THE EFFECTS OF A WILDFIRE ON PINE SEEDLING RECRUITMENT

Paula C. Gnehm and Brad Hadley[1]

ABSTRACT.—We investigated the effects of a single arson wildfire by comparing its impact on pine seedling recruitment with that of both prescribed fire and unburned compartments. Although a t-test detected no significant difference in pine seedling recruitment ($p = 0.38$), the "wildfire" treatment produced 127 more seedlings than the unburned treatment, and 96 more seedlings than the prescribed fire treatment. Managers should consider using burn conditions similar to a wildfire when the primary objective is a simple increase in the pine component of a particular stand.

INTRODUCTION

Wildfires are not an uncommon occurrence in the Missouri Ozarks. The differences between their effects and those of prescribed fire on shortleaf pine (*Pinus echinata* Mill.) seedling recruitment are unknown.

Shortleaf pine is one of the many pine trees that can be found in Missouri, but it is the only pine tree that is native to the state. It takes approximately 2 years for a shortleaf pine seed to germinate naturally. Shortleaf pine seedlings have a persistent J-shaped crook at the ground level (Lawson 2006). A shortleaf pine's above-ground growth during the first year is very minimal compared to the root system it is putting in the ground. A year-old seedling can easily be overlooked because even with its needles, it is only about 1 to 1.5 inch in diameter, and about the same in height. Shortleaf's intense need for full sunlight will allow it to grow only in open areas. Throughout the tree's life this need for sunlight continues; as the tree grows taller, the limbs at the top of the tree shade the older branches on the bottom. The older branches consequently wither and die, giving the tree its characteristic form of bare stems and leafy tops (Dorst and Crandall 2005).

Like other conifers, shortleaf pines are generally prolific seed producers. However, site preparation is usually necessary for natural regeneration. The small, winged seeds must come into direct contact with the soil on the forest floor to effectively germinate and grow. Usually a thick layer of litter deposits, such as leaves, grasses, branches, and weeds, will produce a barrier between the seeds and the soil. Prescribed burning is an excellent method to remove this barrier. This method is used to help promote the natural regeneration of many plants, including shortleaf pine. Fire will also eliminate most of the hardwood and vegetative competition and some of the standing dead trees, ultimately opening the canopy and allowing penetration of the direct sunlight the seedlings need to grow (Zimmerman 2006).

In April 2003, a very intense arson wildfire on Birch Creek Conservation Area burned approximately 160 acres. Four agencies were on site for approximately 8 hours, with an estimated total labor force of 25 people. The roughly 7,000 acres of the Birch Creek Conservation Area are under a 15-year management rotation. The particular area burned had received no management treatments in the recent past (since 1994), leaving it fully stocked with trees but little to no slash. In the 2 years since the fire, the area has had a salvage timber sale.

We investigated the effects of the wildfire by comparing its impact on pine seedling recruitment with that of both prescribed fire and unburned compartments.

STUDY AREA

Three study sites were located within the Current River Hills Subsection of the Ozark Highlands Ecological Section (Nelson 2005) on Birch Creek and Peck Ranch Conservation Areas. The primary study site was the site of the wildfire burn; it had been subject to wildfire 2 years prior to the study period, and was located within an existing pine stand. This site had a slightly north-facing slope. In our choice of comparison sites, we made every effort to match their attributes to those of the primary study site. Variation within a specific stand is always apparent, however, and it is therefore virtually impossible to perfectly "match" attributes among disjunct stands. Nevertheless, the two comparison sites were selected from those available with similar attributes, including aspect, slope, natural community types, seed source availability, and soil type. Beyond these

[1]Resource Assistant (PCG), Peck Ranch Conservation Area, Missouri Department of Conservation, PO Box 180, Jefferson City, MO 65102; and Conservation Agent (BH), Shannon County, Missouri Department of Conservation, PO Box 181, Birch Tree, MO 65438; Biology Department Adjunct Faculty (BH), Drury University, 900 N. Benton Ave., Springfield MO 65802. PCG is corresponding author: to contact call (573) 300-9572 or email at tattat1@hotmail.com

attributes, the second site was within a prescribed burn compartment and had been subject to prescribed fire under conditions that were mild, compared to the wildfire site. The site was located on Peck Ranch Conservation Area. The third site was within an unburned compartment, which was also located on Peck Ranch Conservation Area.

METHODS

Randomly selected plots of approximately 1 acre were chosen within each treatment type. Twelve randomly selected (using random number key for bearing and distance from center) subplots 12 ft in diameter (≈ 113.25 square feet) within each treatment type plot were sampled. Subplots were sampled by driving a rebar stake with a 6-ft length of rope attached into the ground and pivoting around that stake to the true place of beginning, counting all seedlings (fitting subjective assessment as being ≤ 2 years old) observed.

Statistical analysis of sample means (t-test$_{[\alpha.05]}$) was performed using Minitab® 12.1 software (Minitab®, State College, PA) on a standard PC.

RESULTS

Twenty-six seedlings were counted for all three of the study sites. Their distribution in the sample is illustrated in Figure 1. The calculated average number of seedlings per subplot was extrapolated to estimate the number of seedlings per acre by treatment type (Fig. 2). Although the "wildfire" treatment produced 127 more seedlings than the unburned treatment, and 96 more seedlings than the prescribed fire treatment, the t-test detected no significant difference in pine seedling recruitment ($p = 0.38$).

DISCUSSION

The t-test's failure to detect a significant difference may be an artifact of sample size, in that only 3 percent of each of the study sites was sampled. It is possible that by chance alone the least intensely burned areas were sampled in the wildfire area, and the most productive pine seedling areas were sampled in the unburned area. The outcome of such chance events would tend to bias the sample towards no significant difference between treatments. Another factor that could have influenced this study is the fact that the wildfire-burned area had been subjected to a salvage sale. As stated earlier, removal of standing dead trees "opens" the ground to sunlight. This increase in sunlight could have contributed disproportionately to the greater seedling recruitment on the wildfire-burned area. However, the fact remains that this wildfire and its subsequent management resulted in the recruitment of an estimated 127 more pine seedlings per acre on the wildfire burned area than on the unburned area. Managers should consider using burn

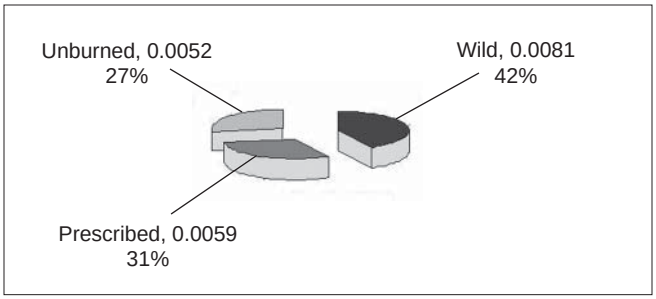

Figure 1.—Average pine seedling recruitment per square foot by fire treatment type, and percent of total number of seedlings in sample.

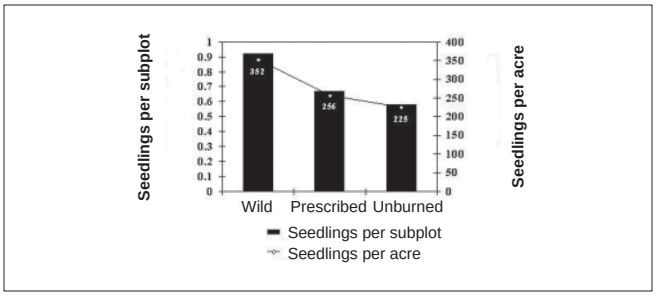

Figure 2.—Number of seedlings per acre as estimated from number per subplot by treatment type.

conditions similar to a wildfire if and when affecting a simple increase in the pine component of a particular stand is their primary objective.

Timing, intensity, and frequency of prescribed burns are critical to establish and develop successful shortleaf pine stands (Cain and others 1998). Our results suggest that to best achieve initial ecological release, prescribed fires should be performed under parameters that allow for intense heat, such as those in "wildfire" conditions.

ACKNOWLEDGMENTS

We thank the Peck Ranch Wildlife Division staff of Dan Drees, Kim Houf, Marshall Price, Patti Vessels, and Leta Hightower, and Eminence District Forestry staff of Johnny Tuttle and Gary Gognat for their time, effort, and support. We also thank reviewers of this manuscript for suggestions that resulted in its improvement.

LITERATURE CITED

Cain, M.D.; Wigley, T.B.; Reed, D.J. 1998. Prescribed fire effects on structure in uneven-aged stands of loblolly and shortleaf pines. Wildlife Society Bulletin. 26(2): 209-218.

Dorst, H.; Crandall, J. 2005 retrieval. An introduction to Ozark trees. [online]. Available: http://www.watersheds.org/nature/trees.htm

Lawson, E.R. 2006 retrieval. *Pinus echinata* Mill. [online]. Available: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_1/pinus/echinata.htm

Nelson, P.W. 2005. The terrestrial natural communities of Missouri. Jefferson City, MO: The Missouri Natural Areas Committee. 550 p.

Zimmerman, M.L. 2006. The effects of prescribed fire on the herbaceous layer in the southern Appalachian Mountains. Johnson City, TN: East Tennessee State University. 111 p. M.S. thesis.