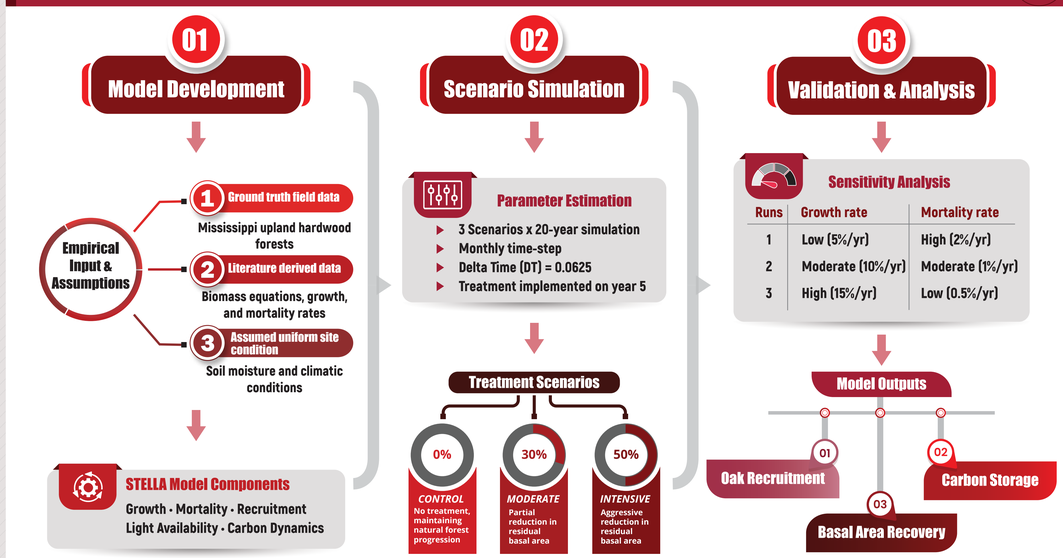


**Figure 2. Workflow for simulating silvivultural treatment impacts on forest dynamics**

## SYSTEM MODEL DIAGRAM 3

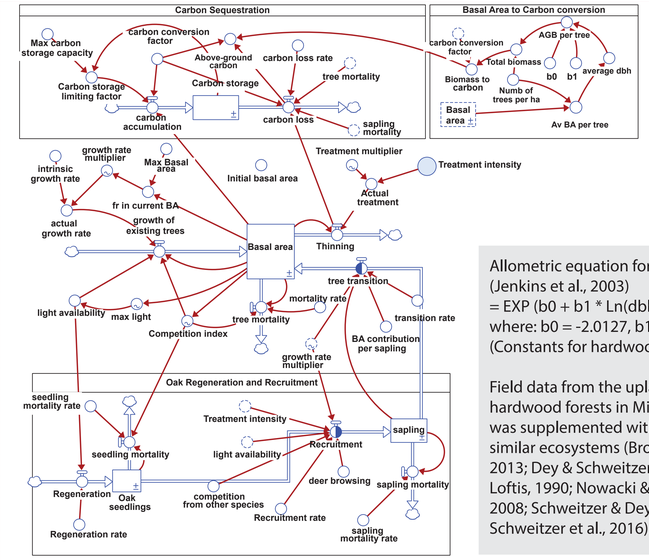


**Figure 3. Forest dynamic model for upland hardwood forest**

Allometric equation for AGB (Jenkins et al., 2003)
= EXP (b0 + b1 * Ln(dbh))
where: b0 = -2.0127, b1 = 2.4342
(Constants for hardwoods)

Field data from the upland hardwood forests in Mississippi was supplemented with data from similar ecosystems (Brose et al., 2013; Dey & Schweitzer, 2014; Loftis, 1990; Nowacki & Abrams, 2008; Schweitzer & Dey, 2011; Schweitzer et al., 2016).

## RESULTS 4

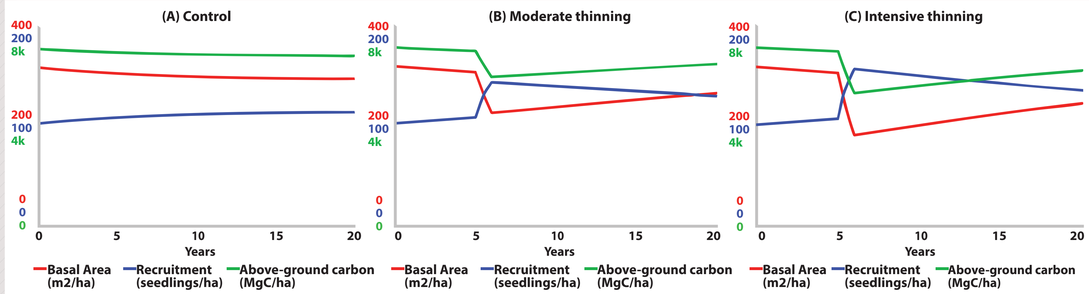


**Figure 4. Trends in oak recruitment, basal area and carbon over time**

**Table 1. Sensitivity outputs for varying growth and mortality rates**

| Treatment | Runs | Basal area (Recovery) | Carbon Storage (accumulation) | Recruitment |
|---|---|---|---|---|
| Control | 1 | Slowed | Reduced | Higher |
| | 2 | Steady | Balanced | Reduced |
| | 3 | Accelerated | Increased | Reduced |
| Moderate thinning | 1 | Slowed | Reduced | Higher |
| | 2 | Steady | Balanced | Moderate |
| | 3 | Accelerated | Increased | Reduced |
| Intensive thinning | 1 | Slowed | Reduced | Higher |
| | 2 | Slowed | Significantly reduced | Higher |
| | 3 | Accelerated | Increased | Reduced |

*For details on the Runs column, see figure 2 step 3 (Sensitivity Analysis)*

## CONCLUSIONS 5

- System dynamics modeling is a powerful tool for ecological silviculture.
- Moderate thinning supports sustainable forest regeneration and carbon outcomes.
- Balancing management intensity is key to achieving ecosystem service resilience.

## ACKNOWLEDGEMENT 6

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## FOR REFERENCES 7