RESPONSE OF TIMBER GROWTH AND AVIAN COMMUNITIES TO QUALITY VEGETATION MANAGEMENT IN MID-ROTATION CRP PINE PLANTATIONS

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Abstract—Provisions of the 2002 Farm Bill gave Conservation Reserve Program (CRP) participants greater flexibility to implement mid-contract management activities that encourage wildlife habitat improvement and timber production. Quality Vegetation Management (QVM) is one such technique that utilizes the selective herbicide Imazapyr and prescribed burning. Timber growth (d.b.h., total/merchantable heights, and cubic foot volume per acre) and summer avian community responses (relative abundance, species richness, and total conservation value) to the QVM treatment are being evaluated in mid-rotation CRP loblolly pine plantations in two physiographic regions of Mississippi. By 2-years post-treatment, significant increases in the relative abundance of six early successional bird species were detected on treated sites. Although not significant, mean pine growth increment increases were slightly greater on treated plots than on control plots.

INTRODUCTION

Since the late 1950s, several federal programs (e.g., Conservation Reserve phase of the Soil Bank, Forestry Incentives Program) have promoted forest management on private lands (Allen and others 1996). Although the majority (34 million acres) of land enrolled in the Conservation Reserve Program (CRP) is distributed throughout the Midwestern and Great Plains states, the program has had a tremendous impact on land-use changes in the Southeast as well (Burger 2000). Through February, 2005, 3,271,838 acres had been enrolled in the CRP across 12 Southeastern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia) (USDA 2005). In the Midwest, the predominant conservation practice is grass establishment, whereas tree planting has been the most commonly used practice in the Southeast, representing 1,868,893 acres, or 57 percent, of the total enrolled acres as of February 2005 (USDA 2005). Pine plantings, either newly established plantations or existing plantations, represent 48 percent of these acres (USDA 2005).

From plantation establishment until stand maturity, competing vegetation will in some way affect the growth of desired crop trees. Some competition can be beneficial; it helps maintain good tree form and small branches. However, substantial competition, usually from other plant species, will negatively affect pine growth through competition for important resources (Schultz 1997). Numerous studies have shown a significant growth response to competition control in young pine plantations (Bacon and Zedaker 1987, Creighton and others 1987, Knowe and others 1985), and others have demonstrated that significant increases in growth can still be achieved with competition removal at mid-rotation (Fortson and others 1996, Oppenheimer and others 1989).

Early successional and disturbance-dependent habitats are in decline in the Southeast as many of the land-use changes (urbanization, modernized farming, introduction of exotic and monoculture communities) within these forested systems have resulted in the loss of many early-successional habitats (Burger 2000). With loss of early-successional and pine-grassland habitats, many bird species dependent on these communities are declining in the Southeast. The enrollment of agricultural lands into the CRP in the Southeast has the potential to provide critical early-successional habitat for many regionally-declining grassland and shrub-successional bird species. Despite success across the Great Plains and Midwest, wildlife habitat value and population response of these regionally-declining bird species to the CRP in the Southeast have not been as positive, largely because of the relatively short window of early-successional habitat in planted pines and lack of mid-rotation management.

Under the 2002 Farm Bill, mid-contract management practices, including thinning, prescribed fire, disking, herbicide, and interseeding of legumes, are permitted on CRP; and effective February, 2004, such practices are encouraged through the availability of cost-share (USDA 2003a, 2003b). Quality Vegetation Management (QVM) is one such habitat improvement technique that utilizes the selective herbicide Arsenal® and controlled burning to improve wildlife habitat and timber production. The application of Arsenal during the late growing season controls most lower to midstory hardwood encroachment with minimal long-term effects on forbs and grasses (Hurst 1989). In a study on the effects of using Arsenal for pine release, Hurst (1989) found that it was effective for controlling midstory hardwoods, but important wildlife plants such as blackberry, dewberry, greenbrier, and other various legumes quickly recovered following initial setback. Winter burning is beneficial for wildlife foods by stimulating prolific sprouting from understory plants and permitting more light to aid herbaceous growth (Chen and others 1975, Dills 1970).

QVM studies have been conducted in mature (45- to 50-years-old) naturally-regenerated pine stands (Edwards and others 2004, Jones and others 2003) and mid-rotation commercial pine plantations (Hood 2001, Thompson 2002, Woodall 2005) in east-central Mississippi. In both instances, preliminary results indicate that QVM can improve wildlife habitat quality; however, research is lacking on the effects of QVM on wildlife habitat and timber production in CRP pine plantations.

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METHODS

Study Area and Treatments

This study was conducted in two physiographic regions (Upper Coastal Plain, Lower Coastal Plain) of Mississippi. There were six study sites (blocks) in each of the two regions. They were located in Kemper (4 sites) and Neshoba (2 sites) counties in northern Mississippi and Lincoln (3 sites) and Covington (3 sites) counties in southern Mississippi. The 12 study sites were chosen based on age (15- to 18-years-old), and enrollment in a cost-share program. All sites had been thinned prior to the start of the study. Each of the 12 study sites consists of approximately 45 acres of privately-owned mid-rotation pine plantation enrolled in the Conservation Reserve Program. Pre-treatment stand conditions [mean, minimum, maximum diameter at breast height (d.b.h., 4.5 feet), mean total height, and volume per acre] are given in table 1. The dominant understory species across study sites in northern Mississippi is sweetgum (*Liquidambar styraciflua* L.), whereas Chinese privet (*Ligustrum sinense* Lour.) is the predominant understory species across study sites in southern Mississippi. There were two treatments at each study site (block), a control and an Arsenal application combined with a winter burn (QVM), which were assigned at random to 20-acre plots within each study site. On the QVM-treated plots, a mixture of Imazapyr, 0.5 pounds active ingredient and a surfactant in 20 gallons of solution per acre, was applied during October to December, 2002, followed by a prescribed burn during January to March, 2003.

Timber Volume and Growth

At 11 of the 12 study sites, 9 permanent 0.05-acre sub-plots [control (n)=108, QVM (n)=108] were established per 20-acre treatment plot on a 3 x 3 grid with a spacing of 4 x 5 chains. Due to space limitations at one study site, only 6 0.05-acre sub-plots were established within each 20-acre treatment plot. All trees [pine and merchantable hardwoods (>4.99 inches at d.b.h.)] in each sub-plot were marked for identification purposes with an aluminum tag placed at breast height. Variables of interest [d.b.h., total height (H), and total merchantable height (MH=height to a 3-inch top)] were recorded pre-treatment (February to March 2003) and twice following application of the QVM treatment (post-treatment) during the 2003-2004 and 2004-2005 dormant seasons. D.b.h., total height, and total merchantable height measurements were used to calculate total and merchantable cubic foot stem volume for each stem, using the equations from Merrifield and Foil (1967). Plot-level mean total and merchantable volumes were averaged and expressed on a per acre basis. Annual growth was calculated as the difference in plot means between years.

Table 1—Pretreatment stand conditions (number of sites; mean, minimum, maximum d.b.h. (inches); mean height (feet); volume per acre (cubic feet) by treatment in mid-rotation CRP loblolly pine plantations in Mississippi

	n	Mean d.b.h.	(Min-Max)	Mean height	Volume/ acre
Control	6	9.2	(2.0-16.6)	56	2,099
QVM	6	9.2	(1.7-22.9)	56	1,974

Avian Community Sampling

The avian community was sampled once in June, twice in July and once in August, 2003, and once in May, and twice in both June and July, 2004. Ten-minute standardized point counts were conducted from the three permanently-marked sampling stations within each treatment plot, [control (n)=36, QVM (n)=36]. All surveys were conducted between 5:30 a.m. and 10:30 a.m. and only when Breeding Bird Survey weather conditions were satisfied (Robbins and others 1986). All birds seen or heard during the 10-minute point count were recorded by appropriate time (0 to 3 minutes, 4 to 5 minutes, 6 to 10 minutes) and distance (<82 feet, 82 to 164 feet, >164 feet flyover) combination. Point count data was used to estimate relative abundance and species richness. Total conservation value is an index to the habitat-specific relative conservation value of the avian community; it is estimated by weighting relative abundance measures by Partners in Flight species conservation priority scores and summing across all species that occurred in a stand, forest, or habitat type of interest (Nuttle and others 2003).

RESULTS AND DISCUSSION

Timber Growth

Similar studies evaluating growth responses from mid-rotation competition control (Quicke 2002, Shiver 1994) have demonstrated that these practices can be successful in producing significant gains in timber growth, but these gains usually begin appearing 3 to 4 years post-treatment or later. By 2 years post-treatment, we found no significant differences in mean growth increments (d.b.h., P=0.15; total height, P=0.25; cubic foot volume per stem, P=0.06), between treated and control plots (table 2). Although not significant, mean growth increment increases on treated plots were slightly greater than on control plots. Due to a variety of circumstances over the past 3 years, which has resulted in the loss of three stands from the study, 2-year results are from the nine remaining stands. As seen in similar studies (Oppenheimer and others 1989, Pienaar and others 1983), growth response continues to increase with time since treatment, and we expect that the small increases in growth seen to this point will become significant by year 4 post-treatment or later.

Avian Community Metrics

Avian community indices of interest [species richness (sprich), total abundance (abundance), and total conservation value (TCV)] did not differ during either year 1 [sprich 2003 ($F_{1,11}$=0.41, P=0.53); abundance 2003 ($F_{1,11}$=0.00, P=0.97); TCV 2003 ($F_{1,11}$=0.07, P=0.80)] or year 2 post-treatment [sprich 2004 ($F_{1,9}$=1.40, P=0.27); abundance 2004 ($F_{1,9}$=1.17, P=0.31); TCV 2004 ($F_{1,9}$=2.17, P=0.17)] (table 3). An initial reduction in all three community indices was expected since

Table 2—Mean diameter (inches), total height (feet), and volume (cubic feet) growth increment on control and QVM plots 2 years post-treatment (nine sites)

Treatment	Diameter	Height	Volume
Control	0.79	5.68	3.2
QVM	0.85	6.04	3.4

Table 3—Mean total abundance, mean species richness, mean conservation priority score, and standard error by year and by treatment in mid-rotation CRP loblolly pine plantations in Mississippi. Standard errors are in parentheses

	2003		2004	
Community indices	Control	QVM	Control	QVM
Mean total abundance	7.86 (0.49)	7.85 (0.49)	8.08 (0.37)	7.73 (0.37)
Mean species richness	4.95 (0.25)	4.83 (0.25)	5.88 (0.23)	5.68 (0.23)
Mean conservation priority score	144.93 (9.14)	143.04 (9.14)	150.98 (8.00)	139.86 (8.00)

the QVM treatment was anticipated to create a shift in the breeding bird community from one dominated by forest interior and edge species to one dominated by early successional, pine-grassland, and shrub-successional species. During this shift in bird communities, these three parameters will decrease slightly until the desired suite of avian species responds to the vegetative shift back to an early successional vegetative community. Although by year 2 no significant increases in any of the three avian community indices were seen, a significant increase in the relative abundance of several target species was observed (table 4).

CONCLUSIONS

The results presented here give 2-year post-treatment responses of timber growth and avian communities to the QVM treatment, and, although still early for this type of study, are promising. A similar study evaluating growth responses from mid-rotation competition control (Pienaar and others 1983) has demonstrated that these practices can be successful in producing significant gains in timber growth. Usually these gains begin appearing 3 to 4 years post-treatment or later and increase as time-since-treatment increases. Given more time to monitor timber growth responses to the QVM treatment, we expect to see similar results. Seeing significant increases in the relative abundance of several target avian species is encouraging. A similar study (Woodall 2005) reports that by year 4, the total abundance, species richness, and total conservation value were significantly higher in QVM-treated plots than in untreated (control) plots. Ongoing monitoring of bird communities on these sites will substantiate whether these patterns observed in commercial pine plantations also exist on CRP plantations.

Table 4—Significant increases ($\alpha = 0.05$) in the relative abundance of the following avian species was observed on treated plots

Common name	Scientific name
Common yellowthroat	*Geothlypis trichas*
Downy woodpecker	*Picoides pubescens*
Eastern wood-pewee	*Contopus virens*
Indigo bunting	*Passerina cyanea*
Pine warbler	*Dendroica pinus*
Summer tanager	*Piranga rubra*

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