

Hard Mast Production Following Two Prescribed Burns in Western NC

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Introduction

Oaks and hickories have replaced the American chestnut as the primary hard mast producing species in the southern Appalachians. Hard mast produced by these trees is a necessary food source for wildlife and is important for species regeneration. Acorn production is variable and can be influenced by weather, insects, wildlife, the tree's crown position and size, and genetics (Dey, 1995)

It is thought that fire suppression has resulted in a decline of oak and hickory species and an increase in fire-intolerant, non-mast producing species. Prescribed burning could mitigate this decline since oaks are fire adapted with thick bark and have a quick re-sprout rate (Abrams and Nowacki, 1992). Periodically reintroducing fire could result in more successful regeneration and restoration of oak hickory forests. However, little is known about the effects of fire on mast production.

The purpose of this poster is to examine the effects of prescribed fire on hard mast production in western North Carolina, focusing on how mast trees with different characteristics (species, diameter, relative mast production) might respond to fire.

Methods

Study site

This project was conducted on the Cold Mountain Game Land in Haywood County, North Carolina between 2006 and 2015 (figure 2). Prescribed burns took place in the spring of 2007 and 2010. The burn unit was 70 acres and consisted of a 60-100 year old oak-hickory stand. One tenth acre plots were established to monitor fire effects. Thirty plots were installed in the burn unit and 22 plots outside the burn unit. Within each plot, up to 3 mature oaks or hickories were selected for evaluating mast production. A total of 56 trees were identified inside the burn unit, and 50 trees were identified outside the burn unit.

Estimating hard mast production

Mast production was estimated for each tree every fall starting the year before the first burn. The NC Wildlife Resources Commission staff estimated the percent of each tree's crown with acorns (PCA) by laying underneath each tree and scanning the tree crown with binoculars for two minutes following the procedure developed by Greenberg and Warburton (2007).

Data analysis

Average PCA values were estimated for each year and treatment (burned or unburned) by species group; White Oak (white and chestnut oak), Red Oak (northern red and scarlet oak) and Hickory (pignut and mockernut hickories). A total of 59 northern red oaks, 25 chestnut oaks, 3 white oaks, 4 scarlet oaks, 6 mockernut hickories, and 9 pignut hickories were assessed.

Treatment effects were compared for each year of the study using a 2-tailed t-test. Diameter was evaluated by comparing the trees greater than the average diameter with those smaller than the average diameter. Relative mast production was determined based on average PCA in all years except the first year post burn. High mast producing trees were those with >25% PCA.

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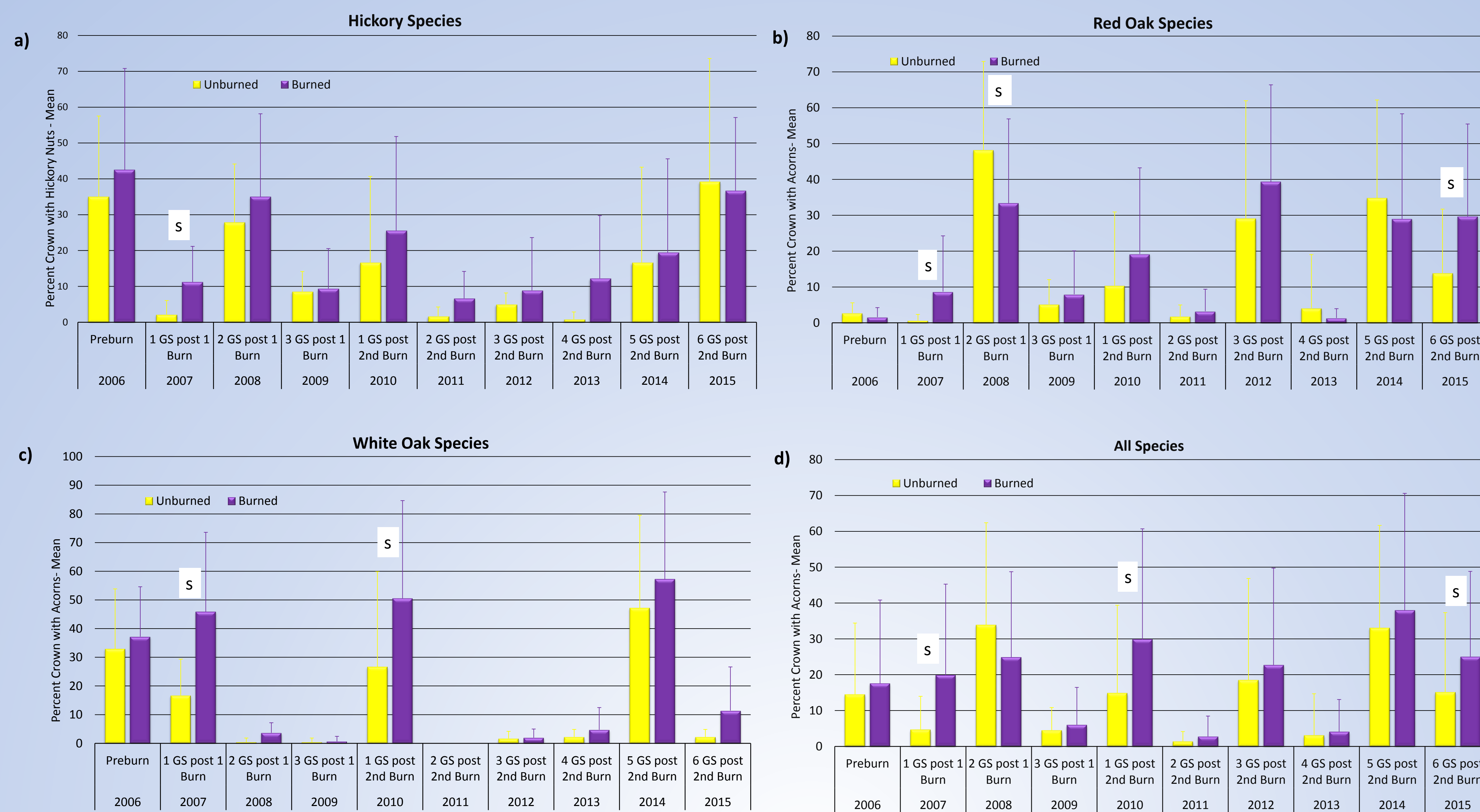


Figure 1: Average percent crown with acorns (PCA) and standard deviation of unburned and burned plots for hickory (a), red oak (b), white oak (c), and all species (d) observed at the Cold Mountain Game Lands in Haywood County, NC. Results within the same growing season with an 's' were significantly different at the 0.05 level.

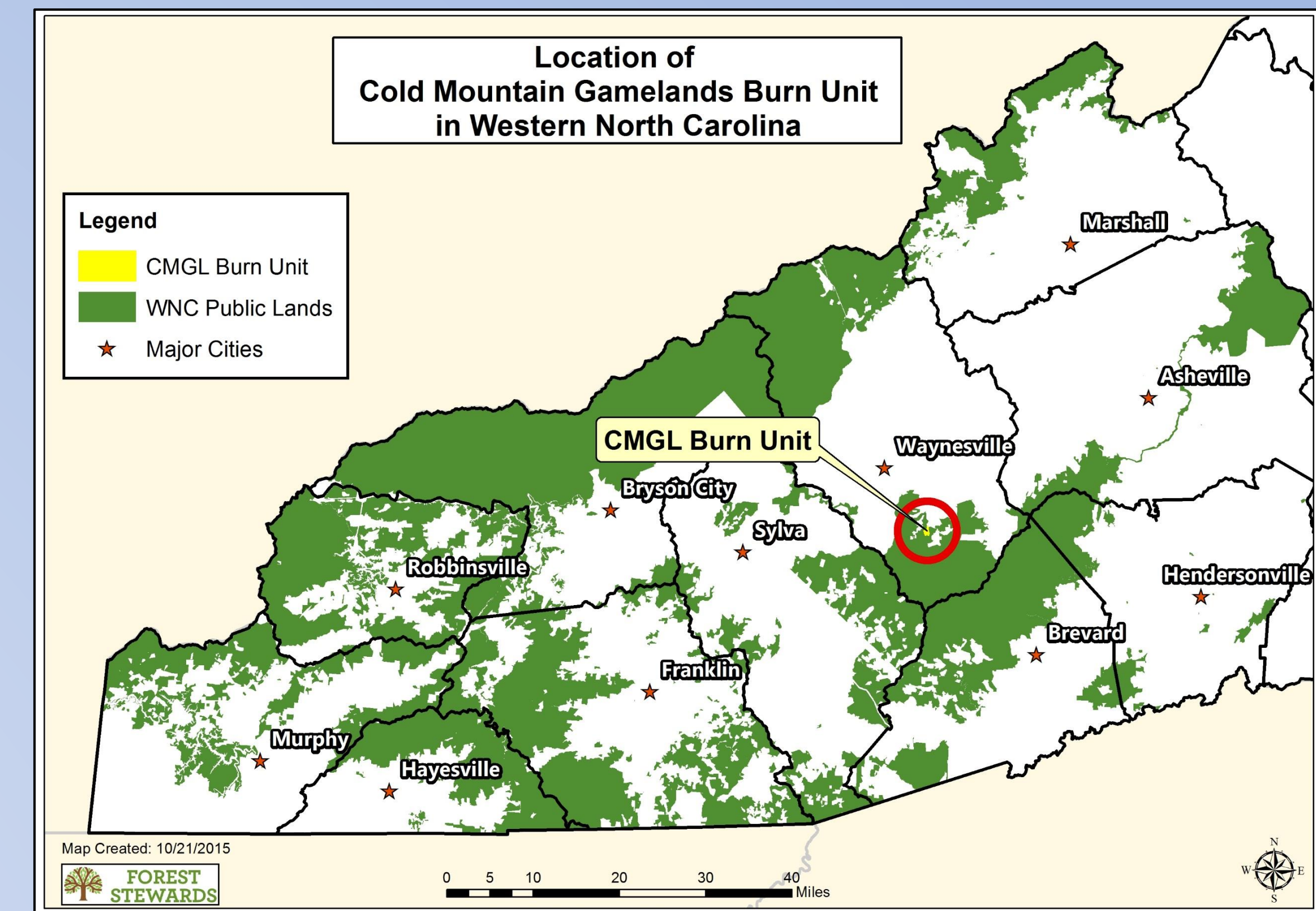


Figure 2: Map illustrating the location of the burn unit in the Cold Mountain Game Land, NC.

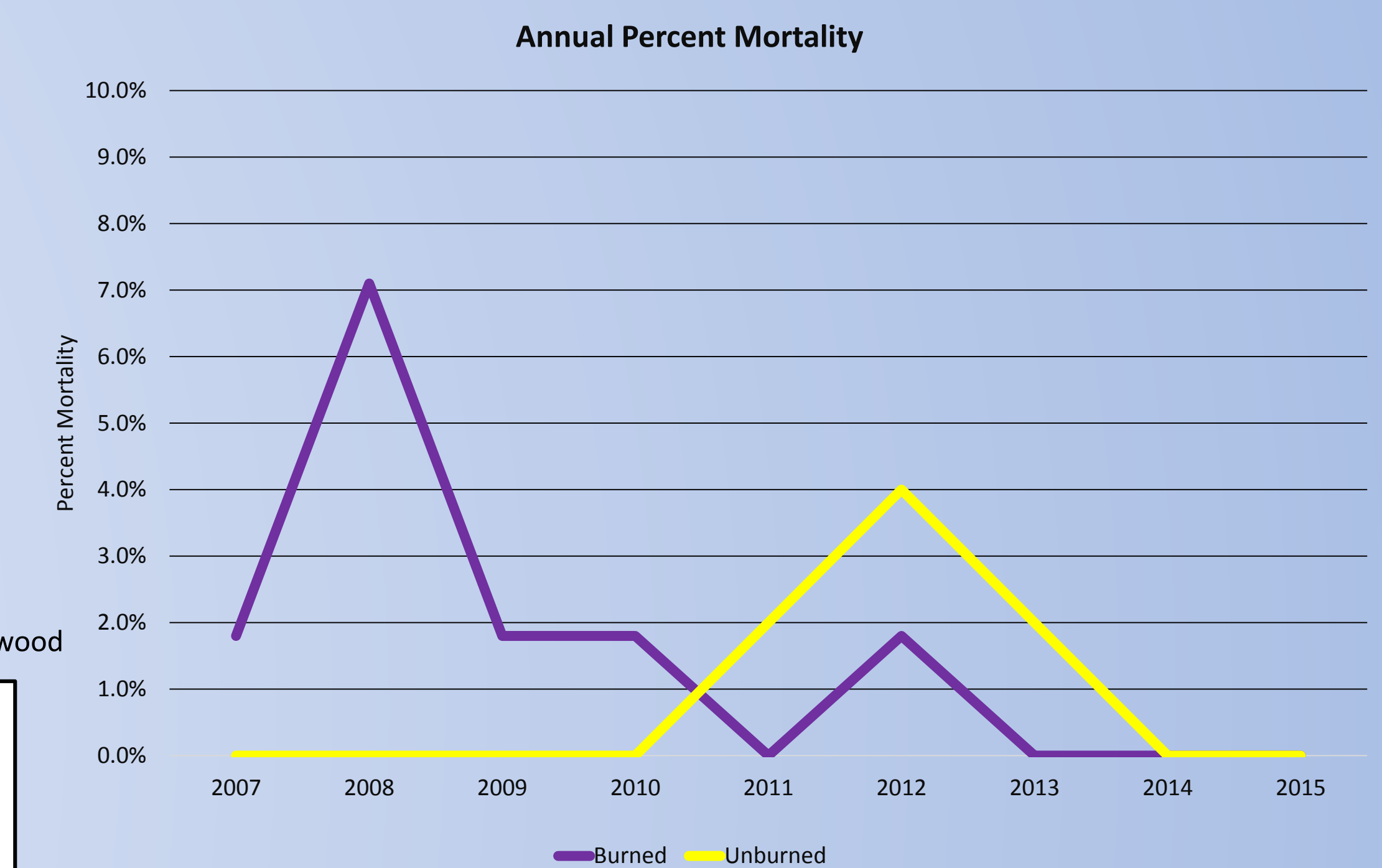


Figure 3: Percent of our study trees that died in the burned and unburned areas over the data collection period

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Results

Overall

In the years of the burns (2007 & 2010) mast production was higher in the burned plots than the unburned plots with p-values of 0.0001 in 2007 and 0.01 in 2010.

Species Groups

Mast production in white oaks (mainly chestnut oaks) was higher in the burned plots both burn years, as shown in figure 1.c. Also, in 2008 (2nd growing season after the 1st burn), white oaks had a significantly higher mast production in the burn unit. Mast production in hickories and red oaks in the burned areas was significantly higher in the year of the first burn (2007), but not the year of the second burn. In 2008 (2nd growing season after the 1st burn), mast production in the red oaks was significantly lower in the burned areas (figure 1.b).

Tree Mortality

Over our 10 year study, we lost 14.3% of the study trees in the prescribed burn area and 8.0% of the study trees in the control area. The majority of the trees lost in the burn unit were lost within 2 years of the first burn (figure 3).

Tree Diameter

Analysis of small versus large tree diameter classes showed no significant difference between burned and control areas, in terms of diameter differences and mast production.

Highest Mast Producing Trees

When considering the highest mast producers versus the lowest mast producers during the years of the burns (2007 and 2010), we found evidence that burning increased mast production in highest mast producers (p-values of 0.04 in 2007 and 0.09 in 2010), but did not affect the lowest producers.

Discussion

Many factors including age and size of the tree, season, fruiting ability, competition, stand age, density, and past history can all influence mast production (Harlow and Van Lear 1989). Multiple variables contributing to mast production can add to the difficulty in determining fire's effects. There are few studies of fire's effects on mast production in the Southern Appalachians.

We found that there was a one year phenomenon with mast production. Following a dormant season burn overall mast production was significantly greater in the burned area than the unburned. Mast production generally increases after burning in Southern forests (Van Lear and Harlow 2002). The same phenomenon was found in 2010 overall, however the white oak group was the only individual species group to have a statistically significant difference between unburned and burned samples. White oaks (particularly chestnut oaks) showed the greatest response to prescribed fire in terms of mast production. Hickories and red oak species did have higher average mast production in the burned areas, but the results were not statistically significant. This may be due to the small sample size or that burning too frequently may reduce mast production (Robbins and Meyers 1992).

Fire intensity was not directly measured, but could be inferred that the 2007 fire had a higher intensity than 2010 due to mortality. This may be due to a the burning technique of creating a ring fire by setting backing fires on ridges and fire breaks and head fires along the base of a slope, road, or fire break. This is a common technique to controlled burns in western North Carolina (Wade 1989). A ring fire can create higher intensity fires due to multiple flames which can intensify when they converge with one another (Lashley et al. 2014).

A continuation of this study in combination with prescribed burns will be of importance towards determining fire's effects on mast production.

Conclusion

Overall prescribed burning appeared to increase hard mast production in both oaks and hickories following the first growing season after spring, dormant-season burning. These effects were no longer evident 2 or more years after the burns. White oaks (chestnut oaks in particular) seemed to respond the most to fire in terms of mast production. Gaining awareness of how prescribed fire can affect mast production in certain trees can help foresters and land managers make better informed decisions in oak-hickory forests.