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Functional morphology of shortleaf pine (*Pinus echinata* Mill) fire-adapted traits

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- Shortleaf pine (SLP) is valued in the Southeast for lumber, plywood, and pulpwood production
- Frequent fire has led to the development of fire-adapted traits in SLP, specifically sprouting from the basal crook after top-kill (figure 1a) and thick bark (figure 1b)
- We aim to determine what fire-adapted traits are responsible for protecting SLP throughout its life, from seedling to mature tree

**Objective**

- To characterize SLP sprouting after top-kill and the increase of bark thickness in relation to stem size

**Methods**

- We top-killed SLP in the Ouachita National Forest (ONF), AR
- Diameter and bark thickness were measured along each stem at 0, 30, and 140 cm above the groundline
- Live/dead status for each stump was determined by the presence of sprouts one growing season following top-kill
- A logistic regression model with a logit link was developed to predict probability of survival (live/dead status) for a given stump as a function of diam.
- Diameter, age, and the interaction were used as predictors for bark thickness in a linear regression
- All analyses were conducted in R version 3.5.2 (Eggshell Igloo)

**Results**

- We found the defense mechanism may depend on tree size: smaller trees sprouted after top-kill, while larger trees were less likely to survive (figure 3)
- Decreased survival of large top-killed trees may be the result of those trees having bark thick enough (> 5mm) to survive a low-intensity surface fire1 and thus the larger trees are less likely to “rely” on sprouting to survive a fire (figure 4)
- We hypothesize that the larger trees did not sprout as readily because the thicker bark would have protected the cambium layer resulting in a decrease in the probability of mortality, ultimately demonstrating a shift in fire-defense mechanisms throughout the life of the shortleaf pine

**Discussion**

- Large trees are less likely to sprout (survive) after being top-killed (figure 3; p = 0.005)
- Age is not a significant predictor of stump survival (sprouting) following top-kill
- Diameter, age, and the interaction effect are all significant predictors for bark thickness (figure 4, p < 0.001)

**Future Directions**

- Examine morphology of the basal crook and determine how sprouting is affected as the tree grows larger and the prominence of the basal crook decreases
- Compare shortleaf pine response to top-kill in two distinct locations within the range of shortleaf pine with different fire regimes
- Determine non-structural carbohydrates in different portions of the tree (roots, basal crook, stem) across a range of stem sizes

**References**


**Acknowledgments**

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**Table 1**

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