RESEARCH NOTE

Preliminary Response of Herbaceous Plants to Biennial Burning Cycles Applied at Different Dates During the Growing Season

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ABSTRACT: The increase in acreage treated with growing-season fire during the past decade indicates that there has been increased interest in burning to enhance southern pine forest health and diversity. Information on how burn dates within the growing season can be manipulated to vary the mix of species is of practical importance. The objective of this study was to determine the response of herbaceous and woody plants to eight, 3-week treatment application windows during a biennial growing-season burn cycle at the Piedmont National Wildlife Refuge in Georgia, USA. Early results indicate other environmental factors, particularly lack of precipitation, had a greater impact on vegetation than prescribed burning.

Respuesta Preliminar de las Plantas Herbáceas al Ciclo de Quema Bienal Aplicado en Diferentes Fechas Durante la Estación de Crecimiento

RESUMEN: El aumento de superficie tratada con fuego en la estación de crecimiento durante la década pasada indica que hubo un interés creciente en la quema para mejorar la salud y diversidad de los bosques de pino del sur. La información de cómo las fechas de quema dentro de la estación de crecimiento pueden ser manipuladas para variar la mezcla de especies es de importancia práctica. El objetivo de este estudio fue determinar la respuesta de las plantas herbáceas y leñosas a la aplicación de un ciclo bienal de ocho ventanas de tratamiento de tres semanas durante la estación de crecimiento en el Refugio de Vida Silvestre Piedmont, en Georgia, USA. Los resultados preliminares indican que otros factores ambientales, particularmente la falta de precipitación, tienen mayor impacto en la vegetación que el fuego recetado.

Index terms: drought, growing-season burns, lower Piedmont, prescribed burning

INTRODUCTION

Numerous authors (Greene 1934; Stoddard 1935; Wahlenberg 1935; Heyward 1937; Oosting 1944; Lemon 1946; Bruce 1947; Cushwa et al. 1966, 1970; Vogl 1973; Christensen 1981) have reported temporary increases in herbs, forbs, briars, and vines after fires during all seasons of the year and of varying intensities. The first observation that spring fires stimulate flower production of native grasses in the southern United States has been attributed to Sheppard (1953), although Stoddard (1935) noted that fires as late as May increased the seed crop of perennial legumes. Burton (1944) reported that fire in January through April increased seed production of some pasture grasses more than either nitrogen fertilization or close mowing, but that burning in April significantly retarded seed production of early maturing grass varieties. Biswell and Lemon (1943) reported late spring/early summer burns stimulated seed-stalk production of native bunch-grasses in southern Georgia, but increased production was only observed the year of the burn. Lemon (1949) determined that andropogons (*Andropogon stolonifer* [Nash] Hitchc., *A. virginicus* L., *Schizachyrium tenerum* Nees, *A. glomeratus* Walt.), and panicums (*Panicum albomarginatum* Nash, *P. ciliatum* Ell., *P. aciculare* Desv.) increased in abundance after winter fire and then slowly decreased, whereas Garren (1943) concluded in a literature review that fire decreased abundance of *Andropogon virginicus* but not *Schizachyrium scoparium* (Michx.) Nash: however, severe burns increased weeds and decreased all grasses. Late summer fires were shown to be as good or better than dormant-season burns in increasing herbs (Lay 1956, Hodgkins 1958). Moore (1956) reported that density of andropogon was higher on unburned sites than on burned sites, but Hodgkins (1958) indicated that finding was simply a result of the time of measurement. Hodgkins (1958) found that forbs tend to dominate the grass-forb strata the first growing season after fire, while grasses and woody plant cover dominate thereafter.

Virtually all fires also promote sprouting of numerous woody plant species (Brender and Nelson 1954, Wenger 1955, Hodgkins 1958) that begin to dominate the groundcover in several years unless another fire occurs. Platt et al. (1988) found significant differences in flowering responses at both the plant and community level associated with changes in the seasonal timing of fire on the coastal plain of north Florida. Waldrop et al. (1987) found that annual growing-season fire eradicated some woody species over time on the South Carolina coastal plain.

Streng et al. (1996) reported that fire frequency is more important than burning season in maintaining groundcover plant diversity on coastal plain sites, with the possible exception of annually burned plots. Wade et al. (1989) compared the vegetation on Piedmont National Wildlife Refuge (PNWR) compartments burned every fourth year since 1964 during the dormant season, with the vegetation on compartments where fire had been excluded. They found that twenty years of winter burning did not alter species composition but had drastically modified vegetation growth form and increased the number of herbs and woody stems in the groundcover. The breadth of the findings described above strongly suggests that, although trends may be at least region-wide, many specific fire effects are influenced at a finer grained scale.

Our study is being conducted on the 14,164-ha PNWR located in the lower Piedmont of Georgia, Jones County, 40 km north of Macon. PNWR was created by executive order in 1939 on severely eroded and abandoned land that had been in row crops for over 100 y. Management objectives of the PNWR include: (1) providing suitable habitat for indigenous wildlife species, (2) managing the timber resource on a sustained yield basis, and (3) serving as a demonstration area for studies that integrate these two objectives.

Overstory vegetation consists of mixed loblolly pine (*Pinus taeda* L.) and broadleaved species, including *Quercus* L. spp., sweetgum (*Liquidambar styraciflua* L.), and Florida maple (*Acer barbatum* Michx.). Midstory is dominated by flowering dogwood (*Cornus florida* L.), black cherry (*Prunus serotina* Ehrh.), and *Smilax* L. spp. Understory vegetation includes *Dicanthelium* spp., *Panicum* L. spp., *Desmodium* Desv. spp., *Lespedeza* Michx. spp., longleaf uniola (*Chasmanthium sessiliflorum* [Poir.] Yates), purple wood sedge (*Carex purpurifera* Mackenzie), Japanese honeysuckle (*Lonicera japonica* Thunb.), and poison ivy (*Toxicodendron radicans* [L.] Kuntze).

The objective of our study is to track the floral response to eight chronological growing-season burn periods. The study was not designed to compare growing-season with dormant-season burns or unburned areas. The study area had been managed over the previous three decades with a 4-y winter-burning cycle. Combining the results of the current study with browse preferences of targeted wildlife species will allow managers to select burn dates to promote desired species.

METHODS

Prescribed fire is scheduled for application at PNWR once every two years over an 8-y span during a specified 3-wk period of the growing season. Eight different periods are used starting April 1 and running consecutively to September 8. The periods are: April 1–21; April 22–May 12; May 13–June 2; June 3–23; June 24–July 14; July 15–August 4; August 5–25; August 26–September 8. Biennial burns are conducted at the first opportunity during each 3-wk treatment period. Treatments are replicated three times yielding a total of 24 0.8-ha plots (8 plots/treatment). Each plot is scheduled to be burned four times during the same treatment window to identify

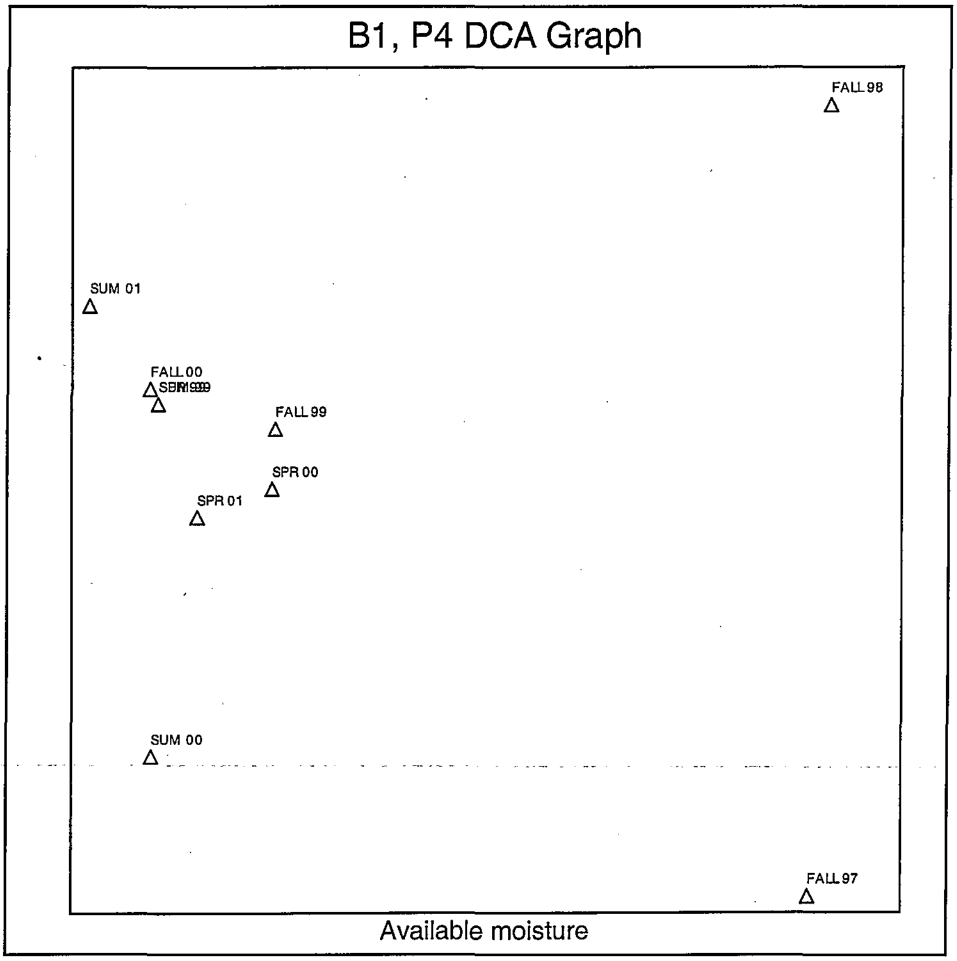

Figure 1. DCA graph of Block 1, Plot 4 vegetation at the Piedmont National Wildlife Refuge, Georgia, USA, from fall 1997 to summer 2001.

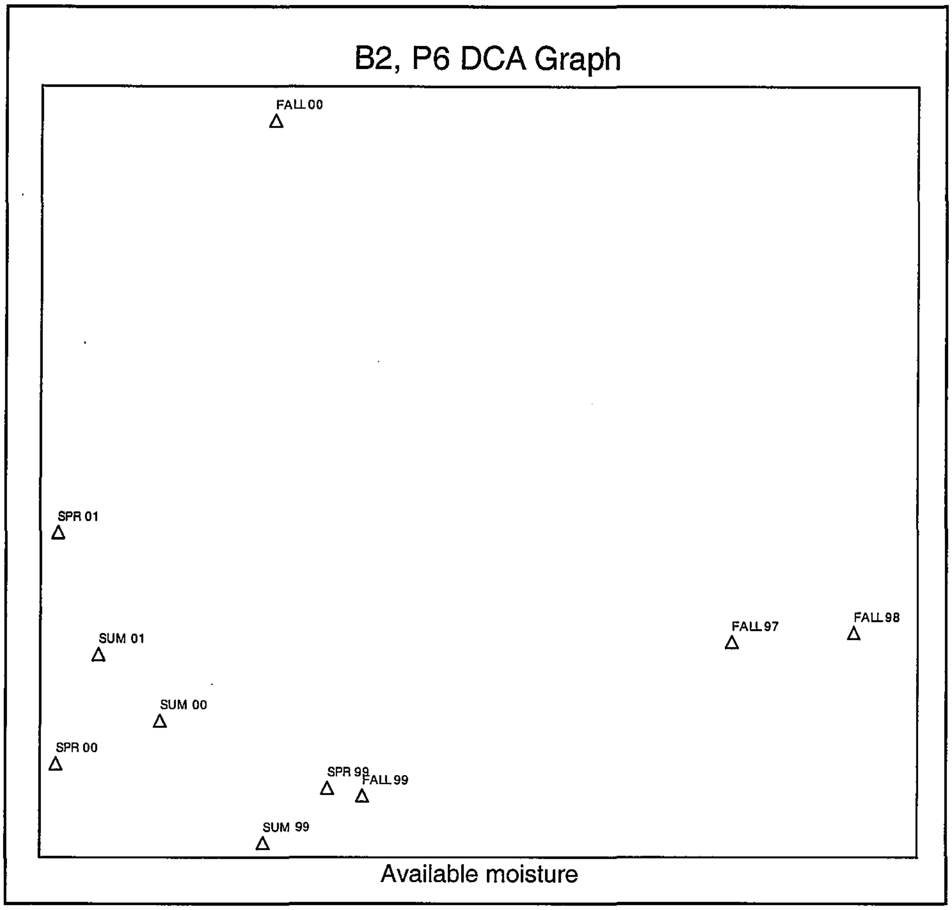

Figure 2. DCA graph of Block 2, Plot 6 vegetation at the Piedmont National Wildlife Refuge, Georgia, USA, from fall 1997 to summer 2001.

cumulative responses emerging with repeated burns, and to accommodate yearly variability in burning conditions.

Two permanent 30-m transects are inventoried along the slope contour of each plot; each transect is divided into 100 0.3-m sections. All living vegetation < 1.4 m tall intercepting the transect is recorded once per species per section. Transects were surveyed during the fall of 1997 and again in the fall of 1998 after the first series of burns was applied. Beginning with spring 1999, each transect was surveyed during spring, summer, and fall each year to assess species composition and frequency. PC-ord (McCune and Mefford 1999) was used to perform Two-way Indicator Species Analysis (TWINSPAN) and Detrended Correspondence Analysis (DCA) on frequency data from the first four years of the study.

RESULTS

Because of prolonged drought beginning in October 1998, several plots could not be burned during the scheduled treatment window. Some were burned outside their scheduled window in 2000, based on the decision that any growing-season burn was better than no burn. Other burns were delayed until 2001. Results reported here reflect the first 4 y of data from 16 plots burned twice during their scheduled treatment window.

Results from both TWINSPAN and DCA indicated that burn treatments have had little impact on vegetation. Because TWINSPAN results so closely mirrored those of DCA, only DCA results are reported. All plots appear to have followed the same compositional trends separating 1997 and 1998 from all later sampling periods (Figures 1 and 2). All plots were burned between 1997 and 1998 sampling periods. They were each also burned again either in 2000 or 2001 during the growing season. Because 1997 and 1998 plots typically grouped together in the ordination space, while all other sampling periods were grouped together, it appears that an environmental factor other than fire has had more impact on vegetation composition.

One explanation for these results is drought that began in 1998 (Figure 3). We think cumulative precipitation is the most likely environmental factor causing the separation of plots on axis 1 of the DCA graphs and in the first division made by TWINSPAN. It appears that above average rainfall in 1997 and into the spring of 1998 influenced vegetation composition during recovery after growing-season burns in those years, and that this composition differed significantly from the composition during years of cumulative drought, illustrated in 1999 and continuing through 2001. It should be noted, however, that the 1997 survey was conducted by a different group of ecologists than conducted subsequent surveys. Personal observations of the ecologist who conducted surveys from fall 1998 through spring 2001 were that the extended severe drought had a significant visual effect on the vegetation (reduced stature and vigor of existing vegetation).

MANAGEMENT IMPLICATIONS

This mid-study analysis leads us to the preliminary conclusion that burn treatments have had less impact on vegetative trends than rainfall has. Assuming more typical annual rainfall patterns return and hold through 2005, the 2002 and 2004 burns will be conducted as scheduled and the surveys over the next four years should allow us to either confirm or reject our preliminary conclusion concerning burn effects. If this conclusion is verified over the remaining 4 y of this study, the take-home message for managers will be that they should conduct growing-season burns in the spring (April and May) when they can still count on frontal winds and cooler ambient temperatures to facilitate burn execution. The lack of steady winds dur-

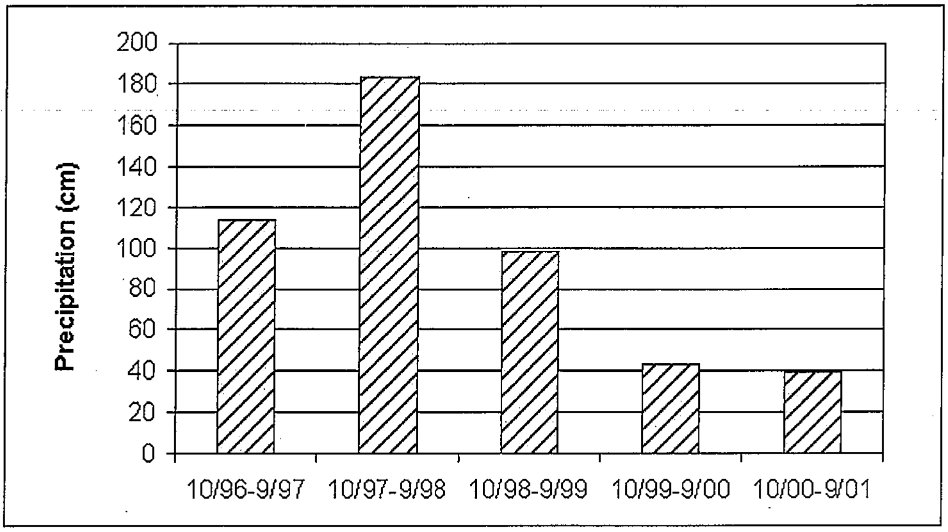

Figure 3. Average annual precipitation from three locations near the Piedmont National Wildlife Refuge, Georgia, USA, from 1997 to 2001.

ing southern summers (June–August) makes it difficult to burn with line fires on areas with little topography. High ambient temperatures also increase the likelihood of overstory crown scorch.

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