The influence of pre-burn stand variability on prescribed fire success

P.C. Bates1, Jon Shaffer2, Wade Johnston1, Dean Simon3, Margit Bucher4, and Beth Buchanan5

1Department of Geosciences and Natural Resources, Western Carolina University, 2Forest Stewards, North Carolina Wildlife Resources Commission, 3North Carolina Chapter of The Nature Conservancy, 4US Forest Service

Introduction

The southern Appalachians have seen a dramatic increase in prescribed burning during the past decade, much of it designed to recreate conditions that have been altered by approximately 80 years of fire suppression. While fuel reduction is often cited as a primary objective, an overarching goal of many prescribed burns is to restore or maintain fire-adapted plant communities. Partner organizations within the Southern Blue Ridge Fire Learning Network (SBRFLN) are exploring the role of prescribed fire in the southern Appalachians. The SBRFLN has identified four forest communities in greatest need of fire restoration. These include shortleaf pine-oak, pine-oak heath, dry-mesic oak-hickory, and high-elevation red oak. SBRFLN is monitoring fire effects on 13 burn units extending from eastern Tennessee through western North Carolina and into north Georgia (Fig. 1, Table 1). Forest overstory, forest regeneration, vegetation life forms, and fuels data are being collected from permanent plots located both within and adjacent to each burn unit. Pre-burn condition has been assessed for all burn units. Initial burns have been completed on 10 units, and fire effects (assessed during the 2nd growing season post-burn) have been evaluated on 7 units. Monitoring results indicate there is considerable variability in preburn forest condition within each target community, and this variability has the potential to significantly affect (1) changes in stand structure required to achieve desired condition, (2) fire behavior, and (3) post-burn stand condition. This variability must be considered when assessing the role of fire as a restoration tool at the landscape level.

Methods

Field Methods

All sites are being monitored to evaluate the effects of operational prescribed burns on restoration and other management objectives. Sampling is conducted using a series of 1/10th acre permanent plots. For most units, 15 plots are located inside the proposed burn unit. Plots are randomly located in areas dominated by the target restoration communities as defined by Simon (2011). An additional 5 control plots are located outside burn unit. Baseline data were collected prior to burning in all units. A brief description of the data collected in each plot includes:

- **Overstory**: Species, DBH, crown class, and condition for all tree species > 2 inches DBH
- **Regeneration** (data collected in 1/50 ac subplots). Species and height of all tree species > 1 ft tall and < 2 in. DBH were recorded. Sprout clumps were treated as a single stem.
- **Ground cover and vegetative life forms** (estimated in 1/50 ac subplots): percent cover was estimated.

Plot and Burn Unit Characterization

**Ecozone** were identified Simon (2011) using a number of topographic and ecological variables to model ecological units. We used GIS to estimate the area of each ecozone in each burn unit (Table 2), and assign an ecozone to each field plot. An **Arboreal Moisture Index (AMI)** was developed based on procedures developed by McNab (2003). Each tree > 2 inches DBH in a plot was assigned a moisture index value based on site conditions where species is typically found in the southern Appalachians. An AMI was then calculated for each plot field by averaging the values for all trees in the plot.

**A Mesophitic Index (MesIND)** was developed to allow consideration of the potential mesophytosis of forest communities postulated by Nowaki and Abrams (2008), and to relate current forest condition to predicted ecozone. MesIND was calculated as the percent of a plot made up of trees indicative of mesophytosis, such as red maple, sugar maple, beech, blackgum, and cherry.

**Fire Effects** measured soon after a single burn are typically short-lived and rarely initiate long-term changes in stand composition (Brose et al., 2012). For the purposes of this paper we considered 2 variables that are likely directly effected by fire and may lead to changes in stand composition of structure. These include:

- **Understory mortality** estimated by (1) post-burn mortality of stems in the 2 to 6 inch DBH class, and (2) post-burn reduction in basal area in trees in the Intermediate and Overtopped crown classes.
- **Changes in advanced regeneration density** following the burn.

Results

- Higher elevation burn units are dominated by Dry Mesic Oak and Montane Oak Hickory ecozones while units and lower elevations are dominated by Shortleaf Pine Oak (Table 2)
- The current vegetative composition seemed consistent with the ecozone model. High Elevation Red Oak and Rich Cove ecozones contained more mesophitic vegetation than did the drier pine communities (Fig. 2)
- Initial prescribed burns appeared to affect stand structure in all community types. In most cases this was evidenced by decreases in understory density and increases in advanced regeneration (Figs. 3, 4, and 5).
- Ecological units responded differently in terms of understory mortality, though the number and percent of understory stems killed by a single burn did not appear to follow a logical ecological gradient. Drier communities represented both ends of the spectrum (Figs. 3 and 4)
- There was evidence that increasing amounts of understory mortality increased the density of post-burn regeneration. In many cases the post burn regeneration exceeded preburn regeneration densities.
- Our preliminary results did not show any major shift in species composition away from more mesophitic species for either the overstory or advanced regeneration.

Conclusions

- It is difficult to identify clear and consistent trends when analyzing the effects of large, landscape scale prescribed burns. This is likely due to a number of interacting factors including variability in stand and topographic properties, weather conditions, and fire behavior. Fire behavior is also greatly affected by lighting strategies and other fire implementation practices.
- While the complexity of factors will continue to make it difficult for resource managers to predict prescribed burning outcomes, this study demonstrates that some fire effects may be correlated with landscape and other ecological variables that may ultimately provide more insight at the landscape scale.
- Prescribed fire success is a difficult concept to define and one that must consider long-term changes in stand structure and forest composition. We hope continued monitoring in these sites will help better define success, and provide managers with better information for achieving it.

Literature cited


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