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EFFECTS OF PRESCRIBED BURNING ON WHITE-TAILED DEER HABITAT IN THE SOUTHEASTERN UNITED STATES

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INTRODUCTION

The white-tailed deer is the most popular game species in the United States. There are many biological, social, and economic reasons for maintaining deer populations. Thus, state wildlife agencies, private lands biologists, and landowners alike are all interested in improving habitat conditions for deer. Ideal deer habitat in the southeast includes access to forest plant communities that are associated with varying successional stages, ensuring the availability of quality forage and protective cover across and within years. In the southeastern United States, prescribed burning is a preferred practice for maintaining such a mosaic of vegetation communities and ensuring all deer needs are being met. In this article, we discuss the effects of prescribed fire, also referred to as controlled burning, on deer populations and provide recommendations for using prescribed fire to improve deer populations.

Ecological succession refers to the development of a plant community over time. In the Southeast, early successional vegetation communities may include grasslands, abandoned agricultural fields and pastures, and recently cleared forests (Fig. 1). They consist of fast-growing plants that provide quality forage and cover for wildlife. Early successional communities are rich in highly preferred deer forages, such as ragweed, blackberry vines, and persimmon. Deer also use early successional vegetation for cover, particularly during the fawning season.

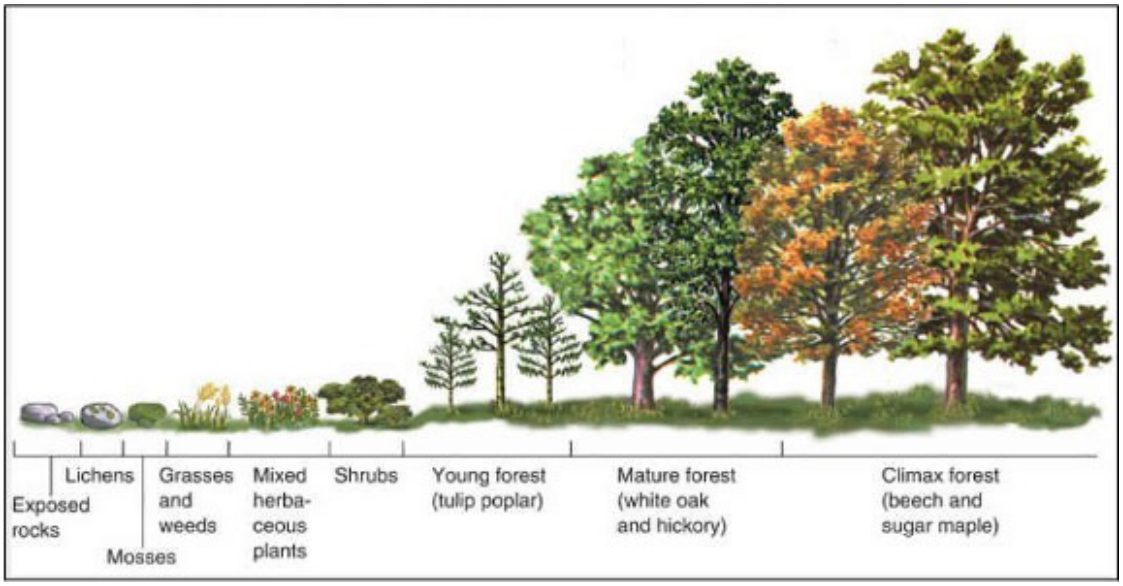

Figure 1: *Diagram demonstrating ecological succession as time progresses from bare rock to climax forest.* (Living Nature 2017)

Over time, and in the absence of active management or natural disturbances such as wildfire or hurricanes, the vegetation progresses toward a mature forest. Late successional forests provide other foods, such as acorns which are a valuable food source for deer in fall and winter months when less herbaceous vegetation is available. Mature forests also provide thermal cover in the form of shade and shelter from extreme weather conditions.

Between early and late successional forest is a progression of successional stages that benefit deer in different ways. Deer ideally have access to a variety of these vegetation communities. Periodic disturbance is required to reset forest succession and prevent canopy closure that blocks sunlight from reaching the forest floor, preventing understory growth, and thus, limiting forage quality and quantity. As a result, the quality and abundance of deer populations may also decline. To counter this process, management techniques, such as prescribed burning, herbicide application, and thinning, create disturbance and reset forest succession.

PRESCRIBED BURNING

Fire has long been a crucial component of forest management in the Southeast. Lightning-ignited fires burned as often as once a year in the Coastal Plain and as infrequently as every fifty years in the mountains[34]. In addition, Native Americans applied fire across the Southeast to promote open grasslands that attracted grazing animals and birds, such as bobwhite quail and turkeys, and facilitated the growth of wild grains, berries, and legumes (i.e., pea-like plants). Today, prescribed burning is used to replicate the effects of those fires.

As the human population continues to grow and development fragments landscapes, suppression of wildfires has become standard practice to protect human life and property. Under such practices, forests progress toward a fire-resistant midstory with little ground cover and woody browse that has grown beyond the reach of deer[25].

Prescribed fire is a cost-effective tool utilized by state and federal agencies, biologists, and landowners to counter this progression. Fire alters the vegetative community and stimulates new growth, increasing plant species richness and diversity. It inhibits the growth of less valuable species, such as sweetgum and tulip-poplar, which compete with more desirable overstory species such as oaks and limit understory growth. Periodic prescribed fire also reduces litter accumulation, eliminating fuel loads that power intense wildfires. How and when fire is applied, however, depends on the specific management objectives for the property.

In the Southeast, fire is commonly used to meet both timber and wildlife objectives, including restoration and maintenance of critical habitats for wildlife (Fig 2). When implementing prescribed fire in wildlife management plans, species-specific guidelines are necessary to inform managers how burning should be conducted to best meet objectives. If you are interested in applying prescribed burns to your property, it is important to do your due diligence as each state has specific laws for burning on private property. Georgia law requires a burn permit to be obtained before conducting any outdoor burn of natural vegetative materials. Permits are only valid for the day they are granted. The Georgia Forestry Commission (GFC) issues permits and assists Georgia landowners in planning a safe and successful prescribed burn.

EFFECTS ON PLANT COMMUNITY

Burning stimulates new growth of plants and enhances species richness and diversity. It sets back forest succession and allows previously outcompeted species to become established.
New growth is observed within a couple of weeks to months post-burn, and most plants fully recover within two years after burning[29].

Figure 2: ***Buck in velvet foraging in a planted longleaf pine stand about four months post-burn.*** Daniel Crawford

BURNING IMPACTS ON DEER

Concerns for human and animal safety are commonly associated with burning and many people may be reluctant to implement burning on their own land. However, if done correctly, burning can be an effective and safe method of creating optimal deer habitat.

DEER BEHAVIOR AND SELECTION

Research has shown that deer do not appear frightened or alarmed by fire. They use moist sites, like streambeds, as refuge from fire[13]. Further, deer do not show long-term shifts in their home range after a burn[13]. Though use of burned sites may decrease immediately after fire, deer return to these areas one to three months after burning[28,24], or even sooner depending how quickly vegetative growth occurs[5]. Deer will continue to use these burned sites for two to five years after a burn as they access the improved forage that results from new plant growth[15,19].

Despite their preference for feeding in burned sites, deer require access to sites that have not been recently burned for concealment cover in the summer during fawning, in the fall and winter during hunting season, and for protection from predators year-round[4]. However, specific needs differ by time of year and sex. Male deer prefer burned areas in summer due to the high-quality forage that maximizes body condition prior to the rut[20]. In contrast, males prefer unburned sites during hunting season because of the protective cover they provide. In comparison, females prefer burned sites in spring, summer, and fall which coincides with their major reproductive periods: late gestation (spring), lactation (summer), and prior to breeding (fall), when access to quality forage is crucial for successful reproduction[20]. On the other hand, if predation risk is high, does will sacrifice higher quality forage for access to concealment cover when raising fawns[4]. Recent burns do not provide sufficient cover to hide fawns from predators. It is crucial to ensure deer have access to high quality forage and protective cover by creating a mosaic of habitats across a deer's home range of 600 to 700 acres.

DEER HEALTH AND NUTRITION

Nutritional requirements of deer vary by age and sex. In general, deer require 13% to 16% protein in their diet for optimal growth[8]. Protein, calcium, and phosphorous all aid in body and antler growth. Females require significant sources of these resources during gestation and lactation. In laboratory trials, fawns fed diets that were low in either of these three crucial components were smaller than those fed nutritionally sufficient diets[8], which in turn negatively impacts fawns because larger fawns are more likely to survive to adulthood and reproduce sooner[3]. Furthermore, deer that consumed deficient diets as fawns experience stunted growth for life, regardless of their diet as adults, and the effects can even be seen in their offspring.

Prescribed burning addresses many of these issues as it leads to increased protein content and digestibility of grasses, forbs, and woody species commonly consumed by deer for up to several years post-fire[7,29,36]. In addition, deer on burned sites have more diverse diets with higher mineral content, including calcium, phosphorous, and nitrogen[2,36], relative to unburned sites[33,38]. Though woody browse is temporarily reduced immediately after burning, increases in nutrient content of forbs and grasses compensate deer diets and directly translate to improved herd health. Further, adult females are still able to maintain body condition and normal gestation to raise healthy fawns after a fire[21].

FIRE FREQUENCY

EFFECTS ON DEER PREDATORS

In a Florida study, researchers found that bobcat and coyote abundances decreased with increasing pyrodiversity. Pyrodiversity refers to areas burned at varying conditions, facilitating heterogeneity across the landscape. Additionally, black bear, bobcat, and coyote abundances increased with proximity to hardwood stands, typically characterized by longer (5+ years) fire return intervals[14].

EFFECTS ON DEER HUNTING

In Texas, Wall (2018) found that most deer were harvested in the first year following a burn, and deer harvest declined as time since last burn increased. However, body weight and antler points, base, beam, and spread measurements of harvested deer peaked two years post-fire.

In general, a 3- to 5-year fire return interval is recommended to best benefit deer in pine and mixed pine-hardwood stands. Fire effects in hardwood stands are less studied than pine systems, but hardwoods can benefit from longer intervals. A burn interval of 1 to 2 years will increase nutritive value of plants and produce a greater quantity of deer-selected forage, but soft mast (fleshy fruits and berries) production may be limited[1,17]. In contrast, a 3-year fire return interval will lead to improved legume and forb (i.e., succulent non-grass plants) production while the woody understory begins to develop, and soft mast production is increased[6]. Shorter intervals see the greatest increase in nutritive value of forage species but eliminate cover crucial for deer habitat. While soft mast begins to develop as early as two years post-burn, many species reach their maximum production at longer intervals[11]. A 4- to 5-year burn interval will provide better cover for deer, higher soft mast production, and greater woody understory development[11,16]. Burning on a longer interval will allow the woody understory to develop, ensuring cover and browse without losing the nutritive value that burning provides early in the fire cycle. However, beyond 5-year intervals, forage availability and nutritive value begins to decline, and deer use of the habitats will decline[22,26]. Together, this suggests burning should be done frequently enough (shorter than 5 years) that forage quality remains high. Overall, deer benefit from pyrodiversity. Managers should vary fire frequency within and among stands to create a mosaic of vegetation types for deer to access.

FIRE SEASON

The season in which a burn is applied will influence the timing and type of vegetation that returns. At this point, no scientific information exists on the impacts of different seasonal burns on deer population health, thus the decision to burn becomes primarily dependent on the manager's objectives and capabilities. Dormant season (winter) burns have logistical advantages because environmental conditions aid in fire control and the lower temperatures reduce the intensity of the burn. There is a slower recovery time for dormant season burns, resulting in exposure of bare ground for a longer period. Bare ground provides no forage, no cover, and has an increased risk of erosion because no plants are present to hold soil in place. However, exposing bare ground helps enhance oak regeneration, another important food source for deer.

In contrast, growing season burns enable faster plant recovery times. However, managers tend to avoid early growing season burns because of the assumption that survival of fawns and other wildlife, such as ground-nesting birds, will be negatively impacted by fire. Because of this, it is recommended that growing season fires be conducted later in the season (late summer and fall) to avoid peak wildlife reproduction. Late growing season burns may have slightly slower plant recovery times, but they are still effective in maximizing forage quality[31].

Studies have shown that burning across each season has positive effects on plant species richness, diversity, and nutrient content[31,32,37]. Ultimately, this suggests that burn season be varied to create a mosaic of habitats that maximize nutrition available to deer within and across years. Remember, if your goal is to improve deer habitat, then use varying fire treatments across the landscape to foster heterogeneity.

HOW MUCH AREA TO BURN?

The key to producing deer habitat is to create a mosaic of habitats across the landscape. Fire prescription (season, interval, intensity) in burn units should be varied to create a variety of habitats at different successional stages.

Burn units should be small (10-30 acres) and dispersed across a deer's home range (600-700 acres).

INFORMATION FOR LANDOWNERS

If done correctly, prescribed burning can be highly effective in creating optimal habitat for deer. However, there are some cases where environmental conditions are not suitable for burning. Site-specific weather, soil, and vegetation characteristics influence the outcome of a burn. In areas prone to drought, regrowth may be severely delayed, potentially reducing forage availability[24]. Further, in drier soil types, fire can burn organic matter in the soil surface layer. Organic matter contains nutrients that are crucial

for plant growth. To prevent this, soil should be wet or damp when burning to protect the organic matter in the soil and ensure vegetation will be able to recover post-fire.

Another factor to consider is pre-fire vegetative characteristics. Burning too frequently can have negative effects on some ecosystems by limiting the growth of plants that take longer to become established, such as soft mast-producing plants[18,10]. Leaving enough time between burns for the desired vegetation to recover is necessary. This will happen at different rates depending on time of year and location, but 3- to 5-year return intervals is recommended because it allows for woody understory development and soft mast production.

Deer density will also influence the ability of vegetation to regrow after a burn. In areas where deer abundance is high, burning may not be ideal because browsing pressure could prevent plants from being able to reestablish following a burn[27]. On the other hand, when deer abundance is at low to moderate levels, deer browsing following a disturbance can promote herbaceous species richness[30]. At low deer densities, competition for resources is reduced and prescribed fire can be used to improve the body condition of remaining deer.

COMBINING TREATMENTS

To maximize positive effects, it is sometimes best to combine prescribed burning with other treatments, such as thinning of trees and herbicide application, to reach desired outcomes. This is especially true for closed canopy, old growth forests and poorly managed stands. Burning in a stand with complete canopy closure without first creating canopy gaps will be ineffective. Timber harvest and herbicides are used to create canopy openings that allow sunlight to reach the forest floor, facilitating regrowth post-fire[12]. Canopy gaps also provide a means for smoke and heat to escape the stand. Additionally, debris left over from timber harvest serve as fuel for fire. Fire then removes the litter layer to allow understory regeneration. These treatments are generally applied before burning. Though combining treatments may result in a more thorough burn with a slower recovery time, the benefits tend to last longer in these stands compared to those that are subject to fire only[12,23]. Further, varying treatment types across units (i.e., one unit is burned, and another is thinned) is another method of creating a mosaic of habitats for deer to access.

Other treatments can also be applied after a burn to maximize deer habitat. Planting food plots can be used to compensate for the loss of forage in the year following a burn or when food resources are low in an area[9]. However, maintenance of these plots can be costly. Burning of natural habitats is a cost-effective alternative.

MANAGEMENT IMPLICATIONS

Burning on a 3- to 5-year fire return interval maintains forage quality and availability, allows soft mast production and woody understory development, and ensures adequate fawning cover.

Managers should vary fire frequency, season, and intensity and avoid burning in large contiguous areas across a deer's home range (600-700 acres). A mosaic of habitats at different successional stages provide deer with access to high-quality forage and concealment cover year-round.

Site-specific weather, soil, and pre-fire conditions influence vegetation response after burning. Burning can be done in combination with other treatments, such as thinning and herbicide, to maximize effects on plant communities.

BURNING IN FOOD PLOTS

Prescribed fire can be used to create and maintain food plots for deer. Additionally, burning food plots can benefit other species, such as mourning dove. Green patches typically maintained for deer can be burned and mowed to create dove fields prior to their hunting season.

NEXT STEPS

If you are unsure whether prescribed fire will be beneficial on your property, you should seek guidance from your area wildlife biologists with the Georgia Department of Natural Resources. Of note, the Georgia Deer Management Assistance Program (DMAP) can provide habitat recommendations to help guide your decision. Once you decide to administer a prescribed burn on your property, you should consult someone who is experienced and can provide guidance in planning your burn. Remember, landowners are required to obtain a burn permit prior to initiating any kind of fire. From there, it is important to monitor your deer herd to better understand how they may respond to habitat changes. Go tinker, try different strategies, and see how the habitat responds.

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