Changes in Forest Structure Following Dormant Season Prescribed Burns in the Southern Appalachians

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Introduction

The past 2 decades have seen a significant increase in the use of dormant-season prescribed burning in the southern Appalachians. The primary goals for burning include fuel reduction and restoring fire-adapted plant communities that have been altered by nearly a century of fire suppression. The Southern Blue Ridge Fire Learning Network (SBRFLN) has been monitoring prescribed fire effects since 2006. If prescribed fire is going to restore desired forest conditions, it must lead to changes in forest structure. The objectives of this study were to evaluate how prescribed burning altered forest structure in southern Appalachian forests.

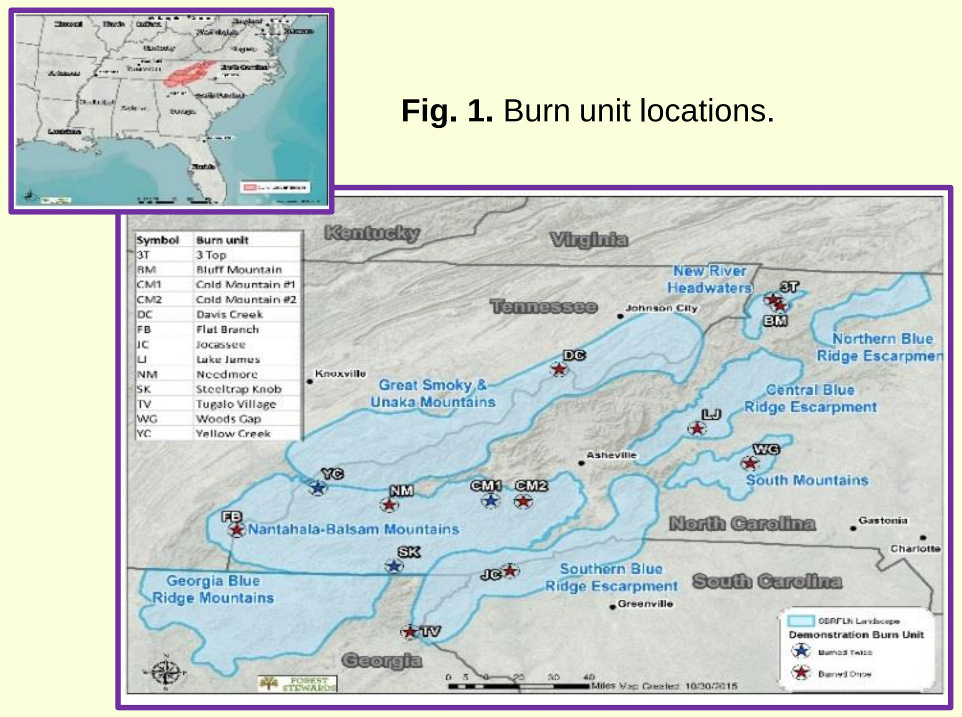

Fig. 1. Burn unit locations.

Methods

STUDY SITES

Thirteen burn units managed by SBRFLN partners were used in this study (Fig. 1). All burn units contained a large proportion of the forest communities targeted for restoration, including High Elevation Red Oak, Dry Mesic Oak-Hickory, Shortleaf Pine-Oak, and Pine-Oak-Heath. Ten units have been burned once and the remaining 3 have burned twice (Fig. 1). All burns were conducted during the dormant season.

FIELD DATA COLLECTION

Data, as described below, were collected during the growing season from 15, 1/10 acre permanent plots that were established in each unit prior to burning. Post-burn data were collected during the 2nd growing season following each burn.

Overstory: species, dbh, and crown class of all trees ≥ 2 inches dbh.

Regeneration: Talley of all species > 1 ft tall and < 2 inches dbh within a 1/50 ac sub plot. Sprout clumps were counted as a single stem.

Understory vegetation: Ocular estimates of percent cover for each life form category (herbs, shrubs, etc.) and the height of the top of the shrub layer within a 1/50 ac plot.

DATA ANALYSIS

Results were analyzed at the plot level, though the authors recognize the potential ramifications of pseudoreplication. Because of the variability of forest communities both within and between burn units, plots were identified as either mesic or xeric based on preburn species composition using an arboreal moisture index modeled after McNab et al. (2003 [*Testing tree indicator species for classifying site productivity in southern Appalachian hardwood stands. Proceedings of the Society of American Foresters, October 5-9, Winston-Salem, North Carolina, p. 350-356].* ANOVA's were performed using the JASP statistical package where forest type (mesic versus xeric) and treatment period (preburn, post 1st burn, and post 2nd burn) were main effects. Results from all sites were used to evaluate 1st burn effects. Second burn effects were assessed using only data from units that had been burned twice.

Results and Discussion

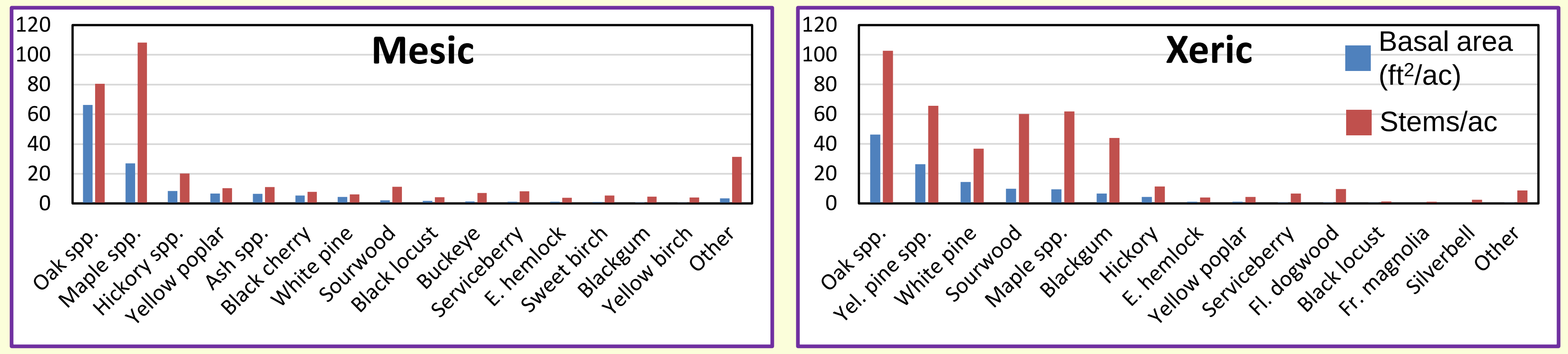

Fig. 2. Preburn overstory Basal area (ft2/ac) and density (stem/ac) by species for Mesic and Xeric communities.

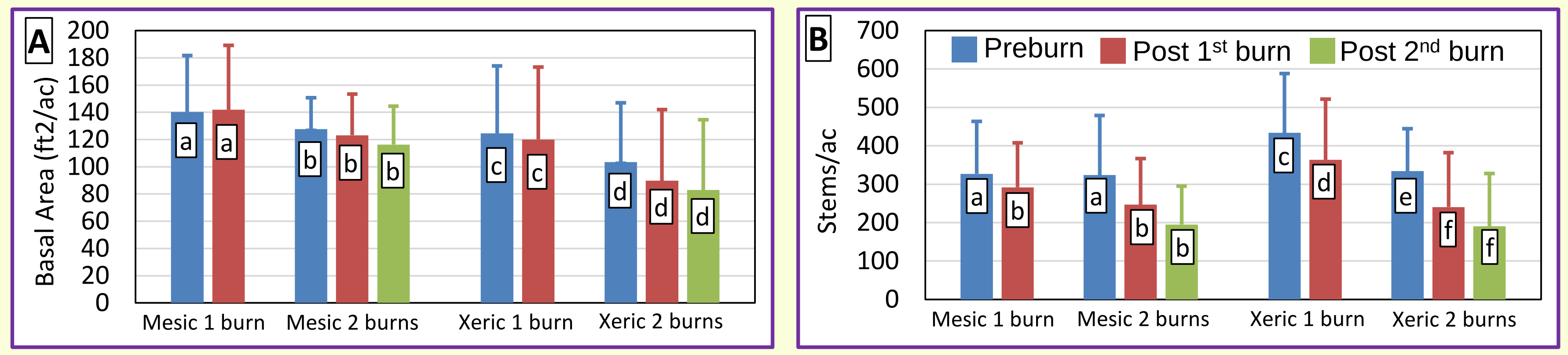

Fig. 3. Mean and standard deviation of overstory basal area (A) and stem density (B) for plots burned once and plots burned twice for mesic and xeric communities. Columns with the same letter are not significantly different at the p = 0.05 level.

Table 1. Diameter classes that were significantly reduced following burns for units burned once and twice.

Diameter Class (inches)	Units burned once	Units burned twice		
	Post 1st burn < preburn	Post 1st burn < preburn	Post 2nd burn < preburn	Post 2nd burn < post 1st burn
2 to 3	Yes	Yes	Yes	No
3 to 4	Yes	Yes	Yes	No
4 to 6	Yes	Yes	Yes	No
6 to 8	No	No	Yes	No
8 to 12	No	No	No	No
12 to 18	No	No	No	No
> 18	No	No	No	No

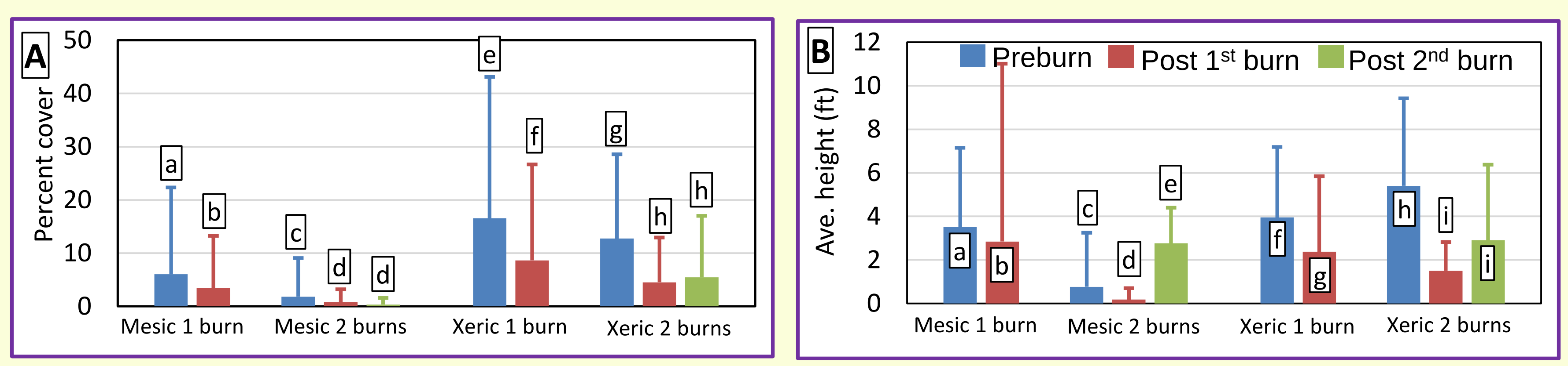

Fig. 4. Mean and standard deviation of percent cover of evergreen shrubs (A) and average height to the top of the shrub layer (B) for plots burned once and plots burned twice for mesic and xeric communities. Columns with the same letter are not significantly different at the p = 0.05 level.

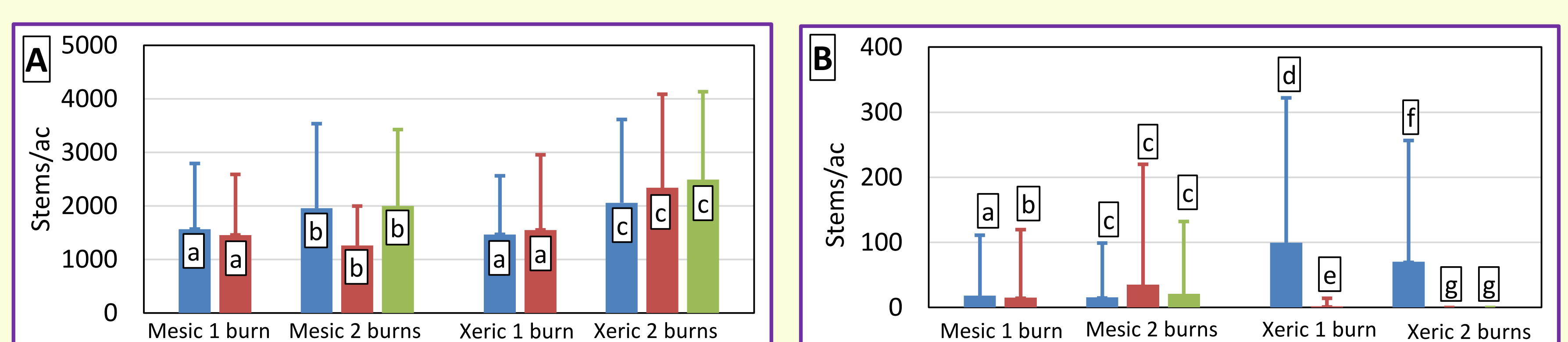

Fig. 5. Mean and standard deviation of total regeneration density (A) and white pine regeneration density (B) for plots burned once and plots burned twice for mesic and xeric communities. Columns with the same letter are not significantly different at the p = 0.05 level.

Forest Communities (Mesic versus Xeric)

- There were distinct differences between the mesic and xeric communities based on preburn overstory species composition (Figs. 2 and 3).
- While the both communities were dominated by oaks, maples, hickory, and other common hardwood species, the xeric communities had noticeably greater amounts of yellow pine, white pine, and blackgum.
- Fire effects were often more pronounced in xeric stands than mesic stands.

Overstory Forest Structure

- A goal of prescribed burning is to change forest structure by opening forest stands. Mesic stands in this study had higher preburn basal areas suggesting a more closed forest condition.
- Burning did not significantly alter stand basal area (Fig. 3A).
- However, burning significantly reduced stand density in both mesic and xeric forest stands (Fig. 3B).
- Stem mortality occurred primarily in smaller diameter stems. Significant reductions in stems up to 6 inches dbh were observed after 1 burn, and 2 burns caused significant reductions in stems up to 8 inches dbh (Table 1).

Evergreen Shrub Layer

- Preburn evergreen shrub cover was significantly higher in xeric stands than mesic stands (Fig. 4A)
- A single burn significantly reduced percent cover and average shrub height in both mesic and xeric stands (Fig. 4A and 4B).
- Further reductions in shrub cover and height were not observed following the second burn (Fig 4A and 4B).

Forest Regeneration

- Total density of forest regeneration was not significantly affected by 1 or 2 burns (Fig. 5A). *Note sprout clumps were tallied as a single plant.*
- The greatest changes in regeneration species composition occurred was a reduction in pine regeneration. This was true in both mesic and xeric stands, though preburn pine regeneration was significantly higher in xeric stands (Fig. 5B).

Conclusions

This study demonstrated that prescribed burning does modify forest structure in Oak-Hickory and Pine-Oak stands in the southern Appalachians. The effects of initial prescribed burns appear to be most pronounced in mortality of trees up to 8 inches in diameter and reductions in the percent cover and height of the evergreen shrub layer. Initial prescribed burns do not appear to drastically alter regeneration density of species composition, with the exception of significant reductions in white and yellow pine regeneration.

Acknowledgements

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