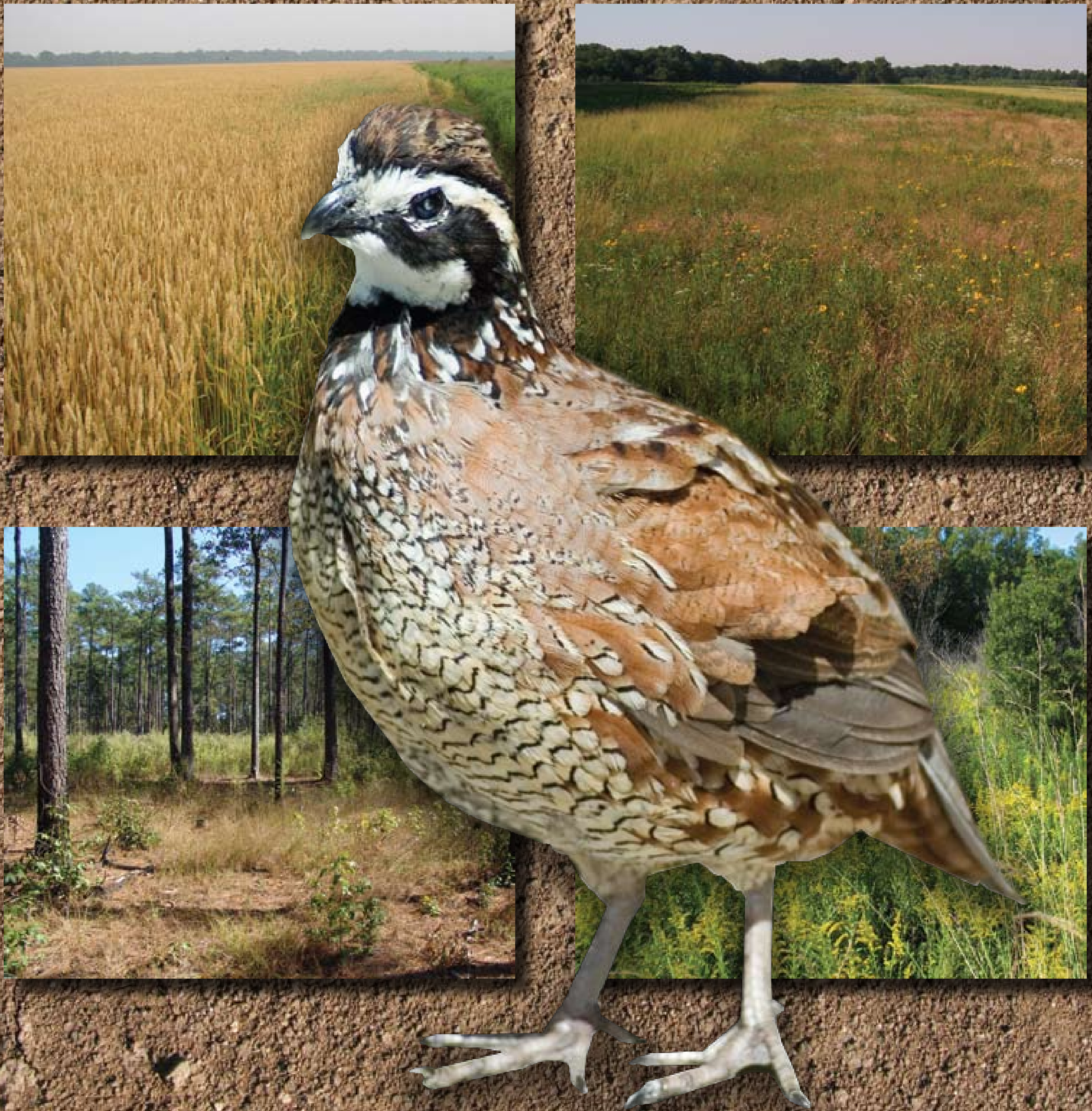
MANAGING WORKING LANDS FOR

Northern Bobwhite

The USDA NRCS Bobwhite Restoration Project



United States Department of Agriculture
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USDA NRCS Conservation Practice Standards are available online (http://www.nrcs.usda.gov/Technical/Standards/nhcp.html).

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FOREWORD

You will find the following report one of the most comprehensive, yet practical pieces of work ever attempted to better understand the bobwhite quail. The overall study, comprised of several coordinated studies in nine States throughout the bobwhite's range, resulted from the precipitous population decline of the bobwhite over the past few decades. The historic popularity of the bobwhite remains among sportsmen who have approached a bird dog, staunch on point, or a grandmother who reminisces from a nursing home window the spring call of "bobwhite" from the family garden. Stirred memories of wildlife leaders within the bobwhite's range caused them to take action as described in the pages that follow. The Southeastern Association of Fish and Wildlife Agencies (SEAFWA) charged the Technical Committee of the Southeast Quail Study Group with development of a national bobwhite restoration plan.

Within the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the former Wildlife Habitat Management Institute (WHMI), renamed the Agricultural Wildlife Conservation Center (AWCC), was formed in 1997 and was in place when the Northern Bobwhite Conservation Initiative (NBCI) plan was completed. The NRCS is the conservation arm of the USDA and plays a lead role in conservation technology development and implementation of conservation practices on private agricultural land in the United States. The AWCC leads fish and wildlife technology development through a competitive grants program. Through a partnership formed with Mississippi State University to lead the USDA NRCS Bobwhite Restoration Project, other partnerships developed as studies began.

You will find clear, concise recommendations and the kind of conservation practices to use on your farm or recommend to others for quail restoration. Much of the bobwhite's needs are supported by Farm Bill programs approved by Congress and administered by the NRCS.

It is our fond hope and desire that this superb research carried out by so many in a highly effective and timely manner will contribute immeasurably to bobwhite numbers in the years ahead.

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ACKNOWLEDGMENTS

The objective of the USDA NRCS Bobwhite Restoration Project was to develop technology that assists the Natural Resources Conservation Service (NRCS) field staffs in the delivery of conservation practices that contribute to restoration of northern bobwhite habitat and populations throughout the range. This goal was accomplished through a grants-in-aid program that supported research and demonstration projects that evaluated the efficacy of NRCS conservation practices and conservation management systems deployed in a manner that achieved the habitat goals of the NBCI. This program was made possible through a generous grant from the USDA NRCS Agricultural Wildlife Conservation Center (AWCC, formerly Wildlife Habitat Management Institute) under the leadership of Pete Heard. The grants-in-aid program was developed, delivered, and coordinated through the Department of Wildlife and Fisheries, Mississippi State University, under the direction of Wes Burger. Ed Hackett, AWCC, provided invaluable assistance as the technical liaison for the AWCC. Mark Smith and Kristine Evans, Mississippi State University, coordinated project activities, subcontracts, reporting, and product development. Kristine Evans and Wes Burger edited technical products and the final report. Karen Brasher provided graphic design support for the final report. Mississippi State University, Forest and Wildlife Research Center provided material support throughout the project. The AWCC gratefully acknowledges all of the principal investigators of the individual projects, graduate students and technicians that collected data, private landowners on whose properties the studies were conducted, and NRCS State and field office personnel.

EXECUTIVE SUMMARY

Populations of northern bobwhite (*Colinus virginianus*) and other early successional species have declined over much of the Unites States during the past 4 decades. These declines have been attributed to loss of habitat associated with intensive farming, forest management, reforestation, advanced natural succession, fire-exclusion, invasion of exotic plants, and urbanization. Historically, many of these species flourished on rangelands, croplands, and forests of the rural American landscape. If broad-scale declines are to be halted and populations restored, essential early successional habitats must be created and maintained on a massive scale.

Because more than 71 percent of the lower 48 contiguous States are in non-Federal rural land uses, privately owned working lands are central to restoration goals. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) plays a pivotal role in developing the technology, providing technical assistance, and delivering programs that conserve natural resources on private working landscapes. The USDA NRCS Bobwhite Restoration Project was developed to evaluate and refine current NRCS conservation practices and develop new innovative techniques for restoration and management of early successional habitat on range, crop, and forest lands. Through a grants-in-aid program, the USDA NRCS Bobwhite Restoration Project provided support to 11 research studies in 9 States across the bobwhite's range. The goal of this project was to provide NRCS personnel with scientifically based technical resources that will assist in planning and implementation of NRCS conservation practices designed to enhance and restore bobwhite and grassland bird habitat. Individual studies were conducted in five general categories: conservation buffer design in row crop systems, rangeland management, restoration and management of grasslands, landscape-scale conservation implementation, and landowner attitudes towards conservation. Collectively, the studies demonstrate that in row crop systems, field borders (upland habitat buffers) can more than double local abundance of bobwhite and grassland songbirds, but bird response varies in relation to landscape context, buffer shape, buffer width, and vegetation composition.

In southwestern rangelands, brush cover is a limiting condition for bobwhite with optimal conditions occurring at an intermediate coverage (~25%). Where brush cover exceeds thresholds, brush control in combination with managed grazing increases local bobwhite abundance. In dry prairie rangelands of south Florida, conditions for many grassland and savannah bird species were improved through the use of frequent (1–3-yr fire return interval) growing season (June) prescribed burning. In rangelands, where saw palmetto predominates, roller-drum chopping is effective in reducing palmetto coverage to levels that can be maintained using only fire.

Established idle grasslands, such as CRP or old fields, provide essential habitat for early successional birds, but must be actively managed to maintain appropriate vegetation structure. Where exotic forage grasses occur, herbicidal eradication and interseeding of native legumes and grasses dramatically increases habitat quality and use by bobwhite, particularly broods. However, appropriate herbicide and planting prescriptions are site specific and must be developed within the context of the weed complex, seed bank, management history, and desired outcomes. In established grasslands, prescribed burning is a cost-effective tool for controlling woody invasion, but timing of fire influences effectiveness. Landscape-scale deployment of a suite of conservation practices will produce measurable population responses by bobwhite and early successional bird species, but implementation must be extensive and sufficiently intensive to affect change. Targeted delivery of conservation practices within defined landscape-scale focal areas will increase the likelihood of producing population responses.

A survey of Missouri landowners demonstrated the importance of understanding landowner attitudes as resource management agencies attempt to deliver conservation programs and initiatives. These honest appraisals of landowner intentions illustrate barriers to adoption of conservation practices and highlight the importance of economic incentives. The results from these studies were reported in a myriad of peer-reviewed journal articles, NRCS technical notes, semi-technical fact sheets, popular articles, and 11 field days that reached more than 850 resource professionals, private landowners, and producers.

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OVERVIEW

The USDA NRCS Bobwhite Restoration Project: An Overview

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Introduction

Historically, northern bobwhite (*Colinus virginianus*) and other early successional species flourished on the rangelands, croplands, and forests of the rural American landscape. However, during the past 4 decades, populations of bobwhite and associated grassland birds have declined over much of the country. These declines have been attributed to loss of habitat associated with intensive farming, forest management, reforestation, advanced natural succession, fire exclusion, invasion of exotic plants, and urbanization. To address this decline, the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) charged the Technical Committee of the Southeast Quail Study Group with development of a national bobwhite restoration plan. This plan, called the Northern Bobwhite Conservation Initiative (NBCI), has the goal of restoring bobwhite populations to a baseline level observed in 1980 (Dimmick et al. 2002). Specific goals of the NBCI include the addition of 2,805,765 coveys to the current population, which is estimated to impact 79 million acres of land (Dimmick et al. 2002). Achieving the habitat and population goals of the NBCI is dependent on being able to alter primary land use on approximately 6 to 7 percent of improvable acres within the bobwhite range. Consequently, privately owned working lands are critical to bobwhite restoration.

Agriculture dominates human uses of land (Robertson and Swinton 2005). In the United States, non-Federal, rural land uses comprise 71 percent of the contiguous 48 States' 1.9-billion-acre landmass. In 2003, 772.9 million acres (40%) of the contiguous 48 States were devoted to cropping or grazing land uses (U.S. Department of Agriculture (USDA) 2007). Cultivated and noncultivated cropland accounted for 367.9 million acres of land use. The condition of these lands influences the function and integrity of natural ecosystems and the wildlife populations that they support. Wildlife resources are valued by society because of the ecological, economic, recreational, and aesthetic values associated with natural habitats and wildlife populations (U.S. Fish and Wildlife Service (USFWS) 2002). The United States agricultural sector is central to protecting and enhancing the Nation's wildlife resources.

Agricultural policy affects producer decisions and, therefore, the environmental impact of agriculture. Federal Farm Bill conservation programs comprise a suite of policy tools that provide incentives for producers to integrate conservation practices into production systems. Most USDA conservation programs rely on a combination of education, technical assistance, and economic incentives to encourage agricultural producers to manage land and water resources in ways that benefit wildlife species and their habitats. The authors of the NBCI envisioned that most habitat goals could be accomplished through Federal Farm Bill conservation programs. Conservation programs achieve environmental outcomes by providing producers with knowledge, technical assistance, and economic incentives to encourage adoption of conservation practices. Conservation practices are specific land management activities that, when applied in a consistent fashion, produce a predictable conservation outcome that remedies a specific resource concern.

The USDA Natural Resource Conservation Service (NRCS) plays a lead role in developing the technology and defining the standards under which conservation practices are implemented. NRCS Conservation Practice Standards (CPS) provide guidance for applying conservation technology on the land and set the minimum acceptable level for application of the technology. The NRCS issues national CPS in its National Handbook of Conservation Practices (NHCP) (http://www.nrcs.usda.gov/technical/Standards/nhcp.html). Practice standards are science-based and validated to ensure predictable conservation outcomes. NRCS State Offices determine which national conservation practices are applicable in their State. States add the technical detail needed to effectively use the practices at the field office level and issue them as State CPS. Practice standards are periodically revised to incorporate new information and technology.

Because of the relationships between rural land use, Federal agricultural policy, conservation programs, and conservation practices, the success of bobwhite restoration under the NBCI is inextricably linked to the practice standards developed, refined, and applied by the NRCS. The U.S. Congress, recognizing the many values of northern bobwhite and its precipitous decline, took the unique action of singling out this species and specifically directing Federal agencies responsible for delivering Federal farm programs to capitalize on opportunities within the 2002 Farm Bill to accomplish the goals and objectives of the NBCI. The USDA NRCS Bobwhite Restoration Project was developed in support of the NBCI to evaluate the efficacy of current NRCS conservation practices in creating suitable habitat for bobwhite and associated early successional species. The goal of this project was to provide NRCS field personnel with scientifically based technical resources that will assist in planning and implementation of NRCS conservation practices designed to enhance and restore bobwhite and grassland bird habitat.

The USDA NRCS Bobwhite Restoration Project was initiated in 2004 and supported a grants-in-aid program that provided funding to universities, State agencies, and private organizations to investigate current NRCS conservation practices and their effects on bobwhite and grassland bird populations and evaluate innovative techniques for managing habitat on working lands. The USDA NRCS Bobwhite Restoration Project was a cooperative effort among several agencies and institutions and includes partners such as the NRCS, Mississippi State University Forest and Wildlife Research Center, Quail Unlimited, Inc., and SEAFWA. The NRCS collaborated with Mississippi State University to coordinate the USDA NRCS Bobwhite Restoration Project Grants-in-Aid Program, which provided funding for 11 individual research studies that evaluated NRCS conservation practices and developed new technologies that relate directly to the restoration of plummeting bobwhite and grassland bird populations. The USDA NRCS Bobwhite Restoration Project studies were conducted in nine States: Arkansas, Florida, Illinois, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, and Texas. Project participants originated from 11 universities, 2 State agencies, and 2 private wildlife organizations. Research studies were specifically chosen to represent a breadth of bobwhite management issues across the species' range. Individual studies were conducted in five general categories: conservation buffer design in row crop systems, rangeland management, restoration and management of grasslands, landscape-scale conservation implementation, and landowner attitudes towards conservation. In this overview, key outcomes of these 11 projects are summarized.

Conservation Buffers in Row Crop Production Systems

Growing demand for food and fiber has resulted in increasingly intensive agricultural production across much of the United States, contributing to soil erosion, impaired water quality, and loss of critical wildlife habitat. National initiatives such as the USDA NRCS NCBI encourage adoption of conservation buffer practices as a means to help restore environmental quality in agricultural landscapes. Conservation buffers were initially defined by the NRCS as strips of permanent vegetation designed to control pollutants and manage other environmental problems (USDA NRCS 1999). However, conservation buffers also produce other environmental benefits by interjecting natural communities in agricultural systems and providing habitat for early successional wildlife.

Many conservation buffer practices are established on downslope field margins to intercept sediment and agrichemicals and protect nearby waterways (Smith et al. 2005a). However, broader implementation of conservation buffers has been shown to provide habitat for early successional wildlife in addition to these environmental benefits (Marcus et al. 2000; Smith et al. 2005a, b; Conover et al. 2007). Upland habitat buffers (field borders) can be established around the entire perimeter of agricultural fields for the express purpose of removing low-yielding field margins from production and providing wildlife habitat. Although upland habitat buffers have been shown to increase local abundance of some farmland wildlife, many questions remain regarding how buffer width, shape, surrounding landscape context, and vegetation composition influence abundances of bobwhite and grassland songbirds (Conover et al. 2007). Answers to these questions are needed to develop technically sound practice standards.

The USDA NRCS Bobwhite Restoration Project funded a study conducted by North Carolina State University on 24 commercial hog farms in the North Carolina lower Coastal Plain. Upland habitat buffers were established on agricultural fields on which hog waste from confinement lagoons was spread as a form of nutrient management. Ten-foot-wide, naturally revegetated buffers were established under standards accepted by CPS Code 386 (Field Border) and CPS Code 647 (Early Successional Habitat Development/Management) for the joint purposes of water quality and wildlife habitat management. This study demonstrated that even narrow (10 ft) buffers, comprising only 2 to 3 percent of cropland acreage, produce a measurable increase (45%) in local abundance of breeding bobwhite. However, the magnitude of response depended on the landscape context and shape of the field border. Breeding bobwhite abundance increased by 87 percent after field border establishment in agricultural-dominated landscapes, compared to a 16 percent increase in forest-dominated landscapes. Breeding bobwhite abundances increased by 57 percent on farms with nonlinear field borders, compared to a 29 percent increase on farms with linear field borders. In forest-dominated landscapes in the Coastal Plain of North Carolina, bobwhite responded better to nonlinear field borders than linear field borders. In agricultural-dominated landscapes of this region, both linear and nonlinear field borders produced measurable population responses. In this landscape, conversion of 2 to 3 percent of row crop acreage to upland habitat buffers had no measurable effect on breeding season abundance of focal songbird species [indigo bunting (*Passerina ciris*), blue grosbeak (*Passerina caerulea*), red-winged blackbird (*Agelaius phoeniceus*), common yellowthroat (*Geothlypis trichas*), grasshopper sparrow (*Ammodramus savannarum*), field sparrow (*Spizella pusilla*), and eastern meadowlark (*Sturnella magna*)]. Researchers suggested that in this landscape, buffers may need to comprise 6 to 7 percent of cropland area to produce measurable responses for a suite of species.

Researchers from Iowa State and Mississippi State Universities measured bird response to implementation of a conservation management system (CMS) that included monotypic switchgrass and diverse native warm-season grass (NWSG) filter strips (Filter

Strips, CPS Code 393; Conservation Cover, CPS Code 327); upland habitat buffers (Upland Wildlife Habitat Management, CPS Code 645; Early Successional Habitat Development/Management, CPS Code 647; early successional riparian forest buffers (Riparian Forest Buffers, CPS Code 391); and early successional block afforestation habitats (Tree/Shrub Establishment, CPS Code 612) in an intensively farmed landscape in the Mississippi Alluvial Valley. On this 6,400-acre study site, conservation buffers accounted for 4 percent, afforestation blocks 31 percent, and row crops 48 percent of the total land use. The surrounding landscape (12,490 acres) was 83 percent cropland and compositionally similar to the study site prior to implementation of the CMS. In this landscape, monotypic switchgrass filter strips, diverse NWSG filter strips, diverse upland habitat buffers, and early successional block tree plantings all supported bobwhite and grassland songbirds. However, diverse plantings supported greater abundance and diversity of birds than monotypic plantings, and block habitats produced greater abundance, diversity, nest density, and nest success of grassland species than buffer practices. Bobwhite exhibited variable annual use over a wide range of habitats in the study area, however, average breeding season abundance of bobwhite under the CMS was 3.4 times that of the surrounding landscape. Fall density of bobwhite under this conservation management system was 4.3 times that observed in the surrounding agricultural matrix. A comprehensive conservation management system integrating both buffers and block plantings in a row crop production system substantially increased abundance and diversity of both bobwhite and grassland birds at the farm and landscape scales relative to conventional agriculture.

Collectively, these studies demonstrate that in modern agricultural systems, conservation buffers can provide essential habitat for bobwhite and some early successional songbirds. However, landscape context, buffer configuration, percent of landscape affected, and diversity of established vegetation will influence the magnitude of response. Conservation buffers will be most valuable as one component of a CMS in which they complement and connect larger patches of habitat, increasing farm-scale usable space for wildlife.

Rangeland Management

Rangelands account for approximately 21 percent of the land area (405 million acres) of the contiguous United States (USDA NRCS 2007) and provide essential habitat for bobwhite and other grassland birds. Rangelands are defined as native plant communities maintained for livestock production (Holechek, Pieper, and Herbel 1998). Rangelands, because of their inherent native plant diversity, have historically been a stronghold for sustainable populations of bobwhite and other early successional bird species. However, the wildlife value of rangelands depends on their ecological integrity. Many rangelands have been degraded by overstocking, introduction of exotic forages, and encroachment of woody species (Fuhlendorf and Engle 2001). The result has been steady declines in grassland bird populations in rangelands across the United States (Fuhlendorf and Engle 2001; Brennan and Kuvlesky 2005).

Enhancing environmental quality in animal production systems is one of the national priorities for the USDA Environmental Quality Incentives Program (EQIP). EQIP provides cost-share and incentives to encourage ranchers to incorporate conservation practices into their grazing management systems. EQIP-approved conservation practices such as Prescribed Grazing, CPS Code 528; Prescribed Burning, CPS Code 338; and Brush Management, CPS Code 314 may simultaneously enhance forage production and wildlife habitat quality.

Two USDA NRCS Bobwhite Restoration Project studies conducted in different regions of Texas demonstrate the importance of region-specific practice standards and site-specific implementation. In the

Rolling Plains ecoregion of Texas, mesquite (*Prosopis* spp.) and pricklypear (*Opuntia* Mill.) dominate rangelands in the absence of disturbance. On brush-encroached rangelands, researchers from Texas A&M University found that 2 to 4 years after moderate brush management (CPS Code 314, Brush Management), breeding season bobwhite abundances were on average 29 percent greater than on adjacent unmanaged rangeland sites. However, moderate brush management did not substantively enhance availability of bobwhite nesting habitat. Deferred grazing, in combination with brush management, may be required to increase grassy nesting cover.

In contrast, in a study conducted in the High Plains ecoregion of Texas, researchers from Texas Tech University found that on sites with less than 25 percent woody canopy cover, brush management was not an effective tool in increasing bobwhite abundance presumably due to dependence by bobwhites on the limited woody cover available in the landscape. In fact, percent woody cover was the single most important factor affecting bobwhite abundances on study sites in the Texas High Plains. Sites with canopy cover of brush in excess of 10 percent supported the greatest bobwhite densities. On rangeland sites with limited cover, Prescribed Grazing, CPS Code 528 and Range Planting, CPS Code 550 may be more effective in enhancing bobwhite habitat than brush management. These two studies, conducted in neighboring ecoregions, exemplify the need to develop regionally specific management guidelines and apply these standards in a site-specific manner to increase local bobwhite abundances. Bobwhites are dependent on shrubby plants for loafing, escape, and thermal cover. However, dominance of woody cover, to the exclusion of equally essential grasses and forbs, will diminish habitat quality. Optimal amount of woody cover on rangelands is likely between 10 and 35 percent. Managing to reduce woody cover to enhance bobwhite populations may be beneficial to bobwhite on some sites and detrimental on another.

Although rangelands typically comprise the western portion of the bobwhite's range, they are also an important land use in parts of peninsular Florida. The dry prairie of southern Florida is listed as a globally imperiled community (Florida Natural Areas Inventory (FNAI) and Department of Natural Resources (DNR) 1990) and has been altered by anthropogenic activities on 98 percent of its landscape (Noss et al. 1995). The Florida dry prairie community evolved through frequent fire disturbance, likely occurring annually or biennially resulting in a pine savannah-type ecosystem (USFWS 1999). Exclusion of fire and overgrazing has led to an overabundance of saw palmetto (*Serenoa repens*) on native rangelands. Although bobwhite and grassland birds are dependent on saw palmetto, these species will abandon the area if it exceeds acceptable levels.

In a USDA NRCS Bobwhite Restoration Project study conducted by Tall Timbers Research and the University of Georgia, fall bobwhite abundances were greatest at 32 percent saw palmetto coverage and exhibited a linear decline as saw palmetto increased above this point. Likewise Bachman's sparrow (*Aimophila aestivalis*) declined after saw palmetto coverage exceeded 40 percent. In the first 2 years of the study, brush management (CPS Code 314) with roller chopping to decrease overabundant saw palmetto prior to applying prescribed burning (CPS Code 338) resulted in a 50 percent increase in fall covey abundance compared to unmanaged sites. Likewise, relative abundance of Bachman's sparrow doubled in response to roller chopping, and there were nearly five times greater relative abundances of grasshopper sparrow *(Ammodramus savannarum pratensis*) in roller-chopped sites compared to unchopped sites. Initial treatment of overabundant saw palmetto (when >50%) with roller chopping, followed by fire disturbance at less than 3-year intervals provided the best habitat for bobwhite and grassland birds in this study. Timing of fire was also important. In this fire-adapted system, growing season fire (June) was more effective than dormant season fire at controlling saw palmetto and releasing a native bluestem community, enhancing rangelands for both native birds and cattle production.

Clearly, rangeland habitats are variable and management practices for bobwhite and other grassland avifauna must be prescribed for the specific ecological community of each region. Disturbance practices, such as prescribed burning, brush management, and brush management with roller chopping, are effective at enhancing early successional habitat and increasing abundances of bobwhite and other grassland birds when brush or saw palmetto exceed optimal thresholds. These practices, in combination with prescribed grazing, allow for restoration of diverse plant communities that had previously been constrained by overgrazing and lack of disturbance. Wildlife populations positively and rapidly respond to plant community restoration.

Restoration and Management of Grasslands

In agricultural landscapes, grasslands provide essential habitat for bobwhite and associated grassland and early successional songbirds. Grassland establishment and management are key conservation practices implemented under a multitude of Farm Bill conservation programs, including the Conservation Reserve Program (CRP), EQIP, and Wildlife Habitat Incentive Program (WHIP). However, grasslands created under Farm Bill conservation programs do not always achieve desired wildlife habitat benefits because of poor cover crop selection, dominance by invasive species, or lack of appropriate management regimes (Burger 2005). Moreover, as grasslands age, dense thatch accumulates at ground level, diminishing habitat quality for ground nesting and foraging wildlife species (McCoy et al. 2001). Active management of grasslands is required to maintain habitat quality for early successional wildlife species, including bobwhite. Management practices frequently employed on conservation program grasslands: herbicidal eradication of exotic or invasive plant species (Pest Management, CPS Code 595); planting of NWSG (Restoration and Management of Rare and Declining Habitats, CPS Code 643; Upland Wildlife Habitat Management, CPS Code 645); interseeding of legumes (Conservation Cover, CPS Code 327; Prescribed Burning, CPS Code 338); disking (Upland Wildlife Habitat Management, CPS Code 645; Early Successional Habitat Development/Management, CPS Code 647); and thinning managed forests (Forest Harvest Management, CPS Code 511/Forest Stand Improvement, CPS Code 666). Scientific information regarding the relative wildlife benefits of alternative establishment and management practices is needed to ensure that wildlife benefits are accrued from Farm Bill conservation program practices.

Eradication of exotic or invasive species is a critical step in establishing and maintaining diverse native grasslands. Tall fescue (*Schedonorus phoenix*) is an exotic cool-season grass that was commonly planted or has invaded CRP fields throughout the Midwest and Midsouth. Fescue provides suboptimal bobwhite nesting and brood-rearing habitat (Barnes et al. 1995). When managing for bobwhite, eradication of fescue is often necessary to release suppressed native grass communities or reestablish NWSG through planting (Madison et al. 2001; Greenfield et al. 2001, 2002). In a USDA NRCS Bobwhite Restoration Project study conducted by the University of Tennessee, researchers found that tall fescue was better controlled with fall rather than spring applications of herbicides (glyphosate (2 qt/acre with surfactant) and imazapic (12 oz/acre with surfactant) (CPS Code 595) with or without disking (CPS Code 647)). Tall fescue coverage was reduced to 2 percent following fall glyphosate application, and 10 percent following fall imazapic application. Importantly, this project demonstrated that planting of NWSG is not always necessary. In areas where desirable native plant species were already present in the seedbank, simply eradicating the exotic forage grasses released a diverse native grass community. They also found that once undesirable plant species were eradicated, late fall to early spring disking and prescribed burning (CPS Code 338) enhanced bobwhite foraging and brood-rearing habitat by reducing undesirable plant species, increasing forb cover, decreasing litter accumulation, and increasing bare ground. Mowing or bush hogging was ineffective at improving bobwhite habitat, and should be discouraged. In the absence of regular disturbance, invasive woody species such as sweetgum (*Liquidambar styraciflua*) and green ash (*Fraxinus pennsylvanica)* frequently dominate CRP fields and old fields in the Midwest and Southeast. Although bobwhite and other early successional species require some degree of woody cover, advanced succession will outcompete herbaceous ground cover and diminish habitat quality. This project demonstrated that September prescribed burning and herbicidal applications were relatively effective at controlling invasive hardwoods, whereas spring prescribed fire, bush hogging, and glyphosate applications were not effective.

In a USDA NRCS Bobwhite Restoration Project study conducted in Illinois, researchers from Southern Illinois University studied effects of various midcontract management practices on 60 established, fescue-dominated CRP fields. They evaluated strip disking (CPS Code 647), glyphosate herbicide application (CPS Code 595), and glyphosate application with legume interseeding (CPS Code 327). Treatments were applied in strips with a third of each treated field (n = 10) receiving the assigned treatment in the first year and another third being treated in the second year. Each treated field was paired with an untreated control field. They found that all management practices increased plant species diversity. Herbicide application alone and herbicide with legume interseeding decreased coverage of tall fescue, whereas strip disking did not substantively reduce fescue coverage. Breeding season bobwhite abundance in managed CRP fields was 3.7 to 11 times greater than in unmanaged fields and was highest in CRP fields managed using herbicide with legume interseeding. Abundance and species richness of grassland birds were greater in managed than unmanaged fields and increased relative to the proportion of the management applied to each field. Bobwhite broods were observed only in managed CRP fields. Herbicide only and herbicide/interseeded fields had a greater number of bobwhite broods than strip-disked fields.

The results from these studies clearly demonstrate that management practices in fescue-dominated fields have a positive effect on bobwhite and grassland bird populations by providing the necessary habitat characteristics such as increased plant diversity for foraging, increased nesting habitat, and greater exposure of bare ground for brood-rearing. Herbicidal eradication of fescue, with or without interseeding of legumes, produces greater enhancements in habitat quality than simply disking. Midcontract management in CRP fields should be strongly encouraged to enhance bobwhite and grassland bird habitat.

Landscape-level Conservation Management

Most bobwhite populations are not distributed evenly, and the potential for population recovery at a given location is dependent on the landscape context. Moreover, population response is scale-dependent. Carrying capacity of a landscape is a function of the percentage of the landscape in usable space (Guthery 1997). Populations show greater response when a critical mass of habitat is created within a given geographic area. Additionally, a given intensity of habitat management will produce a greater response if conducted over a larger geographic region. Therefore, it is important for resource professionals to recognize areas where bobwhite populations will be most likely to respond to habitat restoration and focus conservation activities in these regions. The State of Arkansas has developed and implemented quail restoration focal areas for greater allocation of State resources to areas where suitable bobwhite habitat remains.

In a study conducted in two quail restoration focal areas in Arkansas, collaborative research by the Arkansas Game and Fish Commission, Arkansas State and Arkansas Tech Universities under the USDA NRCS Bobwhite Restoration Project found that bobwhite responded variably to restoration practices such as strip disking (Early Successional Habitat Development/Management, CPS Code 647; Prescribed Burning, CPS Code 338), thinning of timber stands (Forest Stand Improvement, CPS Code 666; Hedgerow Planting, CPS Code 422), eradication of bermudagrass (*Cynodon dactylon*) and tall fescue (Pest Management, CPS Code 595), and planting of NWSG (Upland Wildlife Habitat Management, CPS Code 645). They found that managed areas received heavy use by bobwhites in the winter, but not during the spring and summer. Bobwhites in this study continued to nest and raise broods in moderately grazed fescue pastures in one focal area, but nested in the managed area in another focal area. Arthropods were also less abundant in restoration areas, resulting in slower growth of bobwhite chicks. More bobwhites were detected in managed than unmanaged reference areas in 2005, whereas more bobwhites were detected in reference than managed areas in 2006. In contrast, avian point transect surveys revealed a greater abundance of early successional species and the presence of several priority grassland species of concern on managed areas compared to unmanaged areas. The mixed results from this study exemplify the regional and temporal differences that bobwhite exhibit in response to early successional habitat management practices. It also highlights the need for a greater understanding of reproductive behavior within managed areas, as increases in breeding season abundance do not necessarily indicate breeding preference in restoration areas.

Management practices will likely result in variable habitat effects dependent on the physiographic region of application. The Coastal Plain of South Carolina is a highly productive region with moderate average temperatures and ample annual rainfall. Succession proceeds rapidly in these coastal environments, resulting in the need for extensive management to maintain early successional habitats. It is important to understand the effects of timing and frequency of disturbance on habitat characteristics. In one study conducted in coastal South Carolina, researchers from Nemours Wildlife Foundation and Clemson University working under the USDA NRCS Bobwhite Restoration Project found that disking (CPS Code 647) at less than 3-year intervals produced the greatest percent forb cover, most bare ground, and was best at controlling woody encroachment. Forb cover was greatest in winter disked plots applied at 2- or 3-year intervals, whereas bare ground was greatest in plots that were annually disked in winter or summer. Woody stem growth was best controlled by spring disking applied annually or at 2-year intervals. Plots disked at 2-year intervals in the summer received the most use by radio marked bobwhite of all treatment combinations of seasonal and interval disking and prescribed burning (CPS Code 338); however, bobwhite showed a distinct preference for thinned (40–60 BA) pine stands that were not included in the study. Annual prescribed burns produced the greatest percent grass cover, whereas plots burned at 2- or 3-year intervals produced the best response by desirable native plant species. Established field borders and hedgerows accounted for 61 percent of songbird nests in the study area.

In another study conducted in the South Carolina Coastal Plain, researchers from Clemson University working under the USDA NRCS Bobwhite Restoration Project assessed CPS under the Wildlife Habitat Incentives Program (WHIP), and their efficacy in creating early successional wildlife habitat. They found that field borders (CPS Code 386) and filter strips (CPS Code 393), planted or unplanted, produced quality early successional wildlife habitat, and similarly to the Tennessee study, recommended that the existing seedbank be first evaluated prior to planting. Forest thinning (CPS Code 666), prescribed burning (CPS Code 338), thinning combined with forest openings, and thinned-opened-burned forest stands produced a greater abundance and variety of herbaceous plants and low-growing shrubs important to early successional wildlife compared to untreated forest stands. Thinned-opened and thinned-opened-burned forest stands had the greatest response in early successional plant diversity and abundance. Bird species richness was greater in commercially thinned and untreated forest stands compared to precommercially thinned forest stands, while there was no difference in bird species richness among thinned-opened, thinned-opened-burned, burned, and untreated forest stands.

As exemplified in the aforementioned studies, there are many techniques that, if applied appropriately, will create and enhance bobwhite and grassland bird habitat. Response by bobwhite and other birds is largely dependent on the treatment, season, and frequency of application. Decisions regarding appropriate treatment applications must be made based on regionally specified best practices for management. Historical land use will affect the presence of desirable and undesirable plant species in the seedbank. Climate will impact the pace of succession which will affect decisions regarding disturbance frequencies. Time since disturbance will also be important, as there may be lag between management application and bobwhite population response.

The Landowner Perspective

Privately owned agricultural lands such as crop, pasture, and range lands comprise approximately 40 percent of the 1.9 billion acres of land in the contiguous United States (USDA NRCS 2007). As millions of acres of private lands have been lost to urbanization and agricultural areas have maximized production by shifting to more intensive farming techniques, many bird species that were once abundant in these areas have experienced sharp declines. Thus, a shift in focus toward improving wildlife habitat on private lands is necessary for wildlife restoration efforts to be realized. This is particularly important on agricultural lands where acreages in production translate into profits and financial stability. To restore wildlife populations on private agricultural lands, producers must be offered economic incentives to offset the opportunity costs of diverting lands from production to conservation. Many of these incentives are offered through Federal Farm Bill conservation programs that provide financial payments for landowners to enhance environmental quality and restore wildlife habitat on their property. However, the wide availability of Federal incentives does not necessarily translate into participation by landowners in government conservation programs. Private landowner participation is essential for the success of habitat restoration on the majority of agricultural land base in the United States. However, there is a lack of understanding among resource professionals regarding what drives landowner opinions and willingness to participate in government conservation programs.

Many States have developed species or community-specific focal areas to concentrate wildlife habitat restoration efforts in prespecified regions within the State. However, the focal area approach will only be successful if landowners are willing to implement conservation practices that create and maintain habitat. In a study conducted by the Missouri Department of Conservation under the USDA NRCS Bobwhite Restoration Project, habitat suitability models were combined with results from landowner surveys and focus group discussions to examine interest and willingness to participate in quail restoration programs. They found that over 80 percent of landowners in this region thought it important to have bobwhite on their property, but less than 52 percent of landowners were willing to implement quail friendly practices on their property, and only 15 percent of landowners were willing to join a quail cooperative. However, despite the lack of willingness to participate in quail restoration management activities, the survey responses overlaid with habitat suitability models assisted the Missouri Department of Conservation in development of two 15,000-acre quail restoration focal areas in northern Missouri.

Landowner participation in wildlife-friendly habitat management is key to restoration of many early successional wildlife species. Although human-dimensions type surveys are critical to gain an understanding of a landowner's willingness to participate in habitat restoration programs, the willingness does not necessarily translate to action or participation in government based habitat restoration programs.

Conclusion

Each study under the USDA NRCS Bobwhite Restoration Project has provided a wealth of information regarding effects of conservation practices on bobwhite and grassland bird use and abundances. The results from these studies show that field border shape, plant species composition, landscape context, CRP midcontract management, herbicidal eradication of exotics, prescribed fire, roller chopping, prescribed grazing, brush management, and disking all play an important role in creation and maintenance of bobwhite and grassland bird habitat. However, these studies also emphasize the importance of developing region-specific practice standards and site-specific prescriptions in applying habitat management practices.

Key points from studies under the USDA NRCS Bobwhite Restoration Project include:

- Conservation buffers and field borders around cropped fields produced measurable population responses by bobwhite. However, population responses varied based on the surrounding landscape context and shape of the field borders. Nonlinear field borders and early successional block habitats produced greater population response than linear field borders. A comprehensive conservation management system integrating both buffers and block plantings into a row crop production system will substantially increase abundance and diversity of bobwhite and grassland birds at the farm and landscape scales relative to conventional agriculture.
- Management of rangelands will enhance usable habitat for bobwhite and other grassland avifauna, but management prescriptions must be based on the regional ecological community. Disturbance practices, such as prescribed burning, brush management, and roller chopping, are effective at enhancing early successional habitat and increasing abundances of bobwhite and other grassland birds on rangelands. However, disturbance practices must be conducted in combination with grazing deferment to allow for restoration of diverse plant communities in the landscape.
- Eradication and/or management of exotic forage grasses are essential components of habitat enhancement for bobwhite and other grassland birds. Herbicide applications to eradicate exotic forage grasses followed by disking and prescribed burning to expose bare ground and decrease litter accumulation will enhance early successional habitat; however, timing of application may influence efficacy. Conversion and management of fescue-dominated CRP fields is recommended to elicit population responses by bobwhite and other grassland bird species.
- Landscape level management using prescribed burning, disking, forest stand improvements, and planting of NWSG, hedgerows, and conservation buffers or field borders all created quality early successional habitat, but elicited variable response by bobwhite and grassland birds across the studies. Response by bobwhite and other birds was largely dependent on the type of management, time since management was applied, and season and

frequency of application. Decisions regarding appropriate treatment applications must be made based on regionally specified best practices for management.

- An often overlooked, but critical, component to the restoration of bobwhite and grassland bird populations is the willingness of the landowner to enroll portions of their property in government conservation programs aimed to enhance wildlife habitat. Many landowners report that they would like more bobwhite on their property, and they acknowledge that habitat restoration is the only means to regain quail. However, few were willing to implement proper quail management practices, and even fewer were willing to participate in quail cooperatives. These honest appraisals of landowner intentions illustrate challenges for delivering conservation practices and highlight the importance of economic incentives.

Despite variability among studies and regions, the overwhelming conclusion from these studies is that even in modern working landscapes, habitat management works. Bobwhite and associated songbird populations show rapid and positive responses to creation and maintenance of appropriate plant communities. Even in the most intensively cropped landscapes, broadly applied conservation practices increased farm and landscape-scale bobwhite populations by as much as four-fold. The suite of conservation practices deployed through Federal Farm Bill conservation programs, when appropriately applied under a site-specific prescription, can be used to achieve the habitat and population goals of the NBCI. However, achieving these goals will require targeted delivery by resource management agencies and broad-scale adoption by producers. Producers are most likely to adopt conservation practices if they are delivered through programs that adequately address both the direct and opportunity costs of conservation. The conservation community cannot afford to ignore the economics of wildlife conservation in working landscapes. The information derived from these studies will be applicable and widely available to resource managers and NRCS field staff working toward conservation in a range of working landscapes. Results from the studies supported by the USDA NRCS Bobwhite Restoration Project will contribute to the development and refinement of NRCS practice standards and assist NRCS field staff in establishment of conservation programs while concomitantly realizing the habitat and population objectives of the NBCI.

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CONSERVATION BUFFERS

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Maximizing the Benefits of Field Borders for Bobwhite and Early Successional Songbirds:

What is the Best Design for Implementation?

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Maximizing the Benefits of Field Borders for Bobwhite and Early Successional Songbirds:

What is the Best Design for Implementation?

Northern bobwhite and many early successional songbirds have experienced severe population declines in recent decades. Generally, these declines have been the result of habitat loss. Field borders can increase and enhance early successional habitat for birds in agricultural landscapes. However, field border characteristics, such as their shape, and the landscape context in which they occur may determine their effectiveness for bird conservation. Researchers established linear and nonlinear upland habitat buffers (field borders) on farms in agriculture-dominated and forest-dominated landscapes in the Coastal Plain of North Carolina. Prior to field border establishment in 2004, they collected pre-treatment data on focal songbird species' density, nest success, frequency of brood parasitism, summer bobwhite abundance, and fall bobwhite covey abundance. After field borders were established (2005 and 2006), they continued to collect data on the aforementioned variables, as well as on artificial bobwhite nest success and field border vegetation characteristics. Following establishment of field borders, summer bobwhite abundance increased on farms in agriculture-dominated landscapes by 87 percent and on farms with nonlinear habitats by 57 percent. However, summer abundance did not increase on farms with linear field borders in forest-dominated landscapes. There was a positive but nonsignificant trend toward higher numbers of fall coveys/count on farms in agriculture-dominated landscapes and lower numbers on farms in forest-dominated landscapes after field border establishment. The proportion of depredated artificial bobwhite nests was similar across all treatments, as were the major vegetation characteristics of the field borders themselves. Focal songbird species' density, probability of nest success, and frequency of brood parasitism were unaffected by the establishment of field borders. Focal species' density (with red-winged blackbirds included) was 55 percent higher on farms in agriculture-dominated landscapes than in forest-dominated landscapes. Indigo bunting/blue grosbeak nest success probability was 129 percent higher on farms in agriculture-dominated landscapes than in forest-dominated landscapes. Brood parasitism frequency for indigo bunting/blue grosbeak was 33 percent, but did not differ between landscapes. The results suggest that linear and nonlinear field borders can be used to increase bobwhite populations on farms in agriculture-dominated landscapes. Nonlinear field borders can be used to increase bobwhite populations in forest-dominated landscapes. Early successional songbirds did not respond to field borders in the study. However, the same landscapes that were most conducive to bobwhite management were also the highest quality landscapes for early successional songbirds. Land managers should strongly consider a focal area approach to allocating field borders, especially for northern bobwhite. Specifically, land managers have much flexibility for bobwhite management in agriculture-dominated landscapes because both linear and nonlinear field borders increased quail populations.

TECHNICAL NOTE

CONSERVATION BUFFERS

Maximizing the Benefits of Field Borders for Bobwhite and Early Successional Songbirds:

What is the Best Design for Implementation?

Abundance of northern bobwhite (*Colinus virginianus)* (fig. 1) and many early successional songbirds [e.g., indigo bunting (*Passerina cyanea*), grasshopper sparrow (*Ammodramus savannarum*), and dickcissel (*Spiza americana*)] have declined severely in recent decades. On agricultural lands, many of these declines are believed to be due to the loss and degradation of early successional habitats (i.e., disturbance-maintained habitats comprised primarily of grasses, forbs, and shrubs). These early successional habitats are less common on many modern farms for a number of reasons, including increased field sizes, advances in farming machinery and herbicides, cultural attitudes about farm appearance, and the end of tenant farming.

Figure 1. Male bobwhite with chicks. (Photo credit North Carolina Wildlife Resources Commission)

Upland habitat buffers have been promoted as a way to establish early successional habitat for bobwhite and grassland songbirds on field margins. Also called "field borders," upland habitat buffers are areas of noncrop vegetation usually dominated by herbaceous and/or grassy species that are intentionally managed for wildlife (Field Border, CPS Code 386 and Early Successional Habitat Development/Management, CPS Code 647). Upland habitat buffers are typically maintained in the early successional stage by disking or burning approximately every 3 years.

Research studies have shown that upland habitat buffers can increase bobwhite and breeding songbird populations, as well as provide valuable winter habitat for sparrows (fig. 2). However, little is known about how upland habitat buffer characteristics, such as their shape or the landscape context in which they are established, influence their quality as bobwhite or songbird habitat. Narrow, linear upland habitat buffers may negatively affect nesting bobwhite and songbirds because they may function as travel lanes for nest predators such as raccoons. Nonlinear upland habitat buffers may alleviate this potential negative edge effect because of their relatively low edge-to-area ratios.

Figure 2. Linear upland habitat buffer between pine stand and young soybean field. (Photo credit Jason Riddle)

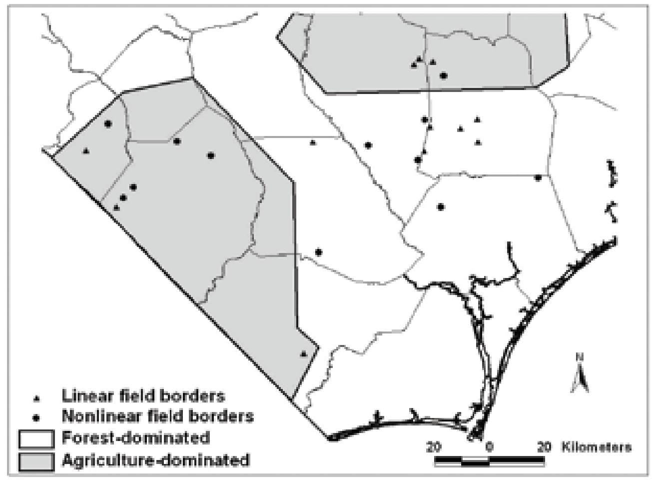

Figure 3. Study farm locations (with treatment assignments) used in this study.

Furthermore, previous research has suggested that bobwhite management should be focused in agriculture-dominated (rather than forest-dominated) landscapes because bobwhite often already are present to respond to management in these landscapes. The objectives were to evaluate the importance of upland habitat buffer shape (narrow linear vs. nonlinear) and landscape context (agriculture-dominated vs. forest-dominated) to northern bobwhite and early successional songbird conservation.

The study was conducted on 24 commercial hog farms in the southern Coastal Plain of North Carolina in Bladen, Columbus, Duplin, Pender, Sampson, Scotland, and Robeson Counties (fig. 3). All farms were owned and operated by Murphy-Brown, LLC. Study sites were selected from a pool of more than 200 company farms to minimize the potentially confounding differences among farms (e.g., crop rotations, recent timber activity, etc.). Each hog farm had one or more hog houses, which were confinement areas for hog production. Hog waste was collected into lagoons adjacent to the hog house(s). This waste was applied to row crop and hay fields as a form of nutrient management. Most farms were on a crop rotation of corn, soybeans, and wheat, although some farms also grew cotton.

Twelve farms in agriculture-dominated landscapes and 12 farms in forest-dominated landscapes were chosen. The 5,000-acre area surrounding each farm in agriculture-dominated landscapes was 49 percent row crop and 18 percent forest, whereas the 5,000-acre area surrounding each farm in forest-dominated landscapes was 20 percent row crop and 44 percent forests. In 2004, areas were delineated for upland habitat buffers on each farm. Location of all upland habitat buffers was based on patterns of waste application and advice given by farm managers and other Murphy-Brown, LLC, personnel. On half of the farms in each landscape, upland habitat buffers were linear and 10 feet wide. Whenever possible, linear upland habitat buffers were oriented so that they were parallel to crop rows to facilitate farm machinery operation within the fields. On the other half of the farms in each landscape, upland habitat buffers were nonlinear blocks located at the ends or corners of fields (fig. 4). To minimize loss of crop production, the most unproductive field ends, corners, and odd areas for nonlinear upland habitat buffers were identified. Upland habitat buffers were not planted, but instead were revegetated through natural colonization and succession. Farms varied by size, but the relative amount of row crop that came out of production on each farm was approximately

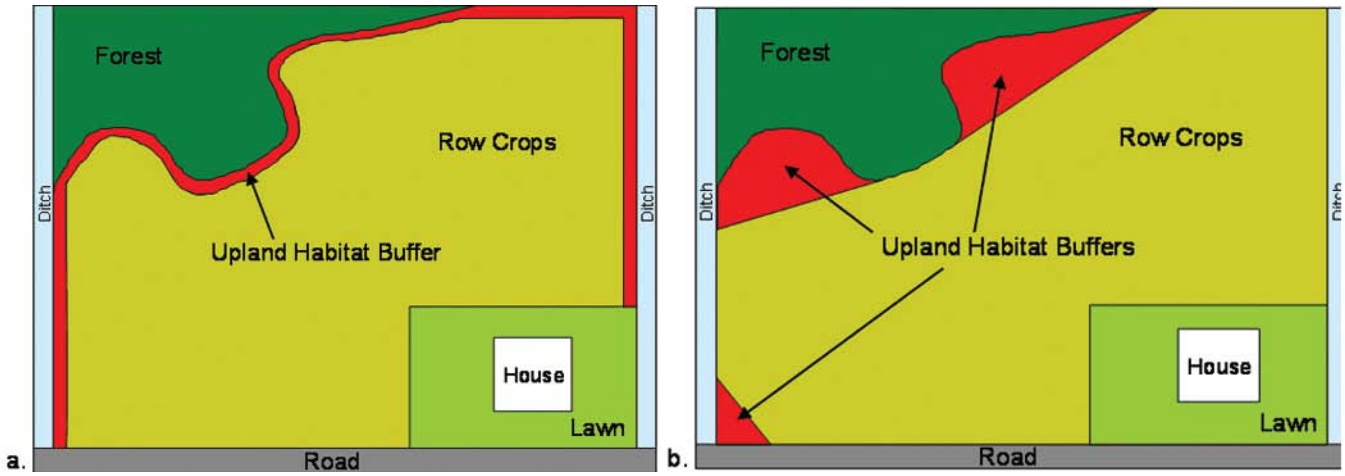

Figure 4. Overhead representation of two identical farms with upland habitat buffers of approximately equal area, but different shapes. One farm has a linear upland habitat buffer (a), and the other farm has nonlinear upland habitat buffers (b).

2 to 3 percent. Farm operators were not permitted to disturb upland habitat buffers (e.g., no mowing, herbicide application, turning of farm machinery) during the study.

Upland Habitat Buffer Characteristics

Linear upland habitat buffers ranged from 218 to 6,360 feet in length and averaged 1,559 feet long. Individual nonlinear upland habitat buffers varied by shape and ranged from 0.12 to 6.13 acres, but most were about 0.5 to 0.6 acre.

The single plant species that most typified each upland habitat buffer, as well as the percent cover of woody vegetation, herbaceous vegetation, and open ground within upland habitat buffers was estimated. The cone of vulnerability (exposure of quail to aerial predators) and the zone of vulnerability (exposure of quail to ground predators) was also measured.

Upland habitat buffers on 22 of 24 farms were dominated or co-dominated by dogfennel (*Eupatorium capillifolium*) (fig. 5). Linear and nonlinear upland habitat buffers had remarkably similar vegetation characteristics in both landscapes. Linear and nonlinear upland habitat buffers did not differ by the percent coverage of herbaceous vegetation or open ground (fig. 6). Although woody vegeta-

Figure 5. Nonlinear upland habitat buffer dominated by dog fennel (Eupatorium capillifolium). (Photo credit Jason Riddle)

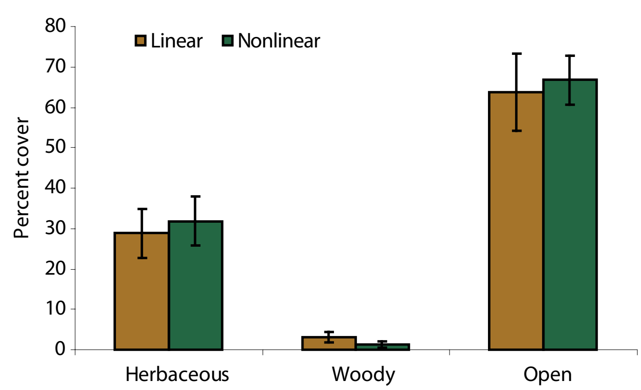

Figure 6. Average percent cover and 95 percent confidence intervals of herbaceous vegetation, woody vegetation, and open ground for linear and nonlinear upland habitat buffers (2005 and 2006 data combined).

tion was a minor component of all upland habitat buffers (overall average = 2.24%), linear upland habitat buffers had more than twice as much woody vegetation as nonlinear upland habitat buffers. The amount of herbaceous vegetation in the field borders was within an acceptable range for bobwhite nesting habitat. The cone of vulnerability and zone of vulnerability did not differ between linear and nonlinear upland habitat buffers (fig. 7). Both of these measures were within recommended ranges for bobwhite habitat.

Northern Bobwhite Response

In 2004, prior to the establishment of buffers, baseline abundance of bobwhite by conducting breeding season point counts (May and June) and fall covey counts (October and November) were estimated. Breeding and fall surveys at the same points in 2005 and 2006 after upland habitat buffers were established were subsequently repeated. Additionally, in 2005 and 2006, an artificial bobwhite nest experiment, which was designed to identify important potential nest predators and gauge relative predation pressures in linear and nonlinear upland habitat buffers in both landscapes, was conducted.

The establishment of upland habitat buffers increased breeding season bobwhite abundance by approximately 45 percent. However, the increase was not consistent across treatments. Breeding season bobwhite populations increased on farms in agriculture-dominated landscapes by 87 percent and on farms with nonlinear upland habitat buffers by 57 percent (fig. 8). Bobwhite decreased by 2 percent on farms with linear upland habitat buffers in forest-dominated landscapes.

Fall coveys increased by 0.27 coveys/farm in agriculture-dominated landscapes and decreased by 0.50 coveys/farm forest-dominated landscapes, but these trends were not statistically significant.

Artificial quail nest success rates were similar across treatments with an overall average of 68 percent success over a 2-week exposure period. The most common identifiable nest predator was raccoon (*Procyon lotor*), which did not appear to be more influential in any particular treatment. Assuming that artificial nest success is an indicator of potential real nest success, it does not appear that bobwhite nests are more vulnerable to predation in narrow, linear upland habitat buffers than in nonlinear upland habitat buffers.

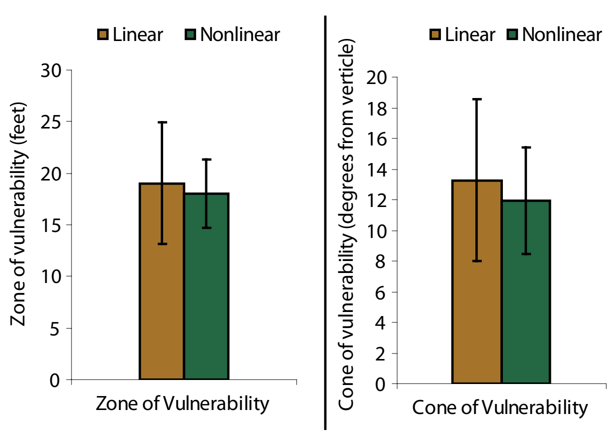

Figure 7. Average cone and zone of vulnerability with 95 percent confidence intervals for linear and nonlinear upland habitat buffers (2005 and 2006 data combined).

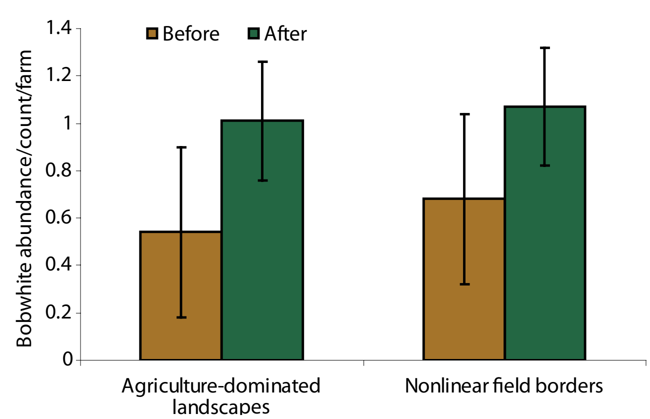

Figure 8. Breeding season bobwhite abundance with 95 percent confidence intervals before and after (2005 and 2006 data combined) the establishment of upland habitat buffers.

Songbird Response

Point counts were conducted during the breeding season of 2004 (May and June) to get baseline estimates of the density of several focal songbird species (indigo bunting, blue grosbeak (*Passerina caerulea*), red-winged blackbird (*Agelaius phoeniceus*), common yellowthroat (*Geothlypis trichas*), grasshopper sparrow, field sparrow (*Spizella pusilla*), and eastern meadowlark (*Sturnella magna*)). In 2004, indigo bunting and blue grosbeak nests (May, June, and July) were also located and monitored to get baseline estimates of nest success and frequency of brood parasitism by brown-headed cowbirds. In 2005 and 2006 after the upland habitat buffers were established, breeding season data on focal species' density, as well as indigo bunting and glue grosbeak nest success and frequency of brood parasitism were collected. All focal species were combined for density estimates, and indigo bunting and blue grosbeak nests were combined for nest success and brood parasitism estimates.

The establishment of upland habitat buffers had no measurable effect on focal species density, indigo bunting/blue grosbeak nest success, or brood parasitism frequency (figs. 9 and 10). Very few nests (<15%) were actually located in upland habitat buffers, probably because woody nest substrates were uncommon in these habitats. Focal species density was 55 percent higher in agriculture-dominated landscapes than in forest-dominated landscapes, most likely because red-winged blackbirds were extremely abundant on several farms in agriculture-dominated landscapes. Indigo bunting/blue grosbeak nest success was more than twice as high on farms in agriculture-dominated landscapes (39%) than forest-dominated landscapes (17%). Brown-headed cowbird parasitism frequency did not differ by landscape, but was high overall (33%).

Summary

In agriculture-dominated landscapes, landowners have greater flexibility because both narrow, linear and nonlinear upland habitat buffers can increase bobwhite populations. However, landowners in forest-dominated areas still may be able to increase bobwhite on their farms, but it will require larger blocks of nonlinear upland habitat buffers or wide, linear upland habitat buffers to do so. The linear upland habitat buffers were relatively narrow (10 ft), which is consistent with practice standard Field Border (CPS Code 386), but well below the minimum average width required for upland habitat buffers practice CP33 (30 ft). It was recognized that

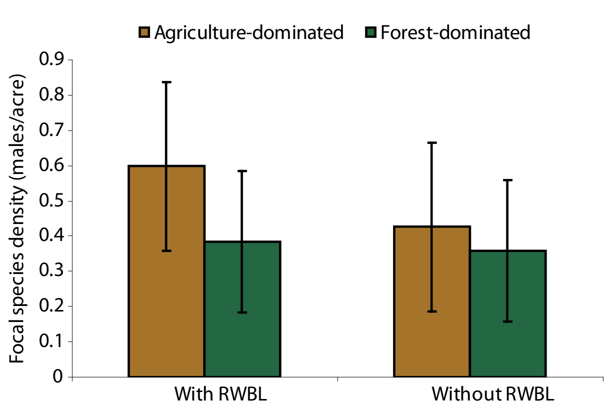

Figure 9. Combined focal species density averages with 95 percent confidence intervals in agriculture- and forest-dominated landscapes (all years combined).

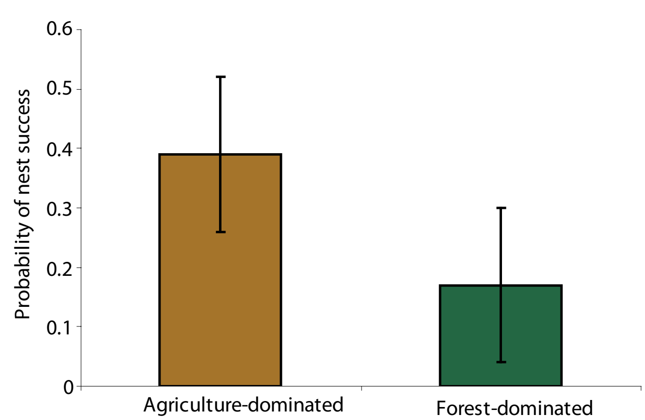

Figure 10. Indigo bunting/blue grosbeak nest success estimates with 95 percent confidence intervals in agriculture- and forest-dominated landscapes (all years combined).

wider (mean ≥30 ft) linear upland habitat buffers may provide the same or even greater benefits than nonlinear upland habitat buffers, regardless of landscape context. The use of wide, linear and nonlinear upland habitat buffers in agriculture-dominated landscapes is recommended whenever possible. It is also recommended that narrow, linear, upland habitat buffers be considered for use in agriculture-dominated landscapes where wider buffers may not fit production objectives. Even if cost-share by Farm Bill conservation programs is not possible, some landowners may be willing to allow 10-foot-wide field borders without financial support. The landowner, Murphy-Brown, LLC, was able to allow borders of this width without accepting subsidies and without compromising commercial hog or row crop production.

Because of the timing of bobwhite increase on these farms, it is believed that the initial gains were by spring-dispersing individuals. The population increased quickly in 2005 and additional gains were not observed in 2006. This indicated that bobwhite quickly colonized and saturated the new habitat. Additional gains on the farms would have been unlikely without adding more upland habitat buffers or significantly improving the surrounding woodlands with thinning and burning. Landowners who have previously experienced quail increases under CP33 or other Conservation Practices and desire additional population increases may be willing to manage timberlands and areas not in production in such a way as to add more suitable bobwhite habitat.

The upland habitat buffers did not result in greater focal songbird density, higher indigo bunting/blue grosbeak nest success, or reduced brood parasitism frequency. The lack of upland habitat buffer effect on songbirds probably was because only 2 to 3 percent of the total row-cropped area on each farm was converted to upland habitat buffers. Other studies have documented increases in early successional birds such as indigo bunting and dickcissel with 6 percent of row-cropped area converted to upland habitat buffers. Therefore, 6 percent as a minimum is recommended for a songbird response. Additionally, the upland habitat buffers probably contained too little woody nesting substrate for primary nesters (indigo bunting and blue grosbeak). Depending on site conditions, managers should promote more woody growth in some upland habitat buffers. Conversion of all upland habitat buffers on a farm to shrubby, woody habitat is not recommended, but more than 2 to 3 percent woody cover is needed to impact the nesting ecology of birds like indigo bunting and blue grosbeak.

The landscapes best suited for quail management (agriculture-dominated landscapes) also supported the highest densities and nest success probabilities for early successional songbirds. Therefore, tremendous potential exists for multispecies management with upland habitat buffers in agriculture-dominated landscapes. It is recommended that landscape context be considered as a critical factor for enrollment into CPS Code 386, CPS Code 647, CP33, or similar practices. Specifically, more acres could be allocated to States, watersheds, or counties predominated by agriculture-dominated landscapes. Alternatively, higher rental rates or sign-up bonuses could be allowed to encourage landowner enrollment in these landscapes.

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North Carolina State University
Wildlife and Water Quality on North Carolina Farms Workshop
August 16, 2006

Dr. Chris Moorman (associate extension professor) and Jason Riddle (Ph.D. candidate) from North Carolina State University (NCSU) hosted their USDA NRCS Bobwhite Restoration Project Field Day on August 16, 2006, at Jones Lake State Park in Bladen County, North Carolina. The Wildlife and Water Quality on North Carolina Farms Workshop featured a morning field tour of one of several study sites used in their research evaluating the effects of field border shape and surrounding landscape context on bobwhite and songbird populations. Just under 100 natural resource professionals and private landowners participated in the workshop (fig. 1). Topics covered in the field tour included native warm-season grass (NWSG) establishment (fig. 2), vegetation management with herbicides, riparian buffers, field border shape and landscape context (figs. 3 and 4), and cost-share programs. The afternoon session consisted of classroom presentations on old-field habitat management, maximizing success of field border implementation, riparian buffer basics, cost-share program implementation, and landscape-level quail management. Displays and educational materials were present from Quail Unlimited, North Carolina Wildlife Resources Commission, and NSCU.

Attendance	
NRCS Personnel	**27**
Private Landowners/Farmers	**16**
Soil and Water Conservation District Staff	**14**
University Faculty and Staff	**13**
Quail Unlimited	**10**
North Carolina Wildlife Resources Commission	**9**
County Cooperative Extension Agents	**3**
NC Department of Agriculture	**3**
US Fish and Wildlife Service	**2**
Mississippi State University	**1**
Total	**98**

Figure 1. Terry Sharpe (NCWRC) provide introductory remarks at the Wildlife and Water Quality on NC Farms Workshop. Nearly 100 resource professionals and private landowners attended.

Figure 2. Benjy Strope (NCWRC) provides an overview of the equipment required to establish native warm-season grasses.

Figure 3. Jason Riddle (Ph.D. candidate at NCSU) and Dr. Chris Moorman (Associate Extension Professor at NCSU) demonstrate how landscape context may influence bobwhite and songbird use of field border habitats.

Figure 4. Bill Edwards (NC-NRCS) and Terry Sharpe (NCWRC, not pictured) discuss the importance of field borders in providing habitat for bobwhite.

Evaluation

All attendees were asked to complete an evaluation form that was included in their packets.

	Attendance	Returned Forms	Response Rate (%)
NRCS/SWCD staff	41	23	56
Private	16	10	63
Other	40	18	45
Total	97	51	53

Attendees were asked to rank the overall value of the workshop in increasing their knowledge of the topic. On a scale from 1 to 5 (5 is highest), participants gave the workshop an average score of 4.32.

Percentage of participants ranking overall workshop value from highest to lowest.

	NRCS/ SWCD	Private	Quail Unlimited	University	Other
High	35	20	67	75	38
	65	80	17	25	38
	0	0	17	0	25
	0	0	0	0	0
Low	0	0	0	0	0

Attendees were asked if the workshop format was suitable, if the information would be useful in their work, and if they would like to attend more NCSU/ NRCS workshops.

Percentage of participants that answered yes”

Format Suitable	Information Useful in Work	Attend More Events
100	98	100

Attendees were asked by which means they would like to receive information about future NCSU/NRCS project results.

Work-shop	Newsletter	E-mail	CD Rom	Fact Sheet	Other
59	61	47	20	45	2

Percentage of participants preferring future information in various formats.

Samples of general recommendations for workshop improvement follow:

- Landowner presentations/testimonials
- Discuss benefits of conservation programs to farmers
- Include more information on forest management and prescribed burning

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

August 2009

CONSERVATION BUFFERS

Benefits of a Buffer-based Conservation Management System for Bobwhite and Grassland Songbirds in an Intensive Production Agriculture Landscape in the Lower Mississippi Alluvial Valley

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Acknowledgments and disclaimer

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Acknowledgments

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Landscape-level Response of Bobwhite to Implementation of a Conservation Management System in the Mississippi Alluvial Valley

The Northern Bobwhite Conservation Initiative is predicated on the assumption that if primary land use is altered on 6 to 7 percent of the landscape, bobwhite populations will respond at focal area (i.e., areas with the greatest potential for restoration of bobwhite populations), bird conservation regions BCR, and national scales. But what level of response can be expected? Many studies have demonstrated field- or stand-level population response to a broad array of conservation practices; however, few studies have demonstrated landscape-scale population responses to broadly-applied conservation practices, especially in working landscapes. This project evaluated bobwhite population response to comprehensive, objective-driven conservation planning on a focal-area-sized landscape in the intensively farmed Mississippi Alluvial Valley (MAV). This study was conducted on a large (6,475 acres) production row crop farm in Coahoma County, Mississippi, in the MAV. The farm on which the research was conducted had implemented a myriad of conservation practices as part of an overall Conservation Management System (CMS). This property was composed of 48 percent row crop, 30 percent early successional hardwood reforestation plantings, 14 percent forested or herbaceous wetlands, 4 percent conservation buffers, 2 percent forested, and 2 percent herbaceous drains. Although management practices under the CMS were generic conservation practices and not specifically designed to increase bobwhite populations, bobwhites were moderately abundant across the entire property. Mean bobwhite abundance across the entire CMS planning boundary (1.69 birds/point) was 238 percent greater than that observed in the immediately surrounding unmanaged landscape (0.51 birds/point), 116 percent greater than that observed on Coahoma County control fields (0.78 birds/point), and comparable to that observed on Coahoma County CP33 fields (1.89 birds/point). During the breeding season, point-specific mean bobwhite abundance was positively associated with percent of the landscape in mixed native warm-season grass (NWSG) buffers, percent of the landscape in all conservation buffers, percent of the landscape in afforestation plantings, and percent of the landscape in all conservation practices. Local bobwhite abundance was negatively associated with percent of the landscape in row crops. During October 2007, mean density of bobwhite coveys within the CMS planning boundaries was 71 percent greater than on Coahoma County CP33 fields and 700 percent greater than observed on Coahoma County control fields. Within the CMS, approximately one covey per 42 acres was observed, whereas one covey per 73 acres on Coahoma County CP33 fields was observed and one covey per 326 acres on Coahoma County Control fields was observed. However, strategic deployment of a suite of conservation buffer practices and large block early successional habitats across a focal area-sized landscape can produce bobwhite populations 230 to 700 percent greater than background densities, while still maintaining nearly 50 percent of the landscape in productive cropland. Even in the most inhospitable agricultural landscapes, creation and maintenance of appropriate habitat through comprehensive conservation planning can restore bobwhite populations to historic levels.

TECHNICAL NOTE

CONSERVATION BUFFERS

Landscape-level Response of Bobwhite to Implementation of a Conservation Management System in the Mississippi Alluvial Valley

Introduction

Abundant bobwhite populations of past decades were an accidental by-product of broadly applied land management practices that created a diverse mosaic of early successional plant communities (fig. 1). In modern working landscapes, the large-scale, creation, and maintenance of early successional habitat can restore bobwhite populations to former densities. The Northern Bobwhite Conservation Initiative (NBCI) is an ambitious, rangewide population recovery plan with a goal to restore bobwhite populations on improvable acres to an average density that existed in 1980. The NBCI depends heavily on the ability to influence land use practices on working agricultural lands. Converting exotic grasses to native grasses, establishing native herbaceous buffers around agricultural fields, and developing shrub cover in areas lacking winter and escape cover are some of the primary conservation practices that have been identified for priority, targeted delivery in agricultural landscapes. Federal Farm Bill conservation programs are the primary policy vehicle envisioned for the delivery of these conservation practices on working private lands.

Figure 1. Northern bobwhite pair in early successional vegetation along row crop margin. (Photo credit Marco Nicovich, MCES)

Under the NBCI, population and habitat objectives are defined for 15 bird conservation regions (BCR) that comprise most of the bobwhite's range. BCR are physiographic regions of similar land use and cover in which bobwhite presumably face similar limiting factors. State wildlife conservation agencies throughout the range are charged with developing State-level step-down plans for implementation of BCR-level habitat goals. Most States have adopted a focal area approach to NBCI implementation in which the areas with the greatest potential for restoration are identified for priority delivery of technical assistance and economic incentives. The goal is to achieve a critical mass of bobwhite habitat within a defined region that is small enough to permit broad-scale land use alterations, yet large enough to support sustainable, viable populations. Focal area size varies dramatically among States, ranging from 5,000 acres to more than 50,000 acres. The NBCI is predicated on the assumption that if these habitat goals are acheived by altering primary land use on 6 to 7 percent of the landscape, bobwhite populations will respond at focal area, BCR, and national scales. But what level of response can be expected? Many studies have demonstrated field- or stand-level population response to a broad array of conservation practices; however, few studies have demonstrated landscape-scale population responses to broadly-applied, conservation practices in working landscapes.

The success of the NBCI in achieving habitat and population goals at national, BCR, State, and focal area levels will depend on the successful planning and implementation of conservation practices at the farm scale. Burger (2006) used the Natural Resources Conservation Service (NRCS) nine-step planning process to illustrate a philosophical framework in which wildlife conservation practices are planned and delivered at the farm scale through an objective-driven process. This project evaluated bobwhite population response to application of comprehensive, objective-driven conservation planning on a focal-area-sized landscape on an intensive, row crop farm in the MAV.

Study Description

This study was conducted on a large (6,475 acres) production row crop farm in Coahoma County, Mississippi, in the MAV. This physiographic region is characterized by large, row crop (e.g., cotton, soybean, and corn) operations. The MAV has nominal topographic relief and the agricultural landscape is sparsely fragmented with noncrop, strip habitats. The landscape matrix surrounding the study farm (~13,000 acres) was intensively cropped and was composed of 83 percent row crop, 8 percent forested or herbaceous wetland, 4 percent woodland, 3 percent developed, and less than 2 percent noncrop herbaceous cover. In contrast, the farm on which the research was conducted had implemented a myriad of conservation practices as part of an overall CMS. This property was composed of 48 percent row crop, 30 percent early successional hardwood afforestation plantings, 14 percent forested or herbaceous wetlands, 4 percent conservation buffers, 2 percent woodland, and 2 percent herbaceous drains (fig. 2).

Bottomland hardwood, afforestation blocks (Tree/Shrub Establishment, CPS Code 612 (CRP CP3A)) were planted primarily with Texas red oak (*Quercus texana*), water oak (*Quercus nigra*), and willow oak (*Quercus phellos*) in the fall of 1999. However during this study afforestation blocks were still in the early successional seral stage and were largely herbaceous with areas of enhanced growth transitioning to shrub-successional habitat (fig. 3). Riparian forest buffers (RFB), CPS Code 391 (CRP CP22)) were planted with hardwood trees (refer to hardwood afforestation block plantings) in the fall of 2004, but throughout the study were still in an annual and perennial weed stage. RFB were 180 feet wide and composed of pioneer, herbaceous plants that invaded naturally (fig. 4). Pioneer species that naturally invaded were similar for RFB and hardwood afforestation blocks, including Canadian horseweed (*Conyza canadensis*), American buckwheat vine (*Brunnichia ovata*), vetch (*Vicia* sp.), goldenrod (*Solidago* spp.), giant ragweed (*Ambrosia trifida*), curly dock (*Rumex*

Figure 2. Conservation practices implemented on Coahoma County, MS, study site.

crispus), southern dewberry (*Rubus trivialis*), sawtooth blackberry (*Rubus argutus*), johnsongrass (*Sorghum halepense*), eastern poison ivy (*Toxicodendron radicans*), and broomsedge bluestem (*Andropogon virginicus*).

Two types of 99-foot-wide filter strips were installed in the spring of 2004. Monotypic filter strips (CPS Code 393 (CRP CP21) (fig. 5)) were completely dominated by switchgrass, which was planted at 8 pounds per acre. Mixed filter strips (CPS Code 393 (CRP CP21)) were planted with little bluestem (*Schizachyrium scoparium*, 5 lb/acre), big bluestem (*Andropogon gerardii*, 1.5 lb/acre), Indiangrass (*Sorghastrum nutans*, 1.5 lb/acre), and partridge pea (*Chamaecrista fasciculata*, 4 lb/acre) (fig. 6). Although filter strips will be maintained using planned disturbance regimes (Early Successional Habitat Development/Management, CPS Code 647), no management had yet commenced.

Figure 3. Early successional afforestation block on Coahoma County, MS, study site. (Photo credit Ross Conover).

Figure 4. Early successional riparian forest buffer on Coahoma County, MS, study site. (Photo credit Ross Conover)

Figure 5. Monotypic switchgrass filter strip on Coahoma County, MS, study site. (Photo credit Ross Conover).

Figure 6. Diverse native warm-season grass/forb filter strip on Coahoma County, MS, study site. (Photo credit Ross Conover)

Bobwhite Population Monitoring

Strip-transect surveys of the entire avian community in early successional afforestation blocks, RFB, monotypic filter strips, and diverse NWSG/forbs filter strips were conducted. These surveys indicated broad use of all conservation practices by bobwhite across the managed landscape. To characterize bobwhite population response to individual and collective implementation of the suite of conservation practices across the entire planning area, 100 breeding-season call count survey points in a 10- by 10, 0.5-mile grid across the entire 13,000-acre landscape matrix were systematically distributed. Forty-two of these points fell within the conservation planning farm boundary, and 58 fell on unmanaged farmland outside the planning boundary. Singing male bobwhites were surveyed using 5-minute call counts at all points within 3 hours of sunrise during the second and third weeks of June across 3 years (2005–2007). Concurrent with this monitoring during 2006 and 2007, as part of the national monitoring program for CP33 (Habitat Buffers for Upland Birds), identical call counts were conducted on 11 randomly selected fields in Coahoma County that had implemented CP33 upland habitat buffers and 11 paired control fields in the same landscape. The observed bobwhite abundance in the immediate unmanaged landscape surrounding the study farm and Coahoma County CP33 monitoring fields as an estimate of baseline bobwhite population levels that might be expected on the study site in the absence of a CMS were used. Additionally, during October 2007, fall covey counts were conducted on 16 of the 42 call count stations located within the planning boundaries. Fall covey density was estimated fusing distance-based methodology in PROGRAM DISTANCE 5.0 (Thomas et al. 2006).

A geographic information system was developed from 2007 NAIP imagery to characterize landscape composition and structure in a 19,322-acre region encompassing the study area. Landscape composition was characterized within a 1,312-foot radius (124 acres) surrounding each of the 100 call count points to examine relationships between mean breeding season bobwhite abundances (2005–2007) and percentage of the surrounding landscape habitat types (monotypic filter strips, diverse filter strips, riparian forest buffers, afforestation plantings, row crop, woods, total conservation buffers, and total conservation practices).

Bobwhite Population Response

Although management practices under the CMS were generic conservation practices and not specifically designed to increase bobwhite populations, bobwhites were moderately abundant across the entire property (fig. 7). Mean bobwhite abundance across the entire CMS planning boundary (1.69 birds/point) was 238 percent greater than that observed in the immediately surrounding unmanaged

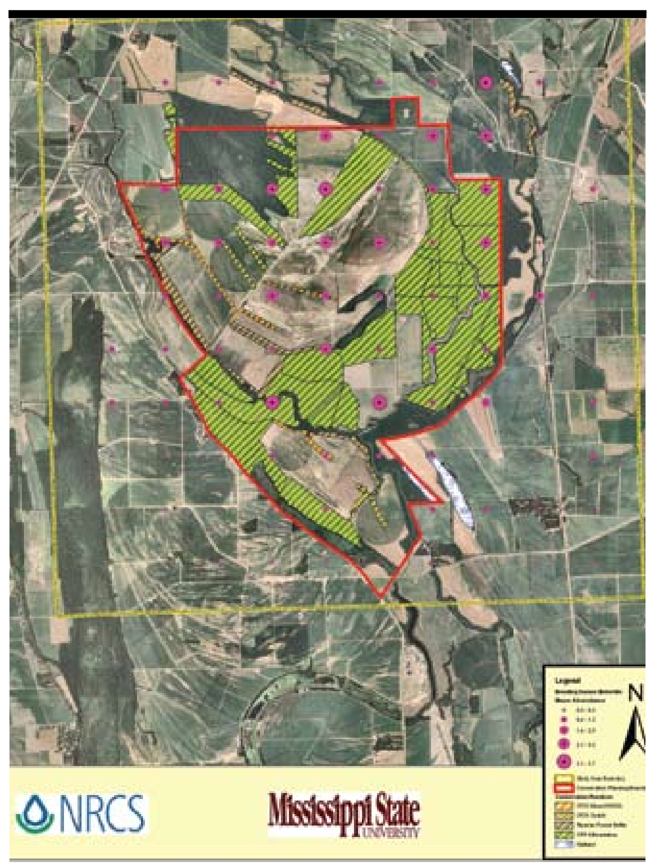

Figure 7. Mean bobwhite abundance at call count points across the Coahoma County study area, 2005–2007.

landscape (0.51 birds/point), 116 percent greater than that observed on Coahoma County Control fields (0.78 birds/point), and comparable to that observed on Coahoma County CP33 fields (1.89 birds/point, fig. 8). Although bobwhite occurred throughout the CMS planning boundary, they were not uniformly distributed. During the breeding season, point-specific mean bobwhite abundance was positively associated with relative landscape proportions of diverse NWSG/forbs buffers, all conservation buffers, afforestation hardwood blocks, and all conservation practices combined. Local bobwhite abundance was negatively associated with percent of row crop cover in the landscape. Bobwhite abundance was uninfluenced by the amount of monotypic switch grass filter strips in the landscape.

During October 2007, mean density of bobwhite coveys within the CMS planning boundaries was 71 percent greater than on Coahoma County CP33 fields and 700 percent greater than observed on Coahoma County control fields. Within the CMS, approximately one covey per 42 acres was observed, whereas one covey per 73 acres on Coahoma County CP33 fields was observed, and one covey per 326 acres on Coahoma County Control fields (fig. 9) was observed.

Management Implications

In modern intensively farmed agricultural systems, early successional habitats are scarce and occur in small, isolated patches. Evidence was found to expect low baseline densities of bobwhite across these highly perturbed landscapes. Implementation of broadly applied, but low-intensity practices, such as upland habitat buffers, can increase local bobwhite populations by 50 to 200 percent and will contribute to State, regional, and national population objectives. However, strategic deployment of a suite of conservation buffer practices and large block early successional habitats across a focal area-sized landscape can produce bobwhite populations 230 to 700 percent greater than background densities, while maintaining nearly 50 percent of the landscape in row crop production. During the study, breeding abundance of bobwhite was most highly associated with percentage of the surrounding landscape in large blocks of early successional habitat. However, breeding abundance was also positively related to percent of the landscape in filter strips planted to a diverse mixture of NWSG and legumes. Breeding season bobwhite abundance was not related to amount of monotypic switchgrass filter strips. This study demonstrates that even in the most inhospitable agricultural landscapes, creation

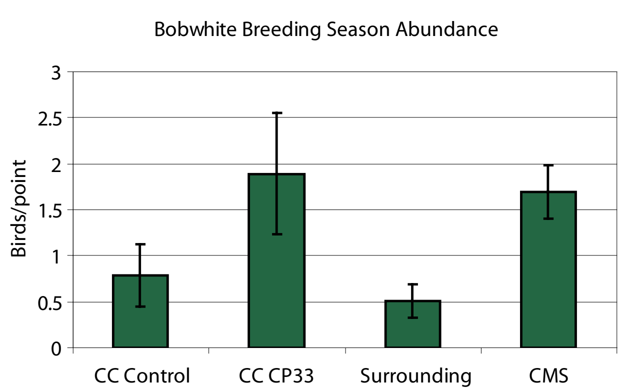

Figure 8. Mean bobwhite breeding abundance within the Coahoma County CMS planning boundaries, in the surrounding unmanaged landscape, on Coahoma County control fields, and Coahoma County CP33 fields, 2005–2007.

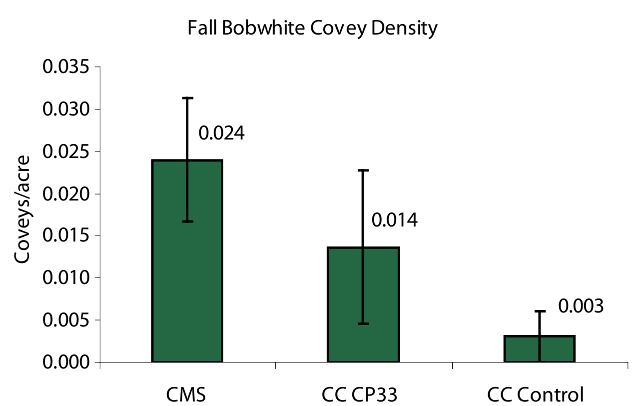

Figure 9. Mean bobwhite covey density within the Coahoma County CMS, on Coahoma County control fields, and Coahoma County CP33 fields, October 2007.

and maintenance of appropriate habitat through comprehensive conservation planning can restore bobwhite populations to historic levels. The population goals of the NBCI are plausible if conservation practices are delivered with adequate intensity over sufficiently large geographic areas.

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Benefits of Early Successional Buffer and Block Habitat for Farmland Avian Communities in the Mississippi Alluvial Valley

Large-scale conversions of native grassland habitat to agriculture in the United States have resulted in population declines of numerous grassland birds. Many species have adapted to widespread habitat loss by exploiting the noncrop habitat fragments that remained on farmlands, an adaptation that included a geographic range expansion for some species. Despite the benefits of this behavioral plasticity, many grassland birds continued to decline. Recent advances in agricultural technology (e.g., aerial chemical application, transgenic crops, large farm machinery, etc.) further perpetuate these losses by favoring large farm fields and ditch-to-ditch row crop production. The U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) has created millions of acres of grassland habitat throughout agricultural landscapes since 1986. The National Conservation Buffer Initiative was launched in 1997 to build on the successes of the CRP and other similar programs by promoting installment of conservation buffers on farm field margins. Considering the well-documented limitations of strip habitat for nesting birds, ecological assessments of buffers are a high priority. This study investigated the relative bird conservation benefits of early successional buffer and block habitats in an intensively cropped agricultural landscape in the Mississippi Alluvial Valley. Specifically, researchers measured species richness, density, nesting density, and nest survival in three types of conservation buffers and early successional afforestation blocks implemented as part of a conservation management system (CMS) on a 6,475-acre production farm in Coahoma County, Mississippi. Conservation buffers included early successional, riparian forest buffers (RFB), diverse native warm-season grass/forb filter strips, and monotypic (switchgrass) filter strips. The results supported expectations that larger, contiguous block habitat provides greater benefits than buffers. However, also observed were substantive wildlife benefits of buffer habitats. Block habitat attracted greater avian abundance and diversity, as well as considerably higher nesting density and slightly increased nest success, indicating that overall area and vegetative diversity are important habitat components for the avian community. The influence of buffers on breeding bird response was positive and RFB and mixed filter strips produced greater benefits than monotypic switch grass filter strips. RFB were colonized by a diverse spectrum of locally abundant forbs and grasses, whereas the filter strips were dominated by planted species, thus reducing their overall structural and compositional diversity. The similarity of avian community metrics between mixed filter strips and RFB provides encouraging evidence that narrow buffers (98 ft) represent suitable habitat given adequate vegetative structure and composition. All early successional birds on the farm nested more frequently in block habitats, except northern bobwhite, which used all habitats relatively evenly except monotypic filter strips. Dickcissels and mourning doves also exhibited reduced nesting activity in monotypic filter strips, whereas red-winged blackbirds were the only species to readily and frequently nest in this treatment. The slightly higher success of nests in block relative to buffer habitats may indicate presence of marginal edge effects. Based on the enhanced benefits provided to the avian community, it is suggested that block habitat establishment receive priority in the development of a farmwide CMS that is intended to benefit grassland birds. The beneficial role of conservation buffer habitats was evident, and the use of buffers to complement ecological functions of a block-based CMS is recommended. Furthermore, buffers represent a viable conservation practice to improve wildlife habitat on farms where large block habitat is incompatible with production systems.

Benefits of Early Successional Buffer and Block Habitat for Farmland Avian Communities in the Mississippi Alluvial Valley

Introduction

Large-scale conversions of native grassland habitat to agriculture in the Midwestern United States contributed to population declines of several grassland bird species. Many species have adapted by fulfilling life-history requirements in the remaining habitat fragments, such as noncrop, weedy, strip habitats that persisted on farmlands (fig. 1). Whereas this adaptability likely maintained populations of some species, grassland birds overall continued to experience more severe population declines than any other avian guild. Recent technological advances (e.g., aerial chemical application, transgenic crops, large farm machinery, precision agriculture) have further altered agricultural production to favor large farm fields and ditch-to-ditch, row crop practices that increase efficiency. The removal of these noncrop habitat remnants has worsened already inhospitable wildlife conditions for grassland birds in North American agricultural landscapes.

Figure 1. Male dickcissel perched on American elm in hardwood afforestation block habitat (Photo credit Adam Efird).

The U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) has created more than 34 million acres of potential habitat on private lands and contributed to recovery of some grassland bird species. However, whole field cropland diversion does not always meet the production and economic objectives of individual producers. The National Conservation Buffer Initiative promotes partial field enrollments of the most environmentally sensitive portions of fields. Conservation buffers, such as filter strips (Conservation Practice Standard (CPS) Code 393) and riparian forest buffers (CPS Code 391), are noncrop, strips of vegetation that are easily integrated into production systems, minimally impact production, and enhance ecological integrity on farm field margins. Although primarily designed to mitigate nonpoint source water pollution, recent prioritization of wildlife benefits has enhanced the ecological breadth of conservation buffers. Additionally, buffers are a research priority because of the presumption of low productivity in strip-habitats associated with increased predator activity and brood parasitism from brown-headed cowbirds (*Molothrus ater*). With continued loss of native grasslands in the Midwest and conversion of nongrassland habitats to agriculture (i.e., bottomland hardwood), grassland birds continue to exploit early successional habitats on the periphery of, or even beyond, their natural geographic range. Little is known of population performance of grassland birds in these intensively cropped landscapes in the periphery of the range.

This study investigated relative benefits of conservation buffer and early successional block (i.e., nonlinear habitat designed to reduce edge:interior ratio) habitats for farmland birds in the Mississippi Alluvial Valley (MAV). Specifically, researchers investigated avian benefits provided by monotypic, switchgrass (*Panicum virgatum*) filter strips (CPS Code 393 (CRP CP21 mono) (fig. 2)), native warm-season grass and forb filter strip plantings (CPS Code 393 (CRP CP21 mix)), early succession riparian forest buffers (RFB) (CPS Code 391 (CRP CP22)), and hardwood afforestation blocks (Tree/Shrub Establishment, CPS Code 612 (CRP CP3A block)). Primary objectives included determining the relative benefits of each habitat type for avian abundance, diversity, and reproduction (e.g., nesting density and success), as well as their relative contribution to farm-level bird populations under a conservation management system (CMS). Researchers hypothesized that the increased overall area of hardwood afforestation blocks would provide greater avian benefits than buffers, RFB would support greater avian abundance, diversity, and nesting activity because of their greater width and vegetative diversity over filter strips, filter strips established in a diverse native warm-season grass legume mixture would provide greater benefits than monotypic switchgrass filter strips, and that a landscape-level implementation of conservation practices would support substantially higher avian densities than the background agricultural matrix.

Figure 2. Switchgrass, monotypic filter strip adjacent to row crop, soybean field. (Photo credit Ross Conover, ISU)

Habitat Treatments

This study was conducted on a large (6,475 acres) production row crop farm in Coahoma County, Mississippi, in the MAV. This physiographic region has undergone drastic landscape conversions from vast, continuous tracts of bottomland hardwood forest to a landscape dominated by large, row crop agricultural (e.g., cotton, soybean, and corn) fields. The MAV has nominal topographic relief and the agricultural landscape is sparsely fragmented with noncrop, strip habitats. The landscape matrix surrounding the study farm (~13,000 acres) was intensively cropped and was composed of 83 percent row crop, 8 percent forested or herbaceous wetland, 4 percent wooded, 3 percent developed, and less than 2 percent noncrop herbaceous cover. In contrast, the farm on which the research was conducted had implemented a myriad of conservation practices as part of an overall CMS. This property was composed of 48 percent row crop, 30 percent early successional hardwood reforestation plantings, 14 percent forested or herbaceous wetlands, 4 percent conservation buffers, 2 percent forested, and 2 percent herbaceous drains.

Bottomland hardwood, afforestation blocks (i.e., nonlinear habitat (CPS Code 612)) were planted primarily with Texas red oak (*Quercus texana*), water oak (*Quercus nigra*), and willow oak (*Quercus phellos*) in the fall of 1999. However, during this study afforestation blocks were still in the early successional seral stage and were largely herbaceous with areas of enhanced growth transitioning to shrub successional habitat. RFB were planted with hardwood trees (refer to hardwood afforestation block plantings) in the fall of 2004, but failed to emerge enough to impact their vegetative structure throughout the study. RFB were 180 feet wide and composed of pioneer, herbaceous plants that invaded naturally. Pioneer species that naturally invaded were similar for RFB and hardwood afforestation blocks, including Canadian horseweed (*Conyza canadensis*), American buckwheat vine (*Brunnichia ovata*), vetch (*Vicia* sp.), goldenrod (*Solidago* spp.), great ragweed (*Ambrosia trifida*), curly dock (*Rumex crispus*), southern dewberry (*Rubus trivialis*), sawtooth blackberry (*Rubus argutus*), johnsongrass (*Sorghum halepense*), eastern poison ivy (*Toxicodendron radicans*), and broomsedge bluestem (*Andropogon virginicus*).

Both types of filter strips were planted to 99 feet widths in the spring of 2004. Monotypic filter strips (fig. 2) were completely dominated by switchgrass, which was planted at 8 pounds per acre. Mixed filter strips were planted with little bluestem (*Schizachyrium scoparium*, 5 lb/acre), big bluestem (*Andropogon gerardii*, 1.5 lb/acre), Indiangrass (*Sorghastrum nutans*, 1.5 lb/acre), and partridge pea (*Chamaecrista fasciculata*, 4 lb/acre). Although filter strips will be maintained using planned disturbance regimes (Early Successional Habitat Development/Management, CPS Code 647), no management had yet been implemented on these buffers. For this study, 66- to 656-foot-long plots within each habitat treatment were randomly selected from the population of potential buffers. Within these 656-foot-long plots, avian response was assessed, while accounting for natural variation among plots of the same treatment.

Breeding Bird Community

Researchers estimated mean species specific density (birds/acre) and richness (no. species/acre) from three strip-transect surveys (May, June, and July) conducted during each breeding season, 2005 to 2007, along each transect (197 ft either side of the transect line).

Over the 3 years of the study, researchers documented 35 bird species using buffer and block habitats. Habitat-specific totals included 25 species in hardwood afforestation blocks, 22 species in mixed filter strips, 18 species in monotypic filter strips, and 19 species in RFB. Dickcissel (*Spiza americana*) and red-winged blackbird (*Agelaius phoeniceus*) dominated avian community assemblages in all habitats; mourning dove (*Zenaida macroura*), eastern meadowlark (*Sturnella magna*), northern bobwhite (*Colinus virginianus*), and grasshopper sparrow (*Ammodramus savannarum*) were also consistently present. Indigo bunting (*Passerina cyanea*) and northern cardinal (*Cardinalis cardinalis*) were frequently observed in buffers juxtaposed to wooded fence rows, emphasizing the incorporation of landscape context for planning a farmwide buffer installment regime. Researchers observed slight temporal changes in avian community composition across 3 years of succession. As afforestation and RFB blocks succeeded from a herbaceous to a shrub community, abundances of red-winged blackbird, eastern meadowlark, and grasshopper sparrow declined and dickcissel increased. Overall avian densities failed to reveal major differences among habitats. However, monotypic filter strips attracted the fewest total birds during all 3 years, whereas block habitat attracted the most birds during 2005 and 2006 (fig. 3).

Mean species richness was consistently higher for block than buffer habitats, with monotypic filter strips attracting the fewest species (fig. 4). This trend is illustrated by the dominance of red-winged blackbirds in monotypic filter strips during 2005 (56%), 2006 (81%), and 2007 (54%). Dickcissel showed a strong relative preference for the early succession blocks, with 1.5 times greater density in blocks (1.7

birds/acre) than buffer habitats (monotypic filter strips, 0.55 birds/acre; mixed filter strips, 0.98 birds/acre; RFB, 1.12 birds/acre (fig. 5)). Dickcissel, a species of regional conservation concern, occurred in all four habitats, although their use of monotypic filter strips was limited. Red-winged blackbirds also used all four habitats without exhibiting strong preferences for particular habitat types, although buffers had higher densities in 2006 and 2007 (fig. 5). The most notable pattern for this species was the precipitous annual decline of their densities in block habitats (2005, 1.27 birds/acre; 2006, 0.71 birds/acre; 2007, 0.28 birds/acre), which is likely attributed to woody succession. Northern bobwhites also used all four habitats but were more frequently observed in early successional block habitats than conservation buffers. The greatest overall densities for eastern meadowlark were recorded in RFB (fig. 5), which may be influenced by the combination of open ground space and broomsedge grass clumps, which provides suitable nesting substrate.

Avian Nesting Ecology

Researchers investigated nesting ecology in all habitats by conducting systematic, intensive nest searches throughout the breeding season (15 May–20 July) each year. Nests were discreetly marked and monitored every 2 to 4 days until becoming inactive, at which point fate (e.g., fledged, depredated, abandoned, etc.) was determined using direct and indirect sign (e.g., nest site condition, brood age, parental behavior, etc.). Nest density (total nests/acre) and apparent nest success (successful nests/total nests) were calculated for habitat comparisons. Nest searches produced a total of 1,314 nests of 14 species over 3 years, including 376 nests of 8 species in 2005, 554 nests of 9 species in 2006, and 384 nests of 12 species in 2007. The two primary nesting species in all habitats were dickcissel (56% of all nests) and red-winged blackbird (31%), although mourning dove (5%), eastern meadowlark (4%), and northern bobwhite (2%) were also frequent nesters. Early successional blocks (5.3 nests/acre) attracted

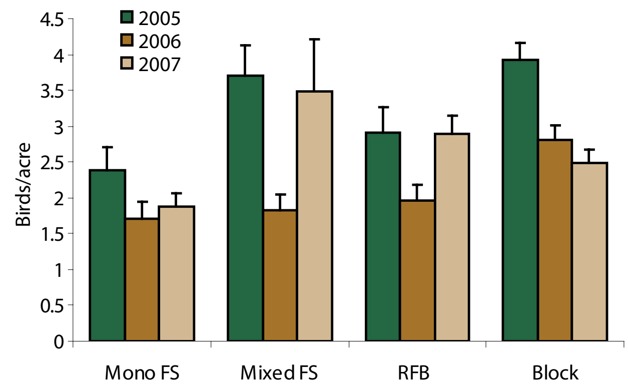

Figure 3. Total avian density (birds/acre + standard error) estimates in four managed, wildlife habitat practices (monotypic filter strip (FS), mixed filter strip, RFB, hardwood afforestation block) on an agricultural farm in the MAV, 2005–2007.

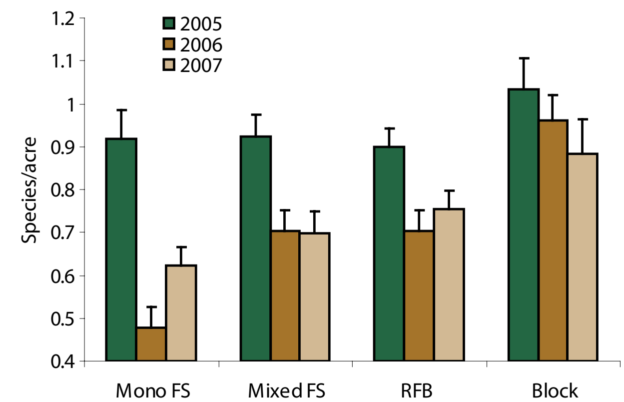

Figure 4. Total number of species/acre (+ standard error) in four wildlife habitat practices (monotypic filter strip (FS), mixed filter strip, RFB, hardwood afforestation block) on an agricultural farm in the MAV, 2005 to 2007.

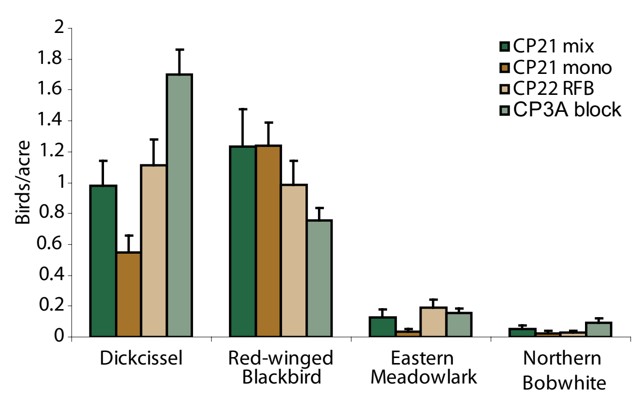

Figure 5. Mean species-specific densities (+ standard error) during the breeding seasons in early successional habitat on an agricultural farm in the MAV, 2005–2007.

nearly five times higher overall nesting densities than any buffers, which attracted nesting birds equally (RFB, 1.1 nests/acre; mixed filter strips, 1.2 nests/acre; monotypic filter strips, 1.1 nests/acre). The nest density in RFB increased steadily with each year, although neither filter strip treatments had consistent positive or negative annual trends in nest density (fig. 6). Analogous to abundance patterns, red-winged blackbirds also exhibited declining nesting density in early successional block habitat across the 3-year study period (2005, 2.06 nests/acre; 2006, 1.28 nests/acre; 2007, 0.44 nests/acre). Grasshopper sparrow nests, though infrequently found, occurred only in block habitat.

Seventy-three percent of avian nests failed to fledge any young during all years combined. Of failed nests, the primary contributing factors included predation (90.1%), nest abandonment (8.1%), and other factors (human- and weather-caused, 1.5%). Brood parasitism was negligible (0.3% of failed nests) and did not represent a concern for grassland bird conservation on this site. Nests located in block habitat were 1.5 times more likely to fledge (30.7%) than nests in buffer habitats (20.2% (fig. 7)). More specifically, dickcissel annual nest success was comparatively higher in block (2005, 22%; 2006, 44%; 2007, 38%) than combined buffer habitats (2005, 25%; 2006, 22%; 2007, 30%).

Summary

Conservation buffers provide resources that fulfill multiple life-history requirements for numerous grassland bird species, including suitable nesting sites. However, the vulnerability of birds nesting in narrow, strip-shaped habitat to edge effects warrants conservation concerns. Researchers investigated differential responses by the avian community in three types of conservation buffers, as well as early successional blocks to evaluate the role of each in the development of an operational CMS. The results supported expectations that larger areas of contiguous block habitat provide superior avian benefits; however, these data also verified the auxiliary wildlife benefits of buffer habitats.

Block habitat attracted greater avian abundance and diversity, as well as considerably higher nesting density and slightly increased nest success. This supports the first hypothesis, indicating that overall area and vegetative diversity are important habitat components for the avian community. Results for dickcissel response were encouraging, as their use of these habitats was unexpectedly dense and

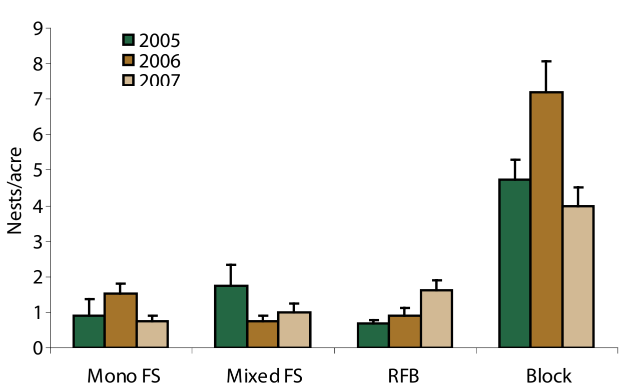

Figure 6. Nest densities (mean nests/acre + standard error) for the avian community in established habitat treatments amongst agriculture in the MAV, 2005–2007.

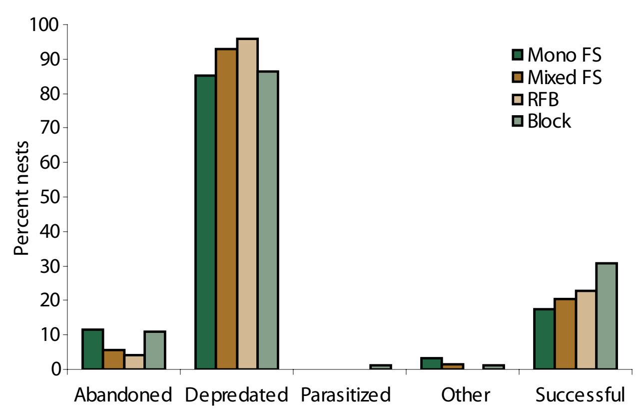

Figure 7. Nest fate proportions for all species in early successional habitats in the MAV, 2005–2007. Successful nests represent percentages of all nests, whereas remaining categories are percentages of total failed nests.

consistent across all 3 years of the study. Furthermore, they experienced comparable nest success rates from those found in other studies. The natural succession of afforested block habitats has temporal restrictions in their benefits to grassland birds and thus, is not a viable, long-term solution to the loss of native grasslands in the Midwest for any bird species.

The influence of buffers on breeding bird response was positive despite tradeoffs in avian benefits among buffer types Overall, riparian forest buffers and mixed filter strips had enhanced performance over monotypic switchgrass filter strips. Riparian forest buffers had increased area and vegetative diversity compared to filter strips, as numerous locally abundant forbs and grasses naturally invaded them. The established grasses in mixed filter strips suppressed their overall vegetative diversity; however, they remained considerably more diverse than monotypic filter strips. Riparian forest buffers and mixed filter strips supported greater avian richness and densities than monotypic filter strips, providing support for the second hypothesis. The similarity of avian community metrics between mixed filter strips and RFB provides encouraging evidence that more narrow buffers may represent suitable habitat given adequate vegetative structure and composition. The greater diversity recorded for monotypic filter strips during 2005 was a probable result of the recent establishment of these plots, as they had not yet achieved the vegetative density that characterized these buffers during 2006 and 2007.

Nest densities and nest success provided further insight to the efficacy of buffer habitats. Riparian forest buffers had an annual, linear increase in nest densities, indicating increased future nesting benefits for grassland birds. Although both filter strips supported nest densities similar to RFB, the annual variability indicates that nesting activity patterns may remain poorly understood in these buffers, thus necessitating post-management data. All dominant nesting bird species on the farm nested more frequently in block habitats, except northern bobwhite, which used all habitats relatively evenly except monotypic filter strips, which was completely avoided (fig. 8). Dickcissel and mourning dove also exhibited reduced nesting activity in monotypic filter strips, whereas red-winged blackbirds were the only species to readily and frequently nest in this buffer type. The slightly greater success of nests in block than buffer habitats may indicate presence of marginal edge effects.

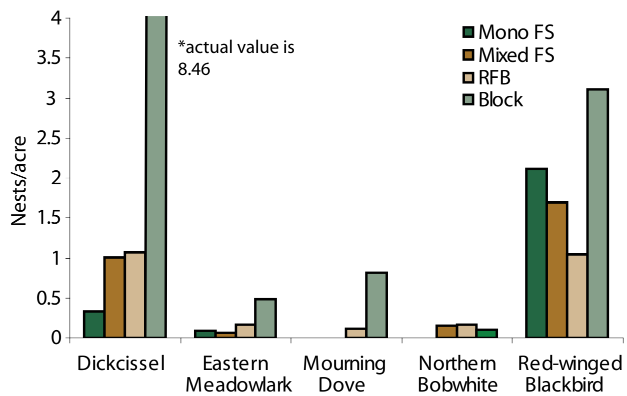

Figure 8. Species-specific nest densities (nests/acre) for dickcissel, eastern meadowlark, mourning dove, northern bobwhite, and red-winged blackbird in early successional habitats in the MAV, 2005–2007. Note the y-axis scale has been altered to enhance graphic detail, thus trimming dickcissel density in hardwood afforestation blocks.

Management Recommendations

- Based on the enhanced benefits provided to the avian community by block habitat, the study suggests that block habitat establishment (through enrollment of eligible fields in CRP or other relevant conservation programs) receive priority in the development of a farmwide CMS that is intended to support grassland bird populations.
- The beneficial role of conservation buffer habitats was evident, and the use of buffers to complement ecological functions of a block-based CMS is recommended.
- Furthermore, buffers represent a viable conservation practice to create wildlife habitat on farms where large block habitat is incompatible with production systems.

Iowa State University and Mississippi State University Wildlife Habitat on Agricultural Farms Field Day July 18, 2007

Dr. Stephen Dinsmore (Associate Professor of Wildlife Ecology) and Ross Conover (Ph. D. candidate) from Iowa State University, Department of Natural Resource Ecology and Management and Dr. Wes Burger (Professor of Wildlife Ecology at Mississippi State University, Department of Wildlife and Fisheries) hosted a USDA NRCS Bobwhite Restoration Project Field Day on July 18, 2007 in Clarksdale, Mississippi. The Wildlife Habitat on Agricultural Farms Field Day featured a morning field tour and afternoon educational sessions held on a 6,574-acre working row crop farm with more than 2,000 acres dedicated to various conservation practices (fig. 1). The field tour had several stops at study sites used in research evaluating bobwhite and grassland songbird response to agricultural conservation practices (fig. 2). The morning field tour included stops at monotypic switchgrass and diverse native warm-season filter strips (fig. 3), a riparian forest buffer (fig. 4), a native warn-season grass upland habitat buffer, and whole field afforestation blocks and featured many topics of discussion including an overview of NRCS conservation programs and practice standards, establishment and management of native vegetation for wildlife, as well as the effects of various conservation practices on northern bobwhite and grassland bird communities. During the afternoon session attendees participated in discussion sessions on producer and landowner perspectives on conservation practices, cost-share opportunities with the NRCS, farm-scale conservation planning, and economics of conservation buffers. There were 86 natural resource professionals and private landowners in attendance from four States.

Attendance	
Natural Resource Conservation Service	**16**
Mississippi Department of Wildlife, Fisheries, and Parks	**10**
Private landowners/producers	**9**
Mississippi State University	**9**
United States Fish and Wildlife Service	**8**
Iowa State University	**6**
Farm Service Agency	**4**
Alabama Department of Conservation and Natural Resources	**4**
MS Land	**2**
Mississippi State University Extension Service	**2**
Auburn University/Alabama Cooperative Extension	**2**
University of Tennessee – Ames Plantation	**2**
U.S. Forest Service	**1**
Alabama Wildlife Federation	**1**
Delta Wildlife	**1**
Farm Press	**1**
Regions Bank Land Trust	**1**
YMD Levee Board	**4**
Unspecified	**2**
Total	**86**

Figure 1. Pete Heard (director of the USDA NRCS Agricultural Wildlife Conservation Center) provides opening and closing remarks at the Wildlife Habitat on Agricultural Farms Field Day. (Photo credit Allison Edmund)

Evaluation

Will the information presented in the Field Day be useful to you in your work?
Yes No N/A Percent favorable
49 0 0 100%
Would you like MSU/ISU and USDA NRCS to hold more of these events?
Yes No N/A Percent favorable
47 0 2 96%
Rank the overall value of this workshop in increasing your knowledge of the topic (5 being the greatest):
Rank: 1 2 3 4 5
Percent: 0% 2% 8% 39% 51%

Figure 2. Ross Conover (Ph.D. candidate at Iowa State University) demonstrated the use of radio-transmitters and telemetry to track the survival of hatchling dickcissels. (Photo credit Allison Edmund)

Figure 3. Dr. Stephen Dinsmore (Assistant Professor of Wildlife Ecology at Iowa State University) discussed the effects of monotypic and diverse filter strips on wildlife populations.

Figure 4. Dr. Wes Burger (Professor of Wildlife Ecology at Mississippi State University) discussed the ecological impacts of riparian forest buffers.

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

August 2009

Assessing Bobwhite Response to the Environmental Quality Incentives Program Implementation in the Rolling Plains of Texas

RANGELAND MANAGEMENT

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Acknowledgments and disclaimer

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Photos provided by Dale Rollins and Ben D. Taylor, Texas AgrLife Research.

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MISSISSIPPI STATE UNIVERSITY

Assessing Bobwhite Response to the Environmental Quality Incentives Program Implementation in the Rolling Plains of Texas

The Rolling Plains of northwest Texas is one of the last bastions for viable northern bobwhite (*Colinus virginianus*) populations, but even here populations are declining about 3.5 percent annually. The decline of bobwhites in its traditional strongholds (i.e., Southeastern United States) has heightened landowner awareness of the plight of quail in Texas. As ranchers and absentee landowners see the value of quail increase, their interest in participating in habitat restoration for quail has concomitantly increased. Farm Bill programs such as the Environmental Quality Incentives Program (EQIP) have been very popular in Texas, and, purportedly, can be used to improve bobwhite habitat. Researchers evaluated bobwhite response to EQIP-sponsored brush management at intervals 2 to 4 years post-implementation during 2005 to 2007. They used paired control-treatment plots in three counties to assess impacts of mesquite and prickly pear cacti control on bobwhite abundance, and used spring call counts to estimate breeding capital and simulated nests to evaluate impacts on nesting habitat. An array of vegetation measures (e.g., nest site availability, forb species richness) were monitored to assess floristic impacts of brush management as it relates to quail habitat. Results showed that mid-term impacts (3–5 years post-implementation) of brush management tended to increase call-counts. For sites where more than 12 paired plots were monitored, brush management increased call counts by an average of 29 percent over control sites. Although treatments positively affected breeding capital, whether such an increase in breeding capital parlays into greater quail densities during the fall hunting season needs verification. Bobwhite abundance tended to become progressively greater on treated areas over the 3 years of the study. Brush control has been a common practice in the Rolling Plains, frequently targeting control of mesquite, juniper, and prickly pear. Although large-scale brush control is detrimental to quail, more judicious approaches can benefit quail. Moreover, the benefits of strategic brush management extend beyond the short term. However, brush management appeared neutral for enhancing nesting habitat. Incentives for grazing deferment (as is currently permitted in the Rolling Plains Quail EQIP program) are more likely to benefit nesting habitat than brush management alone.

TECHNICAL NOTE

RANGELAND MANAGEMENT

Assessing Bobwhite Response to the Environmental Quality Incentives Program Implementation in the Rolling Plains of Texas

The Rolling Plains of northwest Texas are one of the last bastions for viable northern bobwhite (*Colinus virginianus*) populations (fig. 1). The decline of bobwhites in its traditional strongholds (i.e., Southeastern United States) has heightened landowner awareness of the plight of quail in Texas. As ranchers and absentee landowners see the economic value of quail increase, their interest in participating in habitat restoration has concomitantly increased. For example, 19 percent of Texas Quail Unlimited members purchased property specifically for quail hunting during the decade of the 1990s (Rollins 2002). Landowners have also become more conscious of how rangeland management may impact quail populations (Rollins and Cearley 2004) (fig. 2).

Conservation programs administrated by the U.S. Department of Agriculture (USDA) under the Farm Bill have tremendous potential to impact wildlife habitat and populations on private land. In 1996, two new programs were added to the Farm Bill: the Wildlife Habitat Incentives Program (WHIP) and Environmental Quality Incentive Program (EQIP). EQIP is the primary cost-share program for assisting farmers and ranchers to address natural resource issues (Berkland and Rewa 2005) by paying up to 75 percent of cost of implementing a conservation practice for up to 3 years. Although EQIP does not mandate that enrolled landowners establish wildlife as a priority, many of the conservation practices funded by EQIP can benefit wildlife (Berkland and Rewa 2005).

Farm Bill programs like EQIP have been very popular in Texas, and purportedly can be used to improve bobwhite habitat. The Rolling Plains of Texas is one of three EQIP emphasis areas focused on bobwhite habitat concerns. Bobwhites are a priority species

Figure 1. Bobwhites represent an important economic resource over much of Texas (Photo credit Dale Rollins).

Figure 2. Landowner planning a brush control treatment on a pasture in the Rolling Plains of Texas (Photo credit Dale Rollins).

for EQIP in 58 counties of the Rolling Plains. Texas received $78.6 million and $90 million in EQIP funds in 2004 and 2005, respectively. The most frequently adopted EQIP-funded conservation practice in fiscal year 2003 was brush management (CPS Code 314), which accounted for 26 percent of the $46.5 million of EQIP dollars expended.

Brush (e.g., honey mesquite [*Prosopis glandulosa*] and pricklypear [*Opuntia* spp.]) are key components of bobwhite habitat in this region (Slater et al. 2001; Hernandez et al. 2003a, b). Although references in the literature concerning the response of wildlife to EQIP are limited (Esser et al. 2000), brush management in Texas is believed to be (or at least can be) beneficial to bobwhite habitat (Rollins and Cearley 2004). Researchers tested the hypothesis that brush management, if done in moderation, enhances bobwhite habitat and promotes greater bobwhite abundance in the Rolling Plains. They evaluated bobwhite population and habitat responses to EQIP-sponsored brush management (CPS Code 314) at intervals 2 to 4 years post implementation.

Study sites were located in three counties along a latitudinal gradient in the Rolling Plains ecoregion (Coleman, Cottle, and Shackelford Counties) (fig. 3). (Note: some study sites (n = 4) were located in Foard County, which lies adjacent to Cottle County, but in this report, they are referred to as Cottle County). The Rolling Plains ecoregion of Texas encompasses approximately 24 million acres and has an annual rainfall that ranges from 20 to 32 inches. Mesquite was the dominant woody vegetation across all sites. Pinochot's juniper (*Juniperus pinchotii*) was common on the Cottle County site. Pricklypear was common, especially on the sites in Coleman and Shackelford Counties.

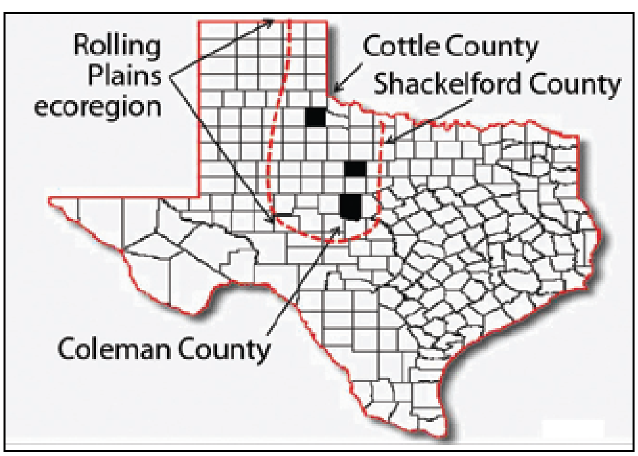

Figure 3. Location of study sites in the Rolling Plains ecoregion of Texas.

Study sites were selected based on four criteria:

- Brush control practices were conducted from 1999 to 2003.
- Sites were either enrolled in EQIP, or were utilizing EQIP- approved brush management practices.
- Control sites, where no brush management had been conducted during the past decade, were present in the immediate vicinity (≥1.0 miles).
- Grazing practices were similar between treated and untreated sites.

Brush management practices typically consisted of (a) aerially applied herbicide (a 1:1 mixture of triclopyr and clopyralid [McGinty et al. 2000]) for mesquite, (b) mechanical control (grubbing) for mesquite, and (c) aerially applied herbicide (0.5 lb/acre picloram) for pricklypear. Stocking rates (cow-calf enterprises) were considered moderate for Coleman and Shackelford Counties, and heavy on Cottle County sites.

Sampling Protocol

A transect line (1,320 yd long) was established to bisect the center point of each site (treatment and control), and served as the central reference point for establishment of sample protocols. At each treatment and control site spring call counts, nest habitat evaluation (i.e., potential nest sites/acre, vegetation height), and predator activity (i.e., simulated nest success) were conducted in a 200-acre buffer around the established center point. GIS and GPS technology were used to create polygons overlaid on digital aerial photography to create a map of the treated area.

Researchers used spring call counts at the center point of each paired study site (i.e., a unique treatment and control) to assess relative abundance of bobwhites (fig. 4). Call counts began at official sunrise and were repeated three times at each site from mid-May to mid-June. Simulated nests situated along transects were used to assess relative nest predation (Slater et al. 2001). Simulated nest transects consisted of 4, 220-yard transect lines every 330 yards along the main transect line. Four artificial nests, consisting of three chicken eggs, were placed at 55-yard intervals down this lateral line. Nests were situated in suitable nesting clumps of grass or pricklypear and checked at 14 and 28 days.

Vegetation dynamics
Researchers estimated the density of potential nesting sites using a belt transect (2 yards in width) overlaid on simulated nest transects (Slater et al. 2001). A Robel pole was used to estimate vegetation height (i.e., screening cover) (Robel et al. 1970) (fig. 5). Forb species richness was recorded at each visual obstruction sample point by recording the number of different forbs within a 1.2-square-yard quadrat. Each paired site (treatment and control) had a total of 60 samples taken for Robel and species richness estimates with four subsamples at each sample point (four cardinal directions with Robel pole, and four quadrats). Samples were taken on alternating sides of the transect, and a random number chart was used to determine the distance off of the transect line for the sample.

Results

Brush management treatments
Study sites were less homogeneous than desired. Coleman County sites were aimed primarily at pricklypear control (18 of 24 treatment sites), whereas mesquite was the primary target species (24 of 24 sites in Cottle and 21 of 27 sites in Shackelford Counties). Mechanical control (grubbing) was the most common treatment in Cottle County (21 of 24 treated sites), whereas chemical control was the most common treatment in Shackelford County (15 of 27 treated sites). Additionally, there was a mix of block treatments and more sculpted patterns (fig. 6) especially when mechanical clearing was employed.

Figure 4. Spring call counts were used to assess bobwhite abundance on treated and untreated areas.

Figure 5. Vegetation height (i.e., screening cover) was assessed by taking measurements with a Robel pole.

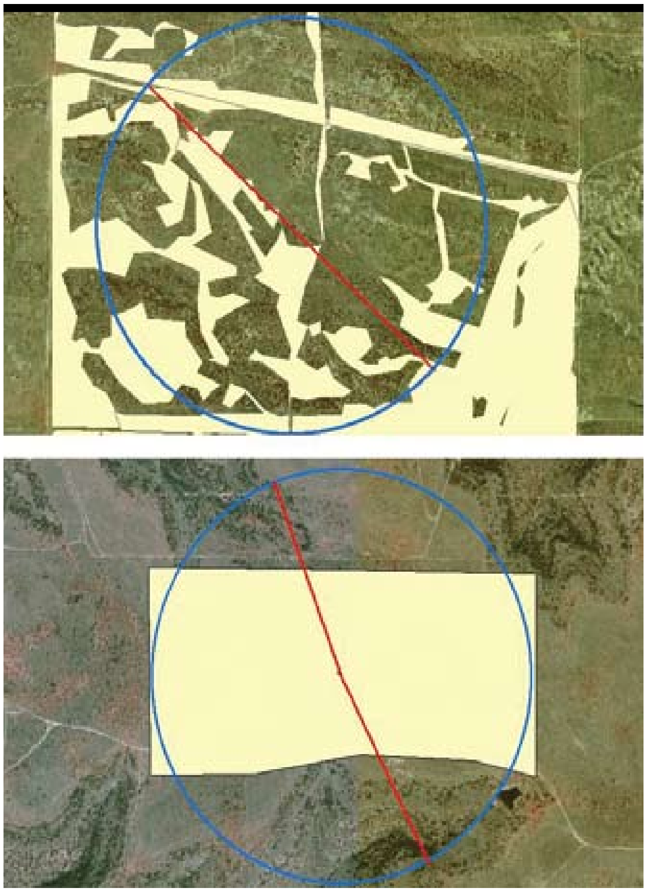

Figure 6. These two treatment sites in Cottle County indicate the difference in a block pattern (bottom) photo and a more sculpted design (top photo). The circle represents a 200-acre buffer around a central point used for call counts.

Population estimates

Researchers did not detect any consistent patterns relative to bobwhite abundance across treatments, years, or sites (table 1). Relative abundance of bobwhite varied across years and sites. Therefore, data were analyzed from each year-county independently. Consequently, some comparisons are based on small sample sizes (≤6 sites/county/yr) and should be cautiously interpreted. Effects of brush management treatments on spring call counts were analyzed within each county to account for site effects. Because of low sample sizes in some treatment classes, researchers only compared sites if n was greater than 6.

2005

Coleman County had higher calling rate than any other county in 2005 (7.4 birds calling/stop vs. 3.8 in Cottle and 3.2 in Shackelford (fig. 7)). Call counts on mesquite-chemical sites in Shackelford County were higher than control sites. In 2005, there were no differences in call counts between control and treatment sites in Coleman or Cottle Counties.

Table 1. Mean number of calling bobwhite point ($\bar{x}$) and standard error (SE) for spring call counts in three counties in the Rolling Plains of TX, 2005–2007.

	Parameter	2005		2006		2007	
		$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Overall		4.77	0.21	3.65	0.13	4.13	0.23
Coleman County	Control	7.58	0.39	3.75	0.19	4.33	0.78
	Mesquite/Mechanical	3.67	0.88	3.67	0.88	2.33	1.20
	Mesquite/Chemical	7.33	0.33	NA[1]	NA	NA	NA
	Pricklypear	7.89	0.51	4.00	0.33	6.60	0.78
	Overall	7.44	0.31	4.04	0.20	4.90	0.53
Cottle County	Control	3.71	0.32	3.50	0.33	3.83	0.45
	Mesquite/Mechanical	4.05	0.31	4.52	0.37	4.52	0.45
	Mesquite/Chemical	3.67	0.33	3.67	0.88	2.67	1.33
	Overall	3.85	0.21	3.96	0.24	4.06	0.31
Shackelford County	Control	2.74	0.29	2.37	0.29	2.70	0.33
	Mesquite/Mechanical	3.83	0.70	3.33	0.72	4.00	1.09
	Mesquite/Chemical	3.87	0.26	3.53	0.34	4.40	0.78
	Pricklypear	3.17	0.65	4.50	0.72	5.17	1.08
	Overall	3.22	0.20	3.04	0.22	3.60	0.34

Note: These sites were unavailable after the 2005 season.

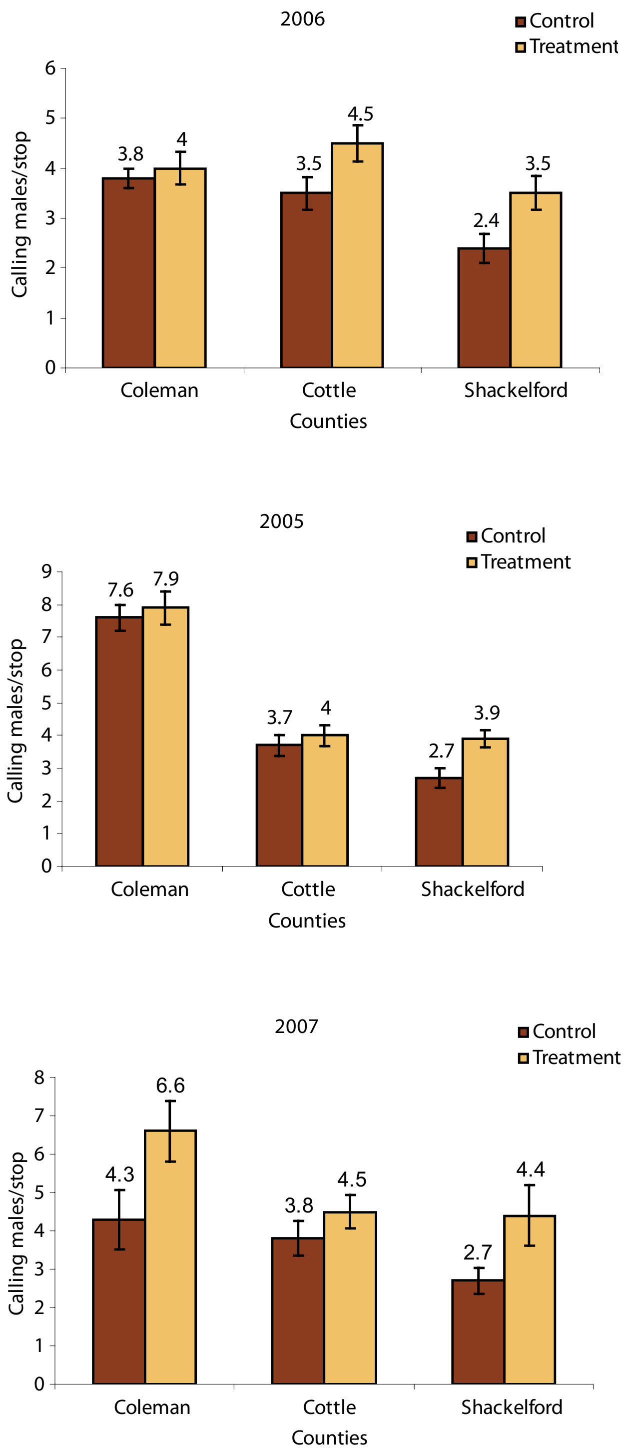

Figure 7. Bobwhite abundance (number of calling males +/- SE) relative to brush management treatments (Coleman—pricklypear; Cottle—mesquite/mechanical; Shackelford—mesquite/chemical) in three counties in the Rolling Plains of Texas, 2005–2007.

2006

As in 2005, differences existed among counties. Shackelford County had a lower number of calling birds than Coleman and Cottle Counties. There were no differences in call counts between Coleman and Cottle Counties, data was pooled on treatment type from these two counties. For Coleman and Cottle Counties, both mesquite treatments had higher call counts than control sites. Treatment type also had a significant effect on call counts in Shackelford County.

2007

Call counts in 2007 differed between Coleman and Shackelford Counties. Counts were similar between Coleman and Cottle Counties, and Cottle and Shackelford Counties. Sites treated for pricklypear in Coleman County had higher call counts than control sites. In Shackelford County, mesquite-chemical and pricklypear treated sites had higher call counts than control and mesquite mechanical sites. There were no differences in call counts between treatment types in Cottle County.

Selected treatment comparisons

Because some sites had limited sample sizes (n<6) for some treatments, researchers examined those treatment comparisons where sample sizes were more meaningful (i.e., n>12) (fig. 8). Pricklypear treatments in Coleman County over all years increased call counts by 17.8 percent. Grubbing mesquites in Cottle County increased call counts by an average of 18.2 percent. The largest increase was observed from herbicidal treatments of mesquite in Shackelford County, where sprayed sites had 51.3 percent more bobwhites calling than control sites. Across all counties and years, treated sites averaged 29.0 percent more calling males.

Simulated nest survival

There were no differences in simulated nest survival at 14 or 28 days, across years (table 2). Nest survival at 14 days was higher in Coleman County compared to Cottle and Shackelford Counties. However, by 28 days, there were no differences among counties in nest success.

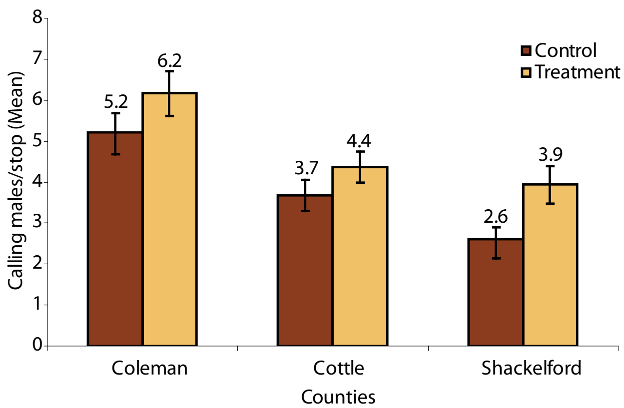

Figure 8. Bobwhite abundance (+/- SE) for selected treatment comparisons averaged over 3 years, 2005 to 2007. Treatments were (a) pricklypear spraying in Coleman County; (b) mechanical mesquite control in Cottle County; and (c) herbicidal control of mesquite in Shackelford County.

Table 2. Mean simulated nest survival and standard error at 14 and 28 days in three counties in the Rolling Plains of TX, 2005–2006.

		2005		2006	
	Parameter	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Overall	14 days	0.53	0.04	0.55	0.04
	28 days	0.40	0.02	0.38	0.03
By county					
14 days	Coleman	0.63	0.04	0.66	0.06
	Cottle	0.51	0.07	0.41	0.08
	Shackelford	0.45	0.04	0.57	0.06
28 days	Coleman	0.38	0.03	0.41	0.03
	Cottle	0.33	0.06	0.28	0.05
	Shackelford	0.36	0.03	0.43	0.06
By treatment type					
14 days	Control	0.53	0.05	0.56	0.06
	Mesquite/Mechanical	0.51	0.09	0.49	0.09
	Mesquite/Chemical	0.46	0.06	0.54	0.13
	Pricklypear	0.60	0.06	0.60	0.10
28 days	Control	0.35	0.04	0.38	0.04
	Mesquite/mechanical	0.39	0.07	0.33	0.07
	Mesquite/Chemical	0.34	0.06	0.38	0.09
	Pricklypear	0.35	0.04	0.42	0.07

Nest site availability

Nest site availability (i.e., potential nest sites/acre) differed between 2005 and 2006 and among counties in 2005 and 2006 (fig. 9). Nest site availability was about 40 percent less in 2006 than in 2005, with the most dramatic decrease observed in Coleman County. Cottle County sites had fewer potential nest sites compared to Coleman and Shackelford Counties in 2005. Shackelford County had more suitable nest sites compared to Coleman and Cottle Counties in 2006. Treatment types were pooled within counties to account for small samples sizes. In 2005, brush management had no effect on nest site availability. However, in Cottle County, treatment sites had almost twice as many suitable nest sites as control sites. In 2006, treatments had no effect on nest site availability in any county. No relationships between simulated nest survival at 14 and 28 days and nest site availability were detected.

Vegetation dynamics

Height of herbaceous vegetation (e.g., grass and forbs) was higher in 2005 than in 2006 across all sites (12.9 ± 2.2 in vs. 8.15 ± 1.69 in) (fig. 10). Treatment sites had taller herbaceous vegetation in Coleman and Shackelford Counties; whereas, control sites in Cottle County had taller vegetation. In 2005, all treatment sites had taller herbaceous vegetation than control sites. Forb species richness in 2005 was greater than in 2006 across all counties and sites (2.5 ± 0.6 species and 1.2 ± 0.2 species, respectively) (fig. 11). Cottle County (treatment and control sites) exhibited greater forb species richness than Coleman and Shackelford Counties in 2005. Control sites in Coleman County had a higher index of forb species richness over treatment sites, primarily Cuman ragweed (*Ambrosia psilostachya*, and croton (*Croton* spp.). No other differences between treatment and control sites were observed. Cottle County exhibited

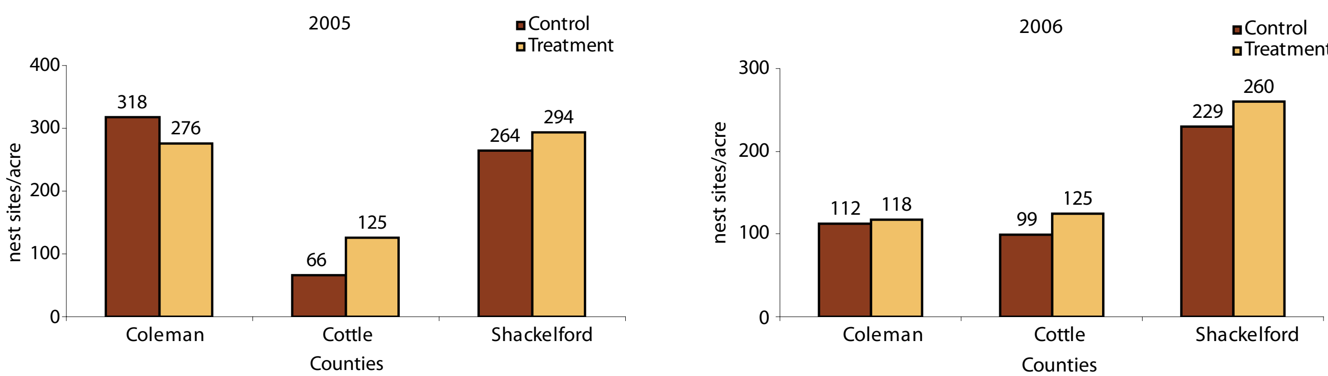

Figure 9. Available nest sites per acre at three sites located in the Rolling Plains of TX, 2005–2006.

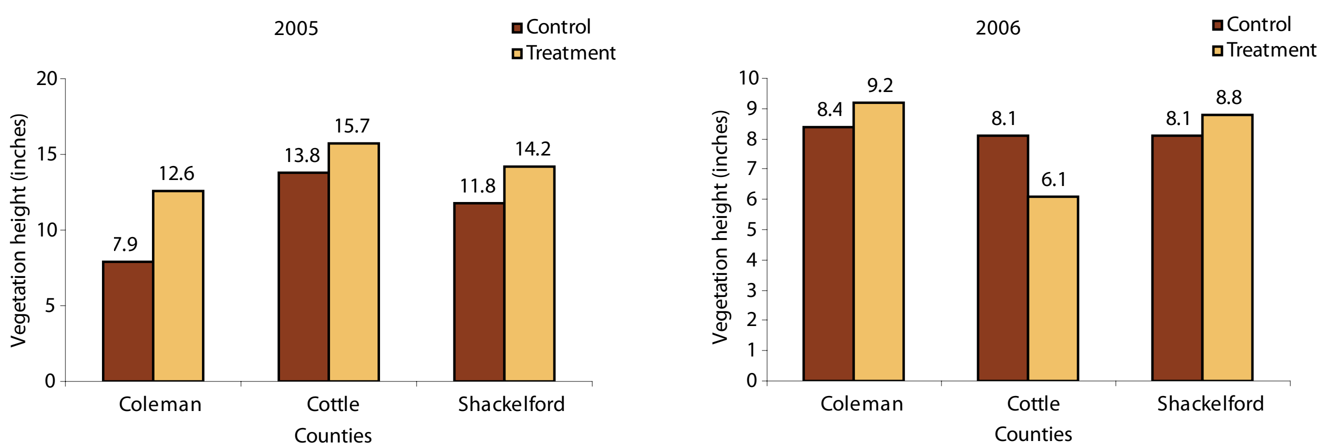

Figure 10. Average vegetation height (in) for study sites located in the Rolling Plains of TX, 2005–2006.

lower forb species richness for both treatment and control sites (0.77 ± 0.08 and 0.74 ± 0.05 respectively) in 2006.

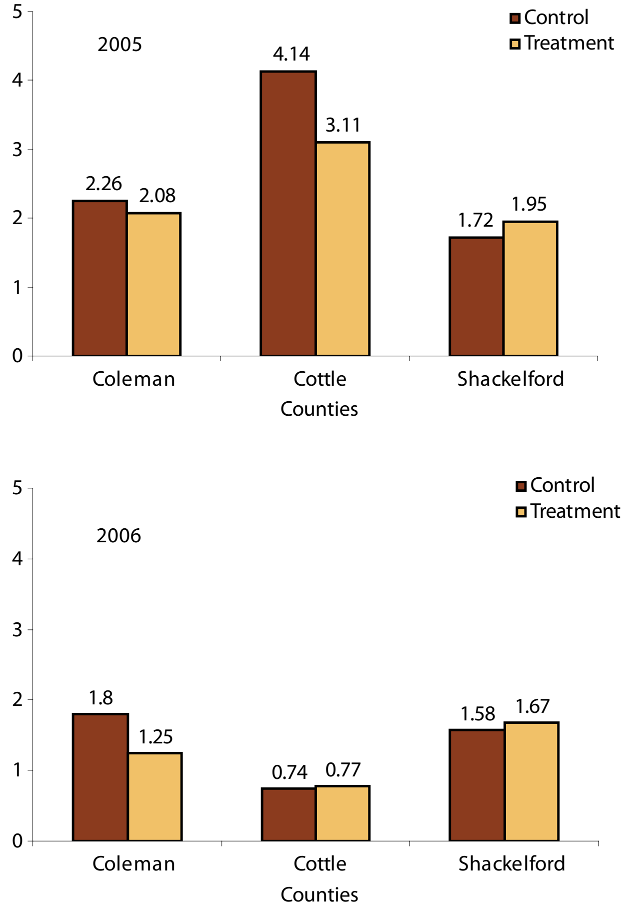

Figure 11. Average forb species richness for brush-managed versus control sites at three sites in the Rolling Plains of TX, 2005–2006.

Summary

Brush management had positive impacts on bobwhite abundance at the three sites (counties) monitored from 2005 to 2007. For sites where more than 12 paired plots were monitored, brush management increased call counts by an average of 29 percent over control sites. Although treatments positively affected calling males, whether such an increase in breeding capital parlays into greater quail densities during the fall hunting season needs verification. Spring cock-call counts are an inexpensive way to index quail populations (roosters/mile) over an extensive area, but results vary on whether spring cock-call counts are effective predictors of hunting-season quail abundance. Future studies should consider distance sampling techniques from helicopters to compute density estimates and provide georeferenced locations for coveys relative to proximity of brush treatment interfaces.

Precipitation often drives bobwhite abundance in semiarid regions like West Texas, thus the results are confounded by annual variation in precipitation. Precipitation was above average in 2004 and 2007, average in 2005 and below average (especially for latter half) of 2006 (fig. 12).

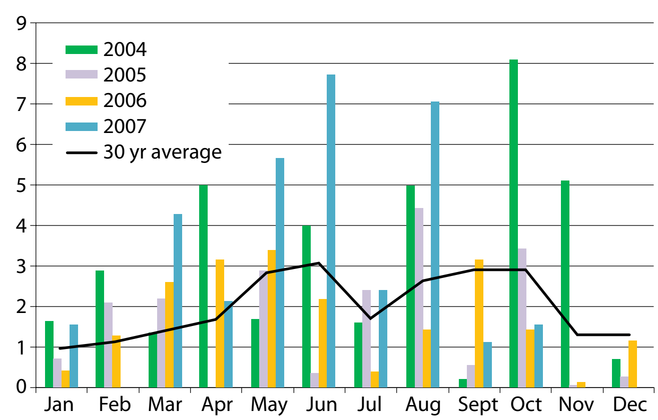

Figure 12. Monthly precipitation (in) received at Abilene, TX, 2004–2007.

Bobwhite abundance increased on treated areas as the study progressed. Above average rainfall in 2004 promoted the greatest bobwhite abundance across the Rolling Plains since 1993 (Texas Parks and Wildlife 2007 (fig. 13)). Spring call counts across a number of counties in the Rolling Plains (n = 13 for 2005, n = 9 for 2006),) averaged 5.6 and 3.5 males calling/stop, respectively (K. Reyna, Texas A&M University, unpublished data). These numbers suggested similar bobwhite abundance occurred across the ecoregion during the study period. The inertia of such a high population likely carried forward into the first treatment year (2005) and may have masked any potentially positive population accruals due to brush management.

Precipitation also impacts quail habitat, especially nesting habitat (i.e., bunchgrass density) and forb diversity. Suitable nesting sites (specifically bunchgrasses) declined 40 percent during 2006 due to lower precipitation. It is also possible that cattle grazed treated areas preferentially, especially if prescribed burning was a component of the particular treatment (Fuhlendorf and Engle 2001).

Conservative stocking rates, like those observed in Shackelford County in 2006, afford better nesting cover for bobwhites during dry years. Lusk et al. (2007) concluded that habitat manipulations aimed at improving habitat conditions during dry periods, such as reducing livestock stocking rates, could provide ground cover similar to that available in wet periods. The data suggest brush management may provide similar benefits.

Populations of gamebirds can attain their density potential when individuals can use any part of a pasture at any time. This philosophy has been called maximization of space time (Guthery 1997); the "usable-space" philosophy serves as the basis for brush management recommendations. Brush control can be positive, negative, or neutral for wildlife habitat, depending on several factors. Bobwhites need areas where more than two vegetation types are interspersed in order to forage while remaining close to cover. While prescriptions for bobwhite habitat are subject to "slack," Guthery and Rollins (1997) recommended the following guidelines when sculpting brush to enhance bobwhite habitat.

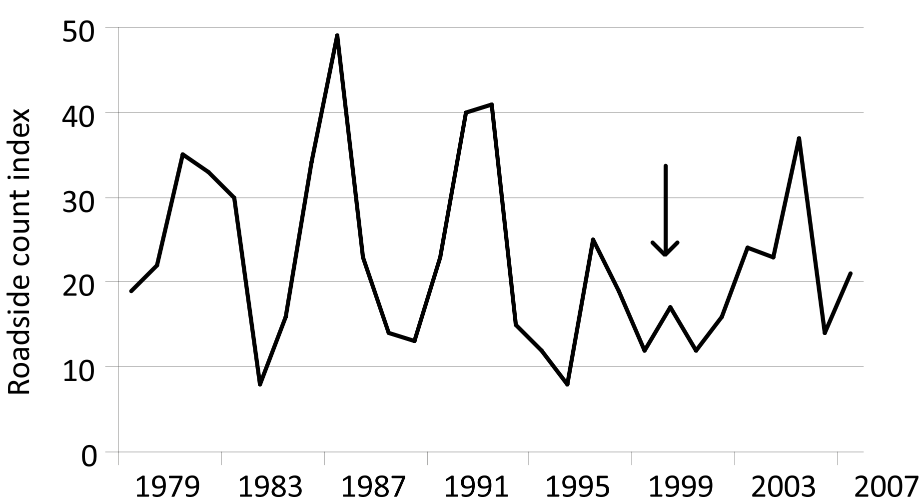

Figure 13. Bobwhite abundance as indicated by summer roadside counts, 1979–2007 (TPWD 2007). Dashed line represents long-term mean for this ecoregion.

- Sites that are cleared should be no more than about 80 yards wide; this keeps all points within 40 yards of woody escape cover.
- No more than 80 percent of the pasture should be treated.
- Areas of woody cover to be spared from clearing should be more than 10 square yards in size.
- Preserve mottes, not just single trees; any mesquite with other shrubs growing under it should be retained.
- Retain patches of taller-growing brush as they are more effective as summer coverts.
- Brush retained as loafing coverts should be no greater distance apart than the sustained flight capability of bobwhite (~1/4 mi).

Post-treatment grazing management is another important management consideration. Quail inhabiting areas with more brush cleared, or less productive sites, are more sensitive to grazing management. Bunchgrass densities of about 300 clumps/acre are recommended for bobwhite nesting habitat in the Rolling Plains (Slater et al. 2001). Bunchgrass densities approached this threshold in Coleman and Shackelford counties in 2005 and in Shackelford County only in 2006. Pricklypear should be maintained in areas when bunchgrasses are limited (Slater et al. 2001).

Brush control has been a common practice in the Rolling Plains, with mesquite, juniper, and pricklypear being the species most commonly targeted for control. Although large-scale brush control is detrimental to quail, the data suggest that more judicious approaches can benefit quail. Dense stands of mesquite are not attractive to quail or hunters. Brush sculpting can also be used to enhance huntability (i.e., increasing accessibility or harvest efficiency). Rollins (2007) recommended that reducing brush canopies to perhaps 15 to 20 percent (on grazed rangelands) and 5 to 10 percent (on ungrazed rangelands) will maintain (or improve) habitat while enhancing hunter access. Clearing may be accomplished in strips or in a motte pattern (which may be aesthetically more pleasing). However, mottes are typically more expensive to implement; additional research is warranted to see if such patterns actually increase bobwhite abundance.

Broadcast herbicide applications are generally less desirable than mechanical brush control methods because they are less selective. Findings suggest that herbicides can be used as an effective tool; herbicidal control of mesquites enhanced call-counts in Shackelford County.

Pricklypear infestations present a dilemma for quail managers in the Rolling Plains (Slater et al. 2001). Although pricklypear serves as a key nesting habitat (Hernández et al. 2003a; Slater et al. 2001), dense stands limit access to forage by livestock and huntability by bird dogs. Hernandez et al. (2003b) found that nesting success and breeding-season survival were similar on sites treated 2 to 4 years earlier with picloram. Researchers found that call counts on sites treated with picloram in Coleman County averaged 18 percent higher than untreated sites.

Care should be taken when the spray mixture includes herbicides such as picloram that result in more broad-spectrum control of woody plants. Including picloram in a mesquite-spray mixture will kill desirable shrubs like netleaf hackberry (*Celtis laevigata* var. *reticulata*) and can decrease key food plants for bobwhites (Hernández et al. 2003c).

Researchers observed greater forb species richness in Cottle County, where grubbing was the treatment of choice, in 2005 (a wet yr), but results were more similar to the herbicide-treated sites in Coleman and Shackelford Counties during a drier year (2006). However, these differences could have been related to edaphic or other factors.

Researchers intentionally selected study sites that had been treated 2 to 4 years prior to the monitoring efforts. It is logical that the forb bloom following brush control (specifically via mechanical methods) could benefit bobwhites in the short term. The data suggest that benefits of strategic brush management extend beyond the short term. Longer term monitoring would be desirable to establish a treatment-response curve for bobwhites for various site-treatment combinations.

Landscape effects of brush management on bobwhite abundance in an area may require some threshold treatment patch (i.e., scale of treatment) to produce a meaningful increase in usable space for bobwhites. Roseberry and David (1994) observed that Conservation Reserve Program fields had little effect on bobwhite populations if the total land area in CRP was less than 6 percent. Hiller et al. (2007) described optimal bobwhite cover in the northern Rolling Plains (Roberts County, Texas) as an area with 30 to 60 percent mixed-shrub cover, with the balance in grass upland and sand sagebrush (or a similar structural homologue), and with cover dispersed such that no point was less than 33 yards from mixed-shrub cover. Suitable prescriptions are needed for the more common mesquite-grassland habitat type that dominates the Rolling Plains.

Management Implications

The data suggest that EQIP CPS Code 314 (Brush Management) can effectively enhance breeding capital (i.e., calling males) of bobwhites on Texas rangelands. Mesquite control via grubbing and herbicides at the scale practiced by landowners in this study appeared to be sufficient to elicit a population response, at least for breeding males. Brush management appeared neutral for enhancing nesting habitat; therefore, incentives for grazing deferment (as is currently permitted in the Rolling Plains Quail EQIP program) are more likely to benefit nesting habitat. Providing an incentive to encourage landowners to document quail response to brush management practices, as is currently implemented for CP-33 (Habitat Buffers for Upland Birds), would expand the knowledge base for different treatment types and in different ecoregions.

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Texas Cooperative Extension—Texas A&M University
Red River Quail Symposium
October 13, 2006

Dr. Dale Rollins (Professor and Wildlife Extension Specialist at the Texas Cooperative Extension Service) and Ben Taylor (graduate research assistant at Texas A&M University) hosted a USDA NRCS Bobwhite Restoration Project Field Day in conjunction with the Red River Quail Symposium (RRQS) on October 13, 2006, in Wichita Falls, Texas. The RRQS featured topics on historical vegetation changes in Texas, role of brush and grazing management to enhance bobwhite habitat, economic impacts of quail hunting, State and Federal financial incentives for accomplishing habitat management, and how to get started in quail management. The RRQS included field tours of two local ranches managed for quail where attendees learned how to identify plants important to bobwhites, use EQIP brush control practices to enhance bobwhite populations, and treat individual plants chemically and mechanically to create desired bobwhite habitat structures. Additional sessions focused on the interactions of quail, quail hunters, and bird dogs while in the field and an open discussion on improving lessee and rancher relations. About 140 people attended the event from seven States (figs. 1 and 2). Exhibitors included Bamert Seed Co., U.S. Bureau of Land Management, German Roasted Nuts, USDA NRCS, Quail Forever, Quail Unlimited, Rolling Red Prairie Kennels, Texas Cooperative Extension—Team Quail, Texas Brigades, The Noble Foundation, Texas Wildlife Association, and USDA NRCS.

Figure 1. Dr. Dale Rollins (Texas Cooperative Extension) provided introductory remarks and an overview of the Field Day sessions. Approximately 140 resource professionals and private landowners attended the Field Day and Red River Quail Symposium.

Figure 2. To illustrate the importance of the interspersion of bobwhite cover relative to food sources, participants engage in the popular and educational Run for Your Life exercise of the Bobwhite Brigade. Participants were required to "forage" in ever decreasing amounts of escape cover while both avian and mammalian "predators" loomed nearby.

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Bobwhite Response to Environmental Quality Incentives Program Practices in the High Plains Ecological Region of Texas

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Photos were provided by Eric Abercrombie, Department of Natural Resources Management, Texas Tech University.

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Bobwhite Response to Environmental Quality Incentives Program Practices in the High Plains Ecological Region of Texas

The Northern Bobwhite Conservation Initiative (NBCI) seeks to reverse declines of northern bobwhite (*Colinus virginianus*) populations across the species' range. The goal for the Texas portion of the Shortgrass Prairie Bird Conservation Region (TBCR 18) is to increase the current bobwhite population by 18,933 coveys. Rangeland provides the most potential for adding usable habitat for quail in TBCR 18. However, brush encroachment and overgrazing have caused much of the rangeland to be unusable by bobwhite. New incentives could change the dynamics in TBCR 18. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) offers incentives for management practices such as prescribed grazing, brush management, and prescribed burning that may produce habitat conditions that benefit northern bobwhite. However, the potential benefits of EQIP practices for northern bobwhite in TBCR 18 have not been evaluated. The objective was to examine northern bobwhite and scaled quail population responses to brush management and grazing deferment in TBCR 18. Additionally, researchers evaluated the relationships between quail abundance and habitat characteristics in an effort to provide specific recommendations for habitat management in TBCR 18. The study was conducted on eight separate study sites within Bailey, Cochran, Hockley, and Yoakum Counties. Of the eight study sites, five were subjected to brush management, and three were subjected to prescribed grazing. Researchers estimated quail abundance on each study site and an adjacent control site using call counts during 2005, 2006, and 2007. They also evaluated vegetative characteristics of the study sites between May and July 2006 and 2007. Across the study sites, percentage woody cover and visual obstruction to a height of 29.53 inches were important predictors of quail abundance in TBCR 18. Woody cover was positively related to and was the most important predictor of bobwhite abundance, followed by visual obstruction at heights between 9.85 and 29.53 inches. Large variation among EQIP sites in percent woody cover and grazing history prior to enrollment precluded detection of relationships between quail abundance and EQIP practices within the context of this study. Nevertheless, relationships between bobwhite abundance and vegetation characteristics that will be influenced by prescribed grazing (CPS Code 528) clearly indicate that the practice has great potential for management of quail habitat in TBCR 18 where woody cover is suitable. When implementing the prescribed grazing practice in TBCR 18, it is recommended that stocking rates and deferment periods be tailored so that visual cover is maintained at a height of 15.75 inches or more if bobwhite habitat is an objective. It is also recommended that the woody component of a habitat not become too dense, so that habitat diversity is maintained and the brush species do not outcompete the important grasses and forbs. The brush management conservation practice (CPS Code 314) is useful if percentage woody cover is in excess of 25 percent and is not allowed to drop below 10 percent following management. In contrast to brush management (removal), range planting (CPS Code 550) may be an approved practice that is a more useful tool for providing quail with the necessary woody component where it is lacking in TBCR 18. EQIP conservation practices can be a powerful tool for encouraging proper grazing management to achieve increased acreage of suitable habitat for northern bobwhite in TBCR 18.

TECHNICAL NOTE

RANGELAND MANAGEMENT

Bobwhite Response to Environmental Quality Incentives Program Practices in the High Plains Ecological Region of Texas

The High Plains ecoregion of Texas has been known to support a wide variety of wildlife, but as land management practices have changed through increased agricultural activities, so have suitable wildlife habitats (fig. 1). According to Breeding Bird Survey data, northern bobwhite (*Colinus virginianus*) abundance has decreased 1.1 percent per year in the Texas High Plains since 1980 (Sauer et al. 2005). Agricultural practices influence more acreage than all other industries combined and, likewise, have a direct influence on available quail habitat. Currently, there are two land uses in this region that seem to have the most impact on bobwhite abundance. First is cotton production, which renders land unsuitable for quail. The second is cattle grazing on natural or seeded rangeland. Cattle grazing can provide suitable habitat for quail, if managed properly. However, many areas have been grazed to the point that they provide no suitable habitat for bobwhite (fig. 2). Farm Bill conservation programs provide opportunities for bobwhite restoration in the Texas High Plains through incentives to implement conservation practices that enhance habitat for quail.

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) is a voluntary incentive program that provides assistance to farmers and ranchers faced with threats to soil, water, air, and related natural resources on their land (USDA NRCS 2004). EQIP offers cost-shares and incentive payments for conservation practices that producers might not otherwise implement. Eligible

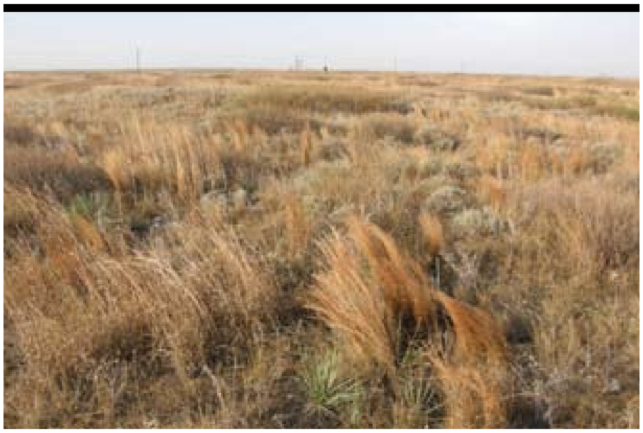

Figure 1. This site in the Texas High Plains holds abundant northern bobwhite. Note the well distributed woody cover and significant herbaceous visual obstruction. (Photo credit Eric Abercrombie, TTU).

Figure 2. Sites such as this heavily grazed rangeland do not provide suitable habitat for northern bobwhite in the Texas High Plains. (Photo credit Eric Abercrombie, TTU).

Conservation Practice Standards (CPS) for EQIP in the Texas High Plains include Prescribed Burning (CPS Code 338), Brush Management (CPS Code 314), and Prescribed Grazing (CPS Code 528) (USDA NRCS 2004). Although the primary wildlife species' of concern in the Texas High Plains are the lesser prairie-chicken (*Tympanuchus pallidicinctus*) and the black-tailed prairie dog (*Cynomys ludovicianus*), these practices can also enhance habitat for bobwhite. However, prior to this study, the potential benefits for bobwhite populations of conservation practices conducted under EQIP had not been evaluated in the Texas High Plains.

Prescribed grazing by periodic grazing deferment may be one of the most effective methods of increasing acreage of suitable bobwhite habitat in the Texas High Plains. The Texas High Plains is a region of relatively low productivity. Grazing deferment provides rangeland an opportunity to return to a higher range condition class with greater vegetation height, thus providing superior cover for bobwhite and more obstruction from predators (Dabbert, Lucia, and Mitchell 2007; Campbell-Kissock, Blankenship, and White 1984). As a result, bobwhite survival and reproductive success may increase. Under NRCS CPS Code 528, prescribed grazing, grazing duration, intensity, and frequency can be adjusted to provide adequate cover for wildlife. More specific guidelines are not available for the Texas High Plains because the relationships among specific habitat characteristics, such as vegetation composition and height and bobwhite population performance, have not been evaluated. The objective was to examine these relationships in an effort to provide more specific habitat prescriptions for bobwhite on rangelands in the Texas High Plains.

EQIP Contract Characteristics

A 2-year study was condected on eight separate study sites (620–>2,500 acres) within four different counties of the Southern High Plains of Texas. Of the eight study sites, three were enrolled in EQIP Prescribed Grazing (CPS Code 528) and five were enrolled in EQIP Brush Management (CPS Code 314). Each study site was subdivided into two units with a unit on which EQIP conservation practice was being implemented (treatment) and second on which the practice was not applied (control). This array of study areas provided a wide continuum of habitat conditions within which to evaluate the relationships between northern bobwhite abundance and specific habitat characteristics.

The guidelines for EQIP Prescribed Grazing practice for the Southern High Plains require that landowners rest their grazing land for at least two, nonconsecutive growing seasons during a 5-year period of enrollment, while also requiring that landowners move from using primarily continuous grazing methods to primarily rotational grazing methods with reduced stocking intensities. This grazing prescription is intended to improve overall range condition, which is important in the High Plains, where productivity is low due to low annual rainfall.

The guidelines for EQIP Brush Management practice for the Southern High Plains require that landowners treat target brush species with herbicide to reduce brush density to a desirable percentage. Target brush species in the study included sand Harvard oak (*Quercus havardii*), honey mesquite (*Prosopis glandulosa*), and yucca (*Yucca* spp.). This management practice is based on the premise that many upland bird species require a certain percentage of woody cover. Too much woody cover is undesirable because the woody plants will outcompete the grasses and forbs that provide nesting cover and food (Guthery 1986).

Estimating Quail Abundance and Habitat Characteristics

Three replicate spring call counts per year were conducted to estimate northern bobwhite abundance during spring 2006 and 2007. Additionally, habitat characteristics on all study sites were measured using two separate methods. First, researchers estimated percentage woody, grass, forb, and litter cover, and bare ground using the step-point method (Evans and Love 1957). Next, estimated visual obstruction was estimated, a measure of the vegetation's ability to provide concealment, using a profile board that provided visual obstruction scores for each 9.84 inches (0–9.84 in, 9.85–19.69 in, 19.70–29.53 in, and 29.54–39.37 in) of height up to 3.28 feet (39.37 in) (Guthery, Doerr, and Taylor 1981). Concealment was scored according to the percent obstruction of each 9.84-inch bar on the profile board (fig. 3). Obstruction scores of 0, 1, 2, 3, 4, and 5 represent 0, 1 to 20, 21to 40, 41 to 60, 61 to 80, and 81 to 100 percent coverage, respectively. Sorrelation analysis and linear regression was used to examine the relationships between northern bobwhite abundance and individual habitat characteristics.

Woody Cover and Visual Obstruction Relate to Quail Abundance

Percent woody cover had a strong positive relationship with and was the most important predictor of northern bobwhite abundance across the study sites. Most studies indicate that northern bobwhite use woody cover for various life history purposes including escape, shelter, and nesting. Studies in other ecological regions have reported that northern bobwhite require between 5 and 30 percent woody cover (Lehman 1984; Guthery 1986; Townsend et al. 2001). Recently, Lusk et al. (2006) suggested a woody cover requirement of greater than or equal to 25 percent for nesting habitat. In this study, northern bobwhite were absent from sites with no available woody cover. Although complete lack of woody cover makes habitat unsuitable for northern bobwhite, it is difficult to define an optimal percent woody cover because of the ability of some herbaceous cover sources to functionally make up for deficiencies in availability of woody cover (Guthery 2002). This interchangeability, or slack, makes it possible for two sites to have different amounts of woody cover and be equally suitable for northern bobwhite (Guthery 2002). In this study, the eight greatest bobwhite abundances were recorded on sites that had greater than or equal to10 percent woody cover. When percent woody cover occurred at a frequency less than10 percent, northern bobwhite abundance was greatly diminished (fig. 4).

Figure 3. The cover board on the left is an example of visual obstruction scores of zero for every 9.84-inch height with the exception of the first 9.84 inches, which would score a 1. The cover board on the right would score much higher. (Photo credit Eric Abercrombie, TTU)

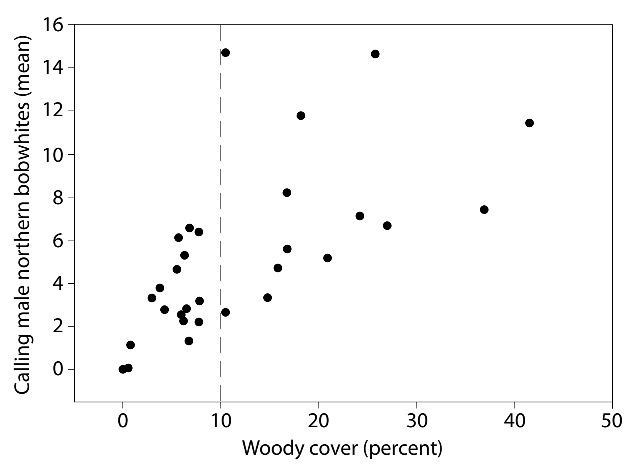

Figure 4. The relationship between northern bobwhite abundance and percent woody cover. Note that most abundant populations occur at sites with greater than 10 percent woody cover.

Other limiting factors including herbaceous cover and bare ground may play more of a role in influencing northern bobwhite abundance on sites with greater than10 percent woody cover (fig. 5). It is suggested that managers maintain 25 percent woody cover, as herbaceous cover may not supply visual obstruction during times of drought, which can occur frequently in the Texas High Plains.

After the requirement for woody cover is satisfied, visual obstruction becomes the next important predictor of northern bobwhite abundance. Visual obstruction at 0 to 9.84 inches, 9.85 to 19.69 inches, and 19.70 to 29.53 inches were all positively related to northern bobwhite abundance. Visual obstruction between 19.70 and 29.53 inches was more important than visual obstruction at 0 to 9.84 inches. As average bobwhite height is 10.24 inches (Rosene 1984), it is intuitive that visual obstruction greater than 9.84 inches would supply more concealment for an animal of this size than visual obstruction below 9.84 inches. Moreover, obstruction between 0 and 9.84 inches might impede movement of chicks and adults. Observations are consistent with Lusk et al. (2006), who reported that northern bobwhite require nest canopy height that is greater than 15.75 inches.

Figure 5. This site held northern bobwhite because of the well-distributed woody cover. However, the quail population was limited due to a grazing intensity, which decreased the height of the herbaceous visual cover rendering the site overall less suitable. (Photo credit Eric Abercrombie, TTU)

Summary

The Texas High Plains, considered to be a low productivity ecological region because of its relatively low annual rainfall, could support both healthy bobwhite populations and productive cattle herds if maintained in a higher range condition class (Campbell-Kissock et al. 1984). The NRCS CPS for Prescribed Grazing (CPS Code 528) has great potential as a tool for management of quail in the Texas High Plains where woody cover is suitable. Other studies confirm that proper grazing management, which incorporates rotational grazing regimes with seasonal deferment and light grazing intensities, can greatly improve northern bobwhite abundance by providing some disturbance to improve plant diversity and increase protective cover (Lusk et al. 2006; Wilkins and Swank 1992; Guthery 1986; Campbell-Kissock, Blankenship, and White 1984). It is recommended, when implementing the Prescribed Grazing practice in the Texas High Plains, that stocking rates and deferment periods be tailored so that visual cover is maintained at a height of 15.75 inches if bobwhite habitat is a consideration.

Brush management was not useful within the context of the study sites because canopy coverage was below the optimal range for bobwhite. However, on sites with extensive brush coverage, brush management may be a useful practice within the Texas High Plains.

Management Recommendations

- Site-specific brush management prescriptions should be tailored to ensure that sufficient residual brush (~25%) is left.
- Also recommend is that the woody component of a habitat not become too dense so that habitat diversity is maintained and the brush species do not outcompete the important grasses and forbs (Guthery 1986).
- In contrast to Brush Management (removal), Range Planting (CPS Code 550) may be an

approved practice that is a more useful tool for providing quail with the necessary woody component where it is lacking.

- EQIP and other Farm Bill programs can be powerful tools for encouraging proper range management to achieve increased acreage of suitable habitat for northern bobwhite in the Texas High Plains.

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Texas Tech University
Department of Natural Resources Management
Quail Management in the High Plains Field Day
May 22, 2007

Dr. Brad Dabbert (associate professor) and Eric Abercrombie (graduate research assistant) of Texas Tech University, Department of Natural Resources Management hosted a USDA NRCS Bobwhite Restoration Project Field Day on May 22, 2007, in the High Plains region of West Texas. The Quail Management in the High Plains Field Day featured morning and afternoon sessions held in two locations. There were 64 natural resources professionals and private landowners from three States in attendance (fig. 1). The morning session was held in Morton, Texas, and included overviews of bobwhite and scaled quail biology, the Environmental Quality Incentives Program (EQIP) and wildlife management practices, and effects of EQIP practices on quail populations. The morning session also included informational sessions about grazing and brush management and the use of prescribed burning as a management technique. Attendees then traveled to Muleshoe, Texas, for an afternoon field tour at one of the eight study sites used in research evaluating bobwhite and scaled quail responses to EQIP Brush Management and Prescribed Grazing practices in the Shortgrass Prairie Bird Conservation Region (TBCR 18). Topics for the afternoon field tour included identification of key quail food and cover vegetation (fig. 2), instruction on formation and the benefits of quail and wildlife cooperatives (fig. 3), conducting quail counts, vegetation monitoring (fig. 4), harvest management, and estimating reproductive success.

Attendance	
Natural Resources Conservation Service (NRCS)	29
Private landowners	19
Texas Tech University	13
Texas Parks and Wildlife Department (TPWD)	1
New Mexico Game and Fish Department	1
Mississippi State University	1
Total	64

Evaluation

Question	Land-owner	NRCS	Profes-sional	All Partici-pants
Was format suitable?	100% yes	100% yes	100% yes	100% yes
Was info useful?	100% yes	100% yes	100% yes	100% yes
Overall Field Day rank (high score = 5)	4.4	4.4	4.0	4.3
Would you like another fielddDay?	100% yes	100% yes	100% yes	100% yes

Figure 1. Attendees visit one of eight study sites used in research evaluating response by bobwhite and scaled quail to EQIP management practices.

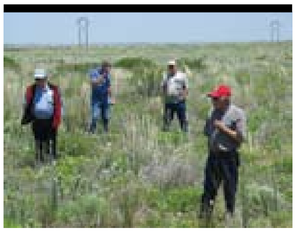

Figure 2. Charles Coffman (NRCS) teaches attendees how to identify key quail food and cover plants and emphasizes the importance of managing for these plants in the landscape.

Figure 3. Jason Brooks (TPWD) provides direction to landowners on how to join forces with other landowners to start a quail cooperative on their land.

Figure 4. Dr. Brad Dabbert and Eric Abercrombie (Texas Tech University) demonstrate how to measure density of vegetation at different heights using a profile board.

RANGELAND MANAGEMENT

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Natural
Resources
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NRCS

Bobwhite Response to Northern Bobwhite Conservation Initiative-based Habitat Prescriptions on Rangelands

RANGELAND MANAGEMENT

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Acknowledgments and disclaimer

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Factors Affecting Grassland Bird Occupancy and Abundance in the Florida Dry Prairie

Large-scale conversion of native grassland and savannah habitats to other land cover types combined with disruption of natural disturbance regimes have caused sharp declines in abundances of North American grassland birds over the past several decades. The Florida dry prairie represents some of the best remaining grassland habitat in the Southeastern United States; however, the remaining dry prairie is fragmented and frequently managed in ways that are suboptimal for grassland birds. The plant community has shifted from herbaceous to shrub, primarily due to a release of native saw palmetto caused by a lack of natural disturbance in the ecosystem. Researchers investigated the effects of prescribed burning and roller chopping on saw palmetto coverage and songbird occupancy and abundance in Florida's dry prairie patches. The study narrowed the inferences to three representative bird species: Bachman's sparrow, eastern meadowlark, and grasshopper sparrow. Songbird point count were conducted to survey bird abundance and assessed vegetation metrics associated with survey points on several properties throughout southern Florida for 2 years. The results indicated low occupancy and abundance of songbirds where palmetto dominated the vegetative community. Conversely, birds were more abundant at sites with higher percentages of grasses and forbs in the ground cover, conditions associated with frequent use of prescribed fire. For example, Bachman's sparrows showed a preference for low to moderate levels of saw palmetto coverage (20–40%), but abundance declined rapidly once saw palmetto reached greater than or equal to 50 percent ground coverage. Abundance of eastern meadowlark showed an inverse relationship with coverage; numbers were highest in areas of low saw palmetto and began to slowly decline as coverage increased. Bachman's sparrow abundance substantially increased (52%) in areas that had been burned and/or chopped within the previous 2 years. Conversely, eastern meadowlark density differed little between managed and unmanaged areas. During winter, probability of grasshopper sparrow occupancy was dramatically higher in areas that had been burned within the previous year. Historical accounts suggest saw palmetto likely only composed 20 percent of the dry prairie vegetative community. The work suggests that conditions for many grassland and savannah bird species can be improved if managers strive to attain this natural level. These conditions can be promoted through the use of frequent prescribed fire (1–3-yr burn intervals). Roller-drum chopping may be applied to reduce saw palmetto in areas where it predominates to levels that cannot be maintained using fire alone. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) programs with conservation objectives such as the Environmental Quality Incentives Program (EQIP) should promote activities that have direct benefit to wildlife. EQIP can be used to target Florida's dry prairie to improve conditions for numerous grassland bird species and likely improve foraging conditions for cattle. Active management strategies on remnant prairie patches that will mimic natural disturbances and shift the dominant plant community from shrub to herbaceous are recommended.

TECHNICAL NOTE

Factors Affecting Grassland Bird Occupancy and Abundance in the Florida Dry Prairie

RANGELAND MANAGEMENT

For the last century, grasslands, savannahs, and early successional habitats have experienced sharp declines in area across most of North America. As a result, many bird species associated with these habits have experienced dramatic population declines (fig. 1). Within peninsular Florida, a large portion of potential savannah habitat occurs within the dry prairie ecosystem in the south-central portions of the State. Over the last half century, dramatic land use changes have reduced the overall quantity and quality of this ecosystem. Conversion of native prairie to exotic forage grasses and urban development have caused the region to become highly fragmented, consequently affecting the way wildlife interact with the landscape. Furthermore, changes in land management, such as altered fire regimes, have lessened the quality of remaining prairie fragments for wildlife. All of these factors have made the Florida dry prairie one of the most endangered ecotypes in North America (fig. 2).

Figure 2. Example of Florida dry prairie (Photo credit Adam Butler and James Martin)

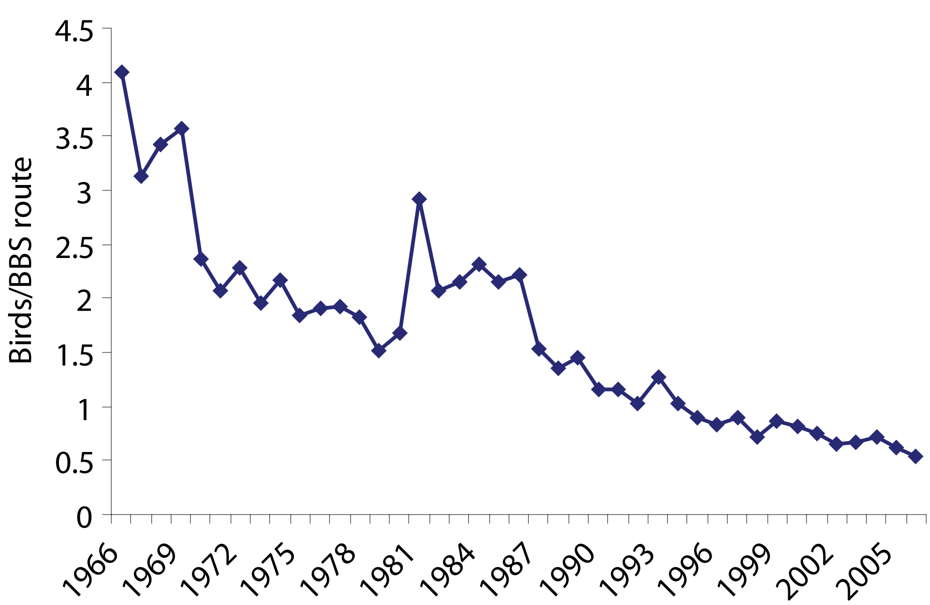

Figure 1. Trends of two grassland birds in southern Florida according to the Breeding Bird Survey (BBS).

In 2004, the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) partnered with the Florida Wildlife Commission (FWC) and Tall Timbers Research Station (TTRS) to create a special project aimed at improving the quality of native rangelands in a five county focal region in south-central Florida. This project targeted the USDA NRCS Environmental Quality Incentives Program (EQIP), which provides financial incentives to landowners who make efforts to reduce soil erosion, enhance water quality, manage nutrient loading, and create fish and wildlife habitat. The objective of this project was to evaluate EQIP management practices, such as Prescribed Burning (NRCS Conservation Practice Code (CPS) Code 338) (fig. 3) and Mechanical Brush Control (e.g., roller chopping; Brush Management, CPS Code 314), that may be beneficial to grassland birds.

Figure 3. Fire on a Florida prairie (Photo credit Adam Butler and James Martin)

To accomplish the habitat improvement objectives within the region, Farm Bill funds were allocated by the NRCS to provide landowners with financial incentives for management practices. Technical guidance was given by NRCS and FWC staffs to identify improvable acres and assist in the implementation of management practices.

A variety of management practices are cost-shared under EQIP, but Prescribed Burning and Brush Management with roller chopping are the two that hold the most potential to increase habitat quality for wildlife on native rangeland. Though these practices have been successfully used to improve conditions for grassland birds in many grass-dominated ecosystems, little research has addressed the use of burning and chopping on dry prairie in southern Florida. Furthermore, few studies have investigated the specific habitat needs of many grassland birds that use the south Florida dry prairie, particularly overwintering migrant species. If south Florida native ranges are to be successfully managed for wildlife, these questions need to be addressed. Therefore, the objectives were to document the habitat needs of grassland birds on native range and investigate their response to land management practices such as prescribed burning and roller chopping.

The study was conducted on fragments of native prairie found within eight separate properties in the south-central Florida focal region. Five properties were privately owned and managed for cattle production, citrus, and landowner recreation, whereas three properties were publicly owned and managed to promote regional biodiversity. Despite the differences in objectives, land management on native range was relatively similar across all sites and involved combinations of prescribed burning and roller chopping. The only major difference in management activities was periodic or continuous grazing (Prescribed Grazing, CPS Code 386) on six sites and total exclusion of cattle on two publicly owned sites.

The researchers were interested in patterns of habitat use and response to management by both resident and migratory species. They surveyed resident species during the breeding season using randomly established breeding-bird point counts in areas that received burning and chopping practices and within areas that received no management (fig. 4). To study wintering grassland birds, they randomly established "flush transects" across native range sites within both managed and unmanaged areas.

Habitat Preferences

Over the course of the study, the researchers observed 42 species during the breeding season; however, 85 percent of all observations were from five species [Bachman's sparrow (*Aimophila aestivalis*), common yellowthroat (*Geothlypis trichas*), eastern meadowlark (*Sturnella magna*), eastern towhee (*Pipilo erythrophthalmus*), and red-winged blackbird (*Agelaius phoeniceus* (fig. 5)). They observed 23 total species on winter transects, nearly half of which were migrants from northern prairies, and included several grassland-obligate species of high concern.

Subtle differences in habitat selection existed between species and, in some cases, within species over time. These results are not surprising when considering the dynamic nature of ecosystems and weather patterns in southern Florida. However, the group of species that were most commonly associated with savannah-type ecosystems exhibited many similarities. These species generally avoided areas of high coverage by saw palmetto (*Serenoa repens*). For instance, Bachman's sparrows showed a preference for low to moderate levels of saw palmetto coverage (20–40%), but abundance declined rapidly once saw palmetto reached greater than or equal to 50 percent ground coverage (fig. 6). Abundance of another resident species, the eastern meadowlark, showed an inverse relationship with coverage. Abundance of meadowlarks were highest in areas of low saw palmetto and declined as coverage increased. A high level of coverage by bunch grasses was also very important to many breeding species. Encouragement of a diverse community of grasses that was composed of bluestems

Figure 4. Surveying for grassland birds (Photo credit Adam Butler)

Figure 5. Eastern meadowlark (top) and Bachman's sparrow, two common resident species of the Dry Prairie. Bachman's sparrow (Photo credit David Arbour, USDA Forest Service)

(*Andropogon* spp.) and panicums (*Panicum* spp.) improved habitat suitability for savannah species.

Migrant grassland species exhibited high year-to-year variability in preferred habitat characteristics. No single habitat characteristic accurately predicted abundance of migrant species across years. For instance, during the first year of the study, high levels of coverage by saw palmetto and dead litter had a strong negative effect on the occurrence of grasshopper sparrows (*Ammodramus savannarum*); however, during the second year, the effect of these variables seemed negligible. A similar pattern was observed in sedge wrens (*Cistothorus platensis*). During the first year, sedge wren abundance was most strongly affected by high levels of bunch grasses and low levels of dead litter, yet during the second year, these variables seemed unimportant.

Response to Management

As expected, response to management practices varied by species. Some species responded sharply to management practices, while response by other species was negligible. Bachman's sparrow abundance substantially increased in areas that had been burned and/or chopped within the previous 2 years. Conversely, eastern meadowlark density differed little between managed and unmanaged areas (fig. 7).

Some wintering species showed impressive responses to management practices. In both years, occurrence of grasshopper sparrows was best predicted

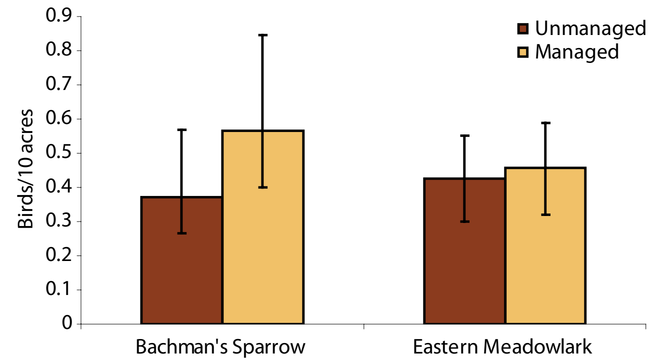

Figure 7. Density of Bachman's sparrows and eastern meadowlarks in areas that had been burned and/or chopped within the previous 2 years and areas that had received neither burning nor chopping within the previous 2 years.

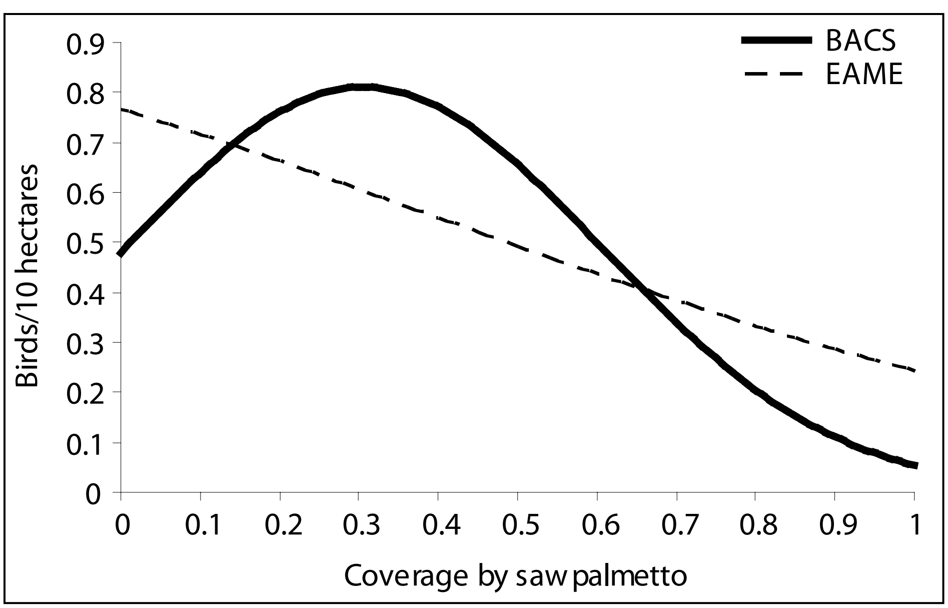

Figure 6. Predicted response of Bachman's sparrow and Eastern meadowlark to increases in coverage by saw palmetto.

RANGELAND MANAGEMENT

by prescribed fire regime (fig. 8). In both study years, probability of grasshopper sparrow occupancy was dramatically higher in areas that had been burned within the previous year. In contrast, sedge wrens seemed to prefer areas that had not been burned in 2 to 3 years. These differences were attributed to changes in food resources following burns. On south Florida prairies, many plants increase seed production following burns, to the benefit of granivorous species such as the grasshopper sparrow. Conversely, sedge wren's diets are primarily composed of insects during winter, and insect populations likely are temporarily suppressed following burns.

On prairie sites that had been fire-excluded for long periods of time, habitat conditions for grassland birds often could not be enhanced through burning alone. In these situations, roller drum chopping reduced palmetto coverage to manageable levels that could then be maintained through frequent burning. Researchers found that coverage by saw palmetto was nearly halved following roller chopping applications. These changes dramatically improved habitat conditions for resident species such as Bachman's sparrows and migrants such as grasshopper sparrows (figs. 9 and 10).

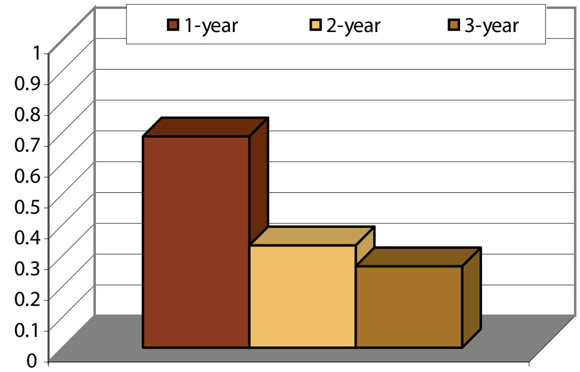

Figure 8. Probability of encountering over-wintering grasshopper sparrows on transects within three different aged burns.

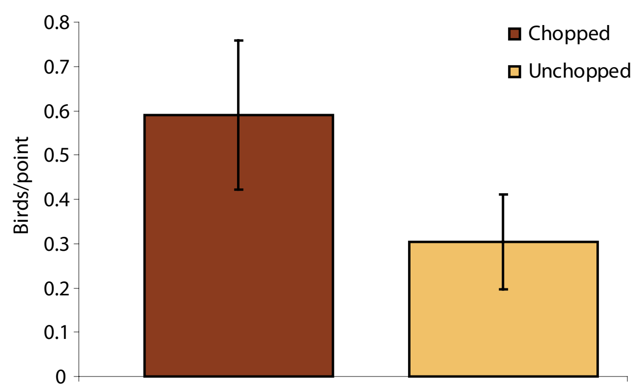

Figure 9. Comparison of the abundance of Bachman's sparrows between areas that had been roller-drum chopped within the previous 3 years and areas that had received no treatment.

Summary

Of the management techniques available, prescribed burning and roller chopping offer the most potential for improving wildlife habitat in south Florida's native range. They prevent over-dominance by saw palmetto and promote grassy and herbaceous conditions that are preferred by many grassland songbirds. Farm Bill incentive programs, such as EQIP, offer financial assistance to landowners to implement these types of practices and likely hold a great deal of potential to help restore habitat for and aid in reversing the decline of grassland songbirds within south Florida rangelands.

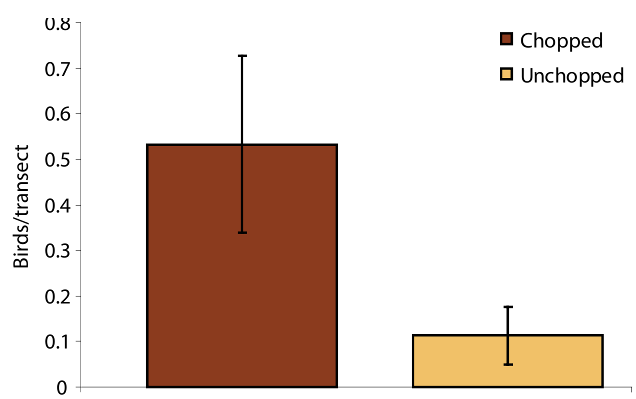

Figure 10. Comparison of the abundance of over-wintering grasshopper sparrows between areas that had been roller-drum chopped within the previous 3 years and areas that had received no treatment.

Within the study, researchers observed a low tolerance for sites where saw palmetto dominated the vegetative community, though low levels of palmetto may be beneficial to some species. Historical accounts suggest that saw palmetto likely only composed 20 percent of the dry prairie vegetative community, and the work suggests that conditions for many grassland and savannah bird species can be improved if managers strive to attain this natural level. These conditions can be promoted through the use of frequent fire (1–3-yr burn intervals). In areas where saw palmetto has become overdominate, roller-drum chopping may be applied to reduce saw palmetto to levels that can then be maintained using fire alone.

Recommendations

- Dry prairie and similar native rangelands in south Florida can provide excellent habitat for grassland and savannah birds if managed properly.
- Maintenance of low (20-40%) levels of saw palmetto coverage, with a rich abundance of bunch grasses will benefit most savannah and grassland species.
- Burn intervals of less than or equal to 3 years are needed to maintain adequate habitat conditions for savannah species. Incorporating growing season burns can aid in keeping saw palmetto at low levels and may further increase habitat quality through subsequent shifts in the plant community.
- Roller drum chopping may be used to quickly reduce palmetto coverage to levels that can be maintained with prescribed fire. However, improvements from roller chopping should be viewed as temporary and are not a viable substitute to frequent fire.
- NRCS landowner assistance programs, such as EQIP, hold much potential for habitat improvements on south Florida rangelands.

Management Example

To illustrate the proper management for savannah species on south Florida prairies, the following hypothetical scenario describes the management of a fictional parcel of dry prairie. This parcel encompasses approximately 500 acres and has not been burned in several years. The lack of fire has allowed saw palmetto to dominate and cover more than 50 percent of the parcel's surface area, resembling the photo in figure 11. These conditions have decreased the value of dry prairie for most savannah species, and active management will be needed to reclaim the site and improve it.

- Objective 1: Apply a roller chopping treatment to 20 percent of the area (100 acres) each year for a 5-year contract, or every other year for a 10-year contract. For best results, chopping should occur during times of adequate soil moisture, just prior to the rainy season (early June–September). If burning regimes are maintained, each compartment should only need to be chopped once.
- Objective 2: Apply a prescribed burn to the parcel every 2 to 3 years for the duration of the contract. To mimic natural processes, growing season burns (April–June) should eventually be integrated into the burning regime.
- Objective 3: Cattle grazing should be deferred for a minimum of 90 days following burning and/or roller chopping. Cattle should be grazed in a rotationally grazed system the rest of the year in compliance with Prescribed Grazing guidelines (CPS Code 528).

Figure 11. Dry prairie site in which saw palmetto covers more than 50 percent of the surface area. (Photo credit Adam Butler and James Martin)

Management for Bobwhites on South Florida Rangelands

Northern bobwhites have experienced sharp declines in abundance throughout their range over the past several decades. Natural disturbance regimes have been disrupted and habitats that once supported abundant bobwhite populations have been converted to other land uses. Habitat fragmentation associated with these changes has driven bobwhites to the verge of recreational extinction. Florida rangelands represent some of the best remaining dry prairie/flatwoods habitat in the Southeastern United States; however, they are highly fragmented and commonly managed in ways that are suboptimal for bobwhite and ecologically unsustainable. Fire exclusion and grazing practices have shifted the plant community from one dominated by herbaceous species to one dominated by saw palmetto, a native evergreen shrub. This project evaluated the plant community and bobwhite population response to a management regime that included roller-drum chopping followed by prescribed burning. Researchers conducted fall covey call counts and measured vegetation characteristics at randomly selected survey points on multiple pastures across seven properties during October 2005 to 2007. Bobwhite abundance was greatest on sites with approximately 30 percent saw palmetto coverage, but declined rapidly as palmetto cover increased beyond 30 percent. Roller-drum chopping, which decreases saw palmetto, increased bobwhite populations two-fold within 2 years of a treatment. Historical accounts suggest saw palmetto likely only composed 20 percent of the vegetative community of Florida rangelands, and the work suggests quality bobwhite habitat can be created if managers strive to attain this natural level. These conditions can be maintained through the use of frequent fire (1–3-yr burn intervals), but initial roller-drum chopping may be required to reduce saw palmetto coverage to levels that can then be maintained using only fire. Conservation practices available under USDA conservation programs, such as the Environmental Quality Incentive Program (EQIP), can be used on Florida's rangelands to improve conditions for bobwhites and other grassland bird species and likely improve foraging conditions for cattle. Active management scenarios on remnant patches of native rangeland that will mimic natural disturbances and shift the dominant plant community from shrub to herbaceous are recommended.

Management for Bobwhites on South Florida Rangelands

During the last century, grasslands, savannahs, and early successional habitats have experienced sharp declines in area and integrity across most of North America. These losses have contributed to precipitous population declines for northern bobwhite (*Colinus virginianus*) and other bird species associated with these habitats (fig. 1). Within peninsular Florida, a large portion of potential savannah habitat occurs within the dry prairie and flatwoods ecosystem in the south-central part of the State. Over the last half-century, broad land use changes have reduced the overall quantity and quality of this ecosystem. Conversion of native prairie/flatwoods to exotic forage grasses and, more recently, urban developments have fragmented the region, affecting the way wildlife interact with the landscape. Furthermore, land management practices including overgrazing, long fire return intervals, and predominance of dormant-season fire have produced a saw palmetto- (*Serenoa repens*) dominated understory, diminishing the quality of remaining prairie/flatwoods fragments for wildlife. The cumulative impacts of these factors have made the dry prairie/flatwoods one of the most endangered ecotypes in North America (fig. 2).

In 2004, the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) partnered with the Florida Wildlife Commission (FWC) and Tall Timbers Research Station (TTRS) to create a special project designed to improve the quality of native rangelands in a five-county focal region. This project, developed under the Environmental Quality Incentives Program (EQIP), provided

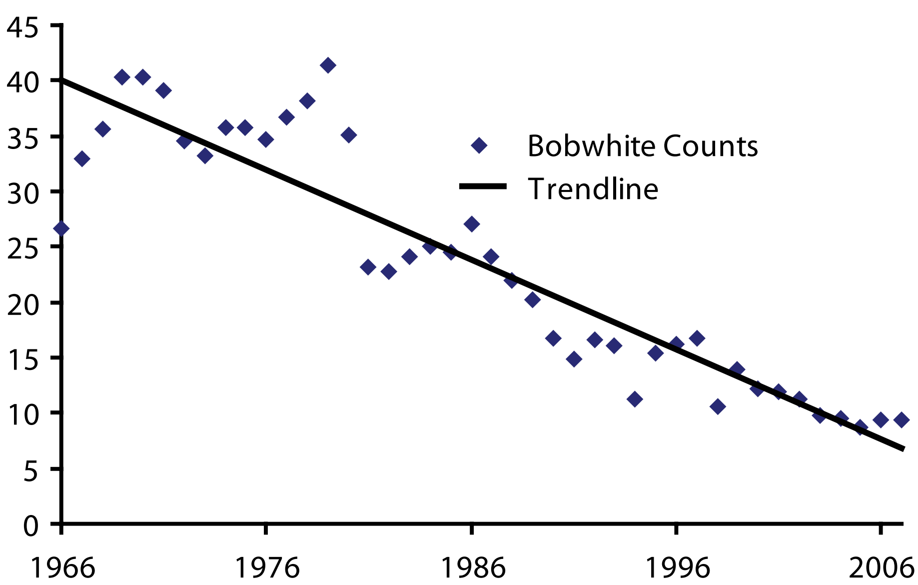

Figure 1. Trend of Northern Bobwhite in Bird Conservation Region 31 according to the Breeding Bird Survey (BBS).

Figure 2. Example of South Florida flatwoods that is properly maintained for bobwhites and many other species. (Photo credit James Martin)

financial incentives to encourage landowners to adopt conservation practices that would simultaneously improve rangeland condition and habitat quality for grassland birds. Cost-share and incentives were available for NRCS Conservation Practice Standards (CPS) Prescribed Burning (CPS Code 338) and Mechanical Brush Control (e.g., roller chopping, Brush Management (CPS Code 314)).

A variety of conservation practices are eligible under EQIP, but Prescribed Burning and roller chopping, Brush Management hold the most potential to increase habitat quality for wildlife on native rangelands. Although these practices have been successfully used to improve conditions for bobwhites in many grass-dominated ecosystems, little research has addressed the use of burning and chopping on rangelands in southern Florida. Study objectives were to document the relationship between bobwhite abundance and saw palmetto coverage, compare bobwhite abundance in native habitats versus altered grasslands (e.g., bahiagrass (*Paspalum notatum*) pasture), and estimate bobwhite population response to conservation practices such as prescribed burning and roller chopping.

The study was conducted on fragments of native prairie/flatwoods located on seven separate properties, six of which were privately owned and managed for cattle production, citrus, and landowner recreation. One property (FWC) was publicly owned and managed to promote regional biodiversity. Despite the differences in objectives, land management on native range was relatively similar across all sites and involved combinations of prescribed burning and roller chopping. Five of the sites were grazed by cattle, and two were not grazed.

Permanent sampling points across all properties using a geographic information system (GIS) were randomly distributed. During the fall of 2005 and 2006, bobwhites at these points were surveyed using the fall covey call technique. At each one of these sampling points, the vegetation was characterized using the line-point intercept method on four 820-foot random transects, centered on the survey point.

Habitat Preference

In this ecosystem, sustainable bobwhite populations can occur at relatively high densities, given adequate habitat. The concept of habitat quality is complex and interacts with other important variables such as the predator context and weather. However, within the context of spatially and temporally varying predator communities and weather conditions, the objective was to characterize the range of vegetative conditions that co-occur with high bobwhite density. For this analysis, the study concentrated on just a few habitat variables that are easily quantified, likely to influence habitat quality for bobwhite, and can be influenced by management activities.

Two main land cover types exist on Florida rangelands: exotic grass pasture and dry prairie/flatwoods (i.e., native grassland). Exotic grass pastures are areas that were once native grassland but have since been converted to an introduced species of forage grass for cattle. Examples of these species include bahiagrass, bermudagrass (*Cynodon dactylon*), limpograss (*Hemarthria altissima*), carpetgrass (*Axonopus* spp.), and many more. Bahiagrass by far is the most common. These pastures are typically grazed intensively and extensively and are relatively monotypic with very little habitat structure for bobwhites. In contrast, native grasslands are structurally and floristically diverse communities, typically dominated by herbaceous vegetation. However, in recent history, these habitats have been degraded by unsustainable grazing practices and an unnatural fire regime. Consequently, the plant community has shifted substantially towards a shrub community dominated by saw palmetto (figs. 3 and 4).

Researchers compared bobwhite relative abundance between "improved" pasture and native grasslands. Native habitats supported approximately 79 percent greater bobwhite densities than pasture habitats (fig. 5). Native habitats provide bobwhites with adequate food and cover for reproduction and survival, whereas exotic pasture habitats do not.

Within native habitats, researchers hypothesized that, beyond some threshold, saw palmetto coverage negatively impacts bobwhite abundance. Therefore, the study modeled the relationship between saw palmetto coverage and bobwhite abundance. The quadratic model depicted in figure 6 best fit

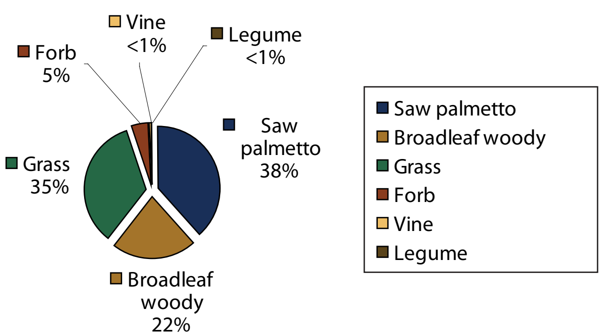

Figure 3. Composition of native rangelands today. Historical data (circa 1960s) suggests a saw palmetto coverage of 24 percent compared to 38 percent today, a 66 percent increase.

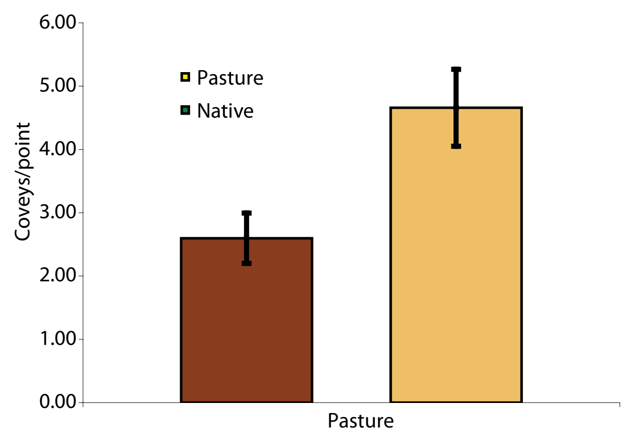

Figure 5. Comparison of relative abundance between pasture and native habitats.

Figure 4. Example of dry prairie site in which saw palmetto covers less than 50 percent of the surface area. (Photo credit Adam Butler)

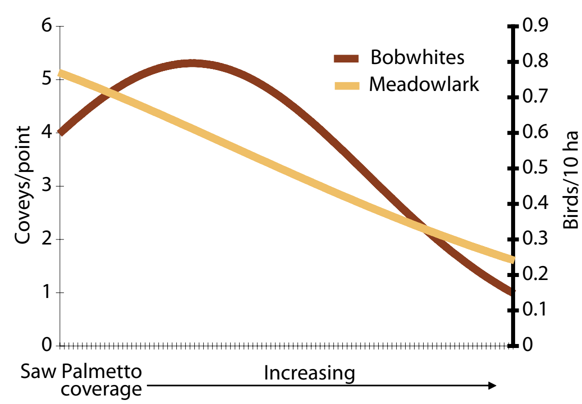

Figure 6. Relationship of saw palmetto coverage and relative abundance of bobwhites and Eastern meadowlark. Both respond negatively to increases in coverage.

the data and illustrates that saw palmetto coverage between 20 to 30 percent is optimal for bobwhites under the conditions observed. Other species, including eastern meadowlark (*Sturnella magna*) and Bachman's sparrow (*Aimophila aestivalis*), respond in similar fashion to saw palmetto coverage.

There are numerous ways to reduce saw palmetto coverage, but most often, Prescribed Burning (CPS Code 338) and roller chopping, Brush Management (a.k.a. drum chopping, CPS Code 314) are used. Prescribed burning is the preferred method because it mimics a natural process and is relatively inexpensive. However, it often takes numerous applications of prescribed burning to reduce the saw palmetto coverage to a desirable level. Growing season fires may more effectively control saw palmetto coverage than dormant-season fire, but more research is needed on this topic. Roller chopping is a widely used brush management tool on Florida rangelands and its effectiveness in reducing saw palmetto coverage is well established. However, little data exist on direct effects of roller chopping on bobwhite abundance. Researchers investigated the short-term (within 18 mo of treatment) effects of roller chopping on bobwhite abundance. Roller chopping had an immediate and positive effect on bobwhite abundance (fig. 7). During fall, bobwhite coveys were 50 percent more abundant in roller chopped rangelands than untreated. This is consistent with the observed relationship between bobwhite abundance and saw palmetto coverage. Roller chopping reduces saw palmetto coverage to a more optimal density for bobwhite and other grassland songbirds (fig. 8). However, roller chopping is not a panacea and should be used carefully because many factors influence vegetative response to roller chopping. For example, adequate soil moisture is critical to ensuring a positive response of grasses and forbs. Also, grazing pressure can potentially stress the plants in such a way that plant species could be eliminated from the system. Furthermore, fire is still an essential ingredient following a roller chopping treatment. Roller chopping is used to recapture the site from saw palmetto and prescribed fire stimulates the desired herbaceous community. A general rule of thumb would be to burn a chopped area when good soil moisture is present or rainfall events are eminent and before the vegetation begins to green-up after chopping.

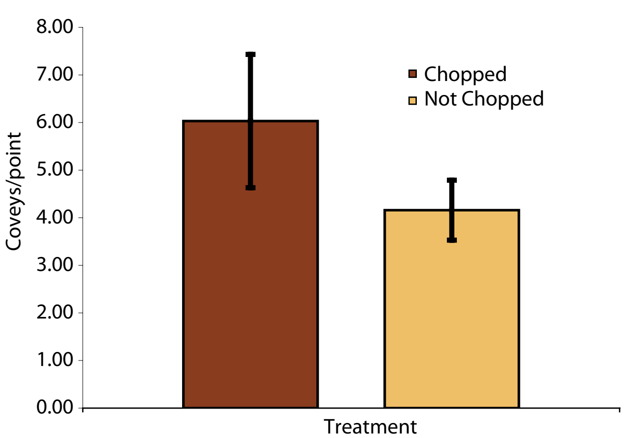

Figure 7. Bobwhite abundance in rangelands treated with roller chopping.

Management Recommendations

- Native rangelands in south Florida can provide excellent habitat for bobwhites and other grassland birds if managed properly.
- Maintenance of low (20–30%) levels of saw palmetto coverage, with a rich abundance of bunch grasses will benefit bobwhites.
- Burn intervals of 3 years or less are required to maintain adequate habitat conditions for bobwhites. Incorporating growing season burns can aid in keeping saw palmetto at low levels and may further increase habitat quality through subsequent shifts in the plant community.
- Roller drum chopping can be used to quickly reduce palmetto coverage to levels that can be maintained with prescribed burning. However, improvements from roller chopping should be viewed as temporary and are not a viable substitute for frequent fire.
- Conservation practices available under Farm Bill conservation programs (i.e., EQIP) hold much potential for habitat improvements on south Florida rangelands.

(a)

(b)

(c)

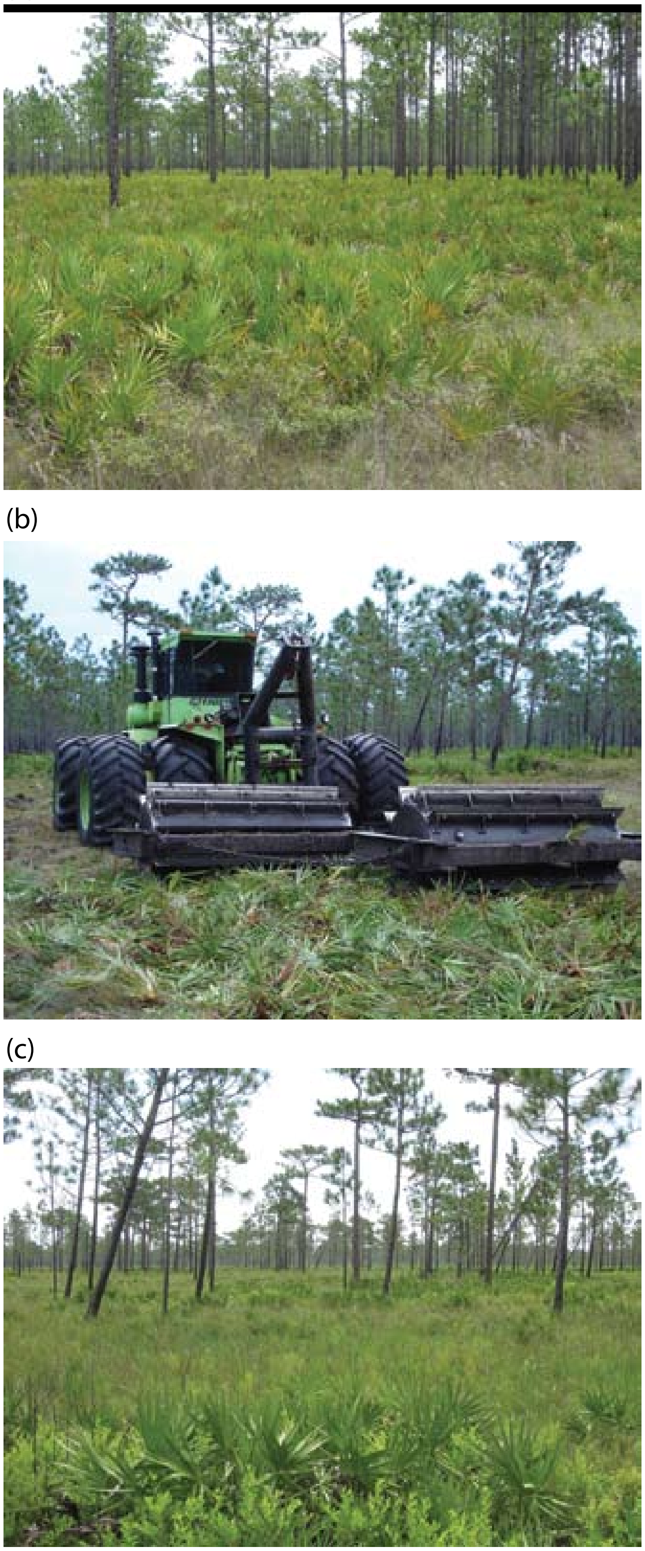

Figure 8. (a) Flatwoods with saw palmetto coverage of approximately 45 percent; (b) Size M drum choppers pulled at tandem by an articulating tractor on area a; (c) Six months post chop with summer burn on same tract of land; notice that saw palmetto is still present, but much less abundant than in a. (Photo credit Greg Hagan, TTRS)

Management Example

The following hypothetical scenario illustrates a management regime designed to increase bobwhite habitat quality on a representative tract of south Florida flatwoods. This parcel encompasses approximately 1,000 acres and has not been burned in several years. The lack of fire has allowed saw palmetto to dominate and cover more than 50 percent of the parcel's surface area, resembling figure 4. Under these conditions, habitat quality for bobwhites has declined and significant active management will be needed to reclaim and create conditions under which bobwhites and other grassland birds will flourish.

- Task 1: Apply a roller chopping treatment to 20 percent of the area (200 acres) each year over 5 years or every other year over 10 years. For best results, chopping should occur during times of adequate soil moisture, just prior to the rainy season. If burning regimes are maintained, each compartment should only need to be chopped once.
- Task 2: Apply a prescribed burn to the parcel on a 2-year fire return interval. To mimic natural processes, growing season burns (April–June) should eventually be integrated into the burning regime.
- Task 3: Cattle grazing should be deferred for a minimum of 90 days following burning and/or roller chopping. Grazing pressure should be managed under a rotational prescribed grazing system the rest of the year in compliance with NRCS guidelines (CPS Code 528, Prescribed Grazing). If fencing does not exist to keep cattle out of the area install cross fencing in such as fashion that cattle can be rotated on a regular basis (CPS Code 382, Fencing).

Tall Timbers Research Station and Land Conservancy Bobwhite and Rangeland Management Field Day October 26, 2007

Dr. Bill Palmer (Gamebird Management Research, Tall Timbers Research Station and Land Conservancy), James Martin (Ph.D. candidate at the University of Georgia, Warnell School of Forest Resources) and the Society for Range Management hosted a USDA NRCS Bobwhite Restoration Project Field Day on October 26, 2007, in Kenansville, Florida. The Bobwhite and Rangeland Management Field Day featured an educational field tour held on one of the primary study sites used in research evaluating bobwhite and grassland songbird response to various management practices on rangelands and quail hunting plantations in south Florida (fig. 1). The field tour included several stops to compare the effects of summer and winter prescribed fire, roller chopping, and prescribed fire roller chopping combinations in the south Florida flatwoods ecosystems. Featured presenters discussed the need for management of the south Florida flatwoods to prohibit encroachment of saw palmetto and promote bobwhite and grassland bird habitat. Presenters stressed the importance of prescribed fire on 1 to 3-year rotations as a management tool, as well as the differences in vegetation response to seasonal timing of prescribed fire application (fig. 2). There was also ample discussion on the issues that prescribed fire raises in the drought-prone south Florida environment (fig. 3). Roller chopping was also discussed and demonstrated as a means to control saw palmetto and other woody encroachment (fig. 4). Presenters then tied their discussion on management techniques back to the effects on bobwhite and other grassland bird communities. There were more than 80 natural resources professionals and private landowners in attendance from more than four States.

Figure 1. It was an excellent turnout at the Bobwhite and Rangeland Management Field Day held in Kenansville, FL. James Martin provides an introduction to management for bobwhite in the south Florida flatwoods ecosystem.

Figure 2. Adam Butler (graduate research assistant at the University of Georgia) provide Field Day attendees with a summary of his M.S. research on grassland songbird use in response to various precribed burning and roller chopping management regimes.

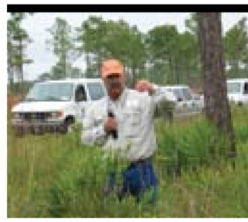

Figure 3. Sam Vanhook (Kissimmee Valley Forester) give perspective on forestry in the FL flatwoods, including the integration of prescribed fire and other management techniques into a forest management practice. Sam provided an insiders perspective on the issues that Florida foresters face, including hurricanes, wildfire, and woody encroachment.

Figure 4. Although when present in moderation, saw palmetto can be an excellent source of food and cover for wildlife, when left unmanaged, it will take over open areas, virtually eliminating bobwhite and grassland songbird habitat and cattle forage. Saw palmetto can be controlled using techniques such as prescribed burning or roller chopping.

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Department of
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Natural
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Conservation
Service

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Conservation Practices to Promote Quality Early Successional Wildlife Habitat

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Acknowledgments and disclaimer

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Acknowledgments

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MISSISSIPPI STATE UNIVERSITY™

Eradicating Tall Fescue and Other Nonnative, Perennial, Cool-season Grasses for Improved Early Successional Wildlife Habitat

The quality of early successional cover for wildlife is determined by plant composition and structure. High-quality habitats are dominated by plants that provide protective cover; nutritious food sources; and allow travel, feeding, and loafing within and under the cover. Tall fescue develops a dense structure near the ground and a deep thatch layer that limits mobility of several wildlife species, including gamebird chicks and ground-feeding songbirds. Dense growth and thatch also suppress germination of desirable forbs that provide an important food resource. To determine the best methods for eradicating tall fescue, researchers evaluated two herbicides (glyphosate and imazapic) applied at different times of the year (spring and fall) with and without disking in the season after application. They applied these treatments in three fields across Tennessee. Prior to herbicide application, fields were prepared for spraying by haying or grazing to remove all debris from the field. The tall fescue was allowed to regrow 6 to12 inches before applying herbicides. Fall applications of glyphosate (2 qt/acre with surfactant) and imazapic (12 oz/acre with surfactant), with and without disking, provided greater reduction in tall fescue coverage than spring applications, with and without disking. Disking following fall herbicide applications did not further reduce tall fescue coverage. By the second growing season after treatment, coverage of native warm-season grasses increased after fall herbicide applications, with or without disking, and after spring herbicide treatments. Forb coverage increased dramatically following all treatments. Like the warm-season grass response, many of the forbs were desirable and some were undesirable. Nonetheless, food resources for northern bobwhite were increased following all treatments. Forb coverage, both desirable and undesirable, tended to decrease in the second year after treatment. The structural characteristics of the field improved dramatically following eradication of tall fescue. The openness at ground level was increased following all treatments, especially the disking treatments. Vertical structure was increased following all treatments except for spring sprayings, which did not kill tall fescue, as well as the fall spraying treatments. Increased vertical structure provides additional winter cover as well as nesting cover. Spraying tall fescue in the fall with 2 quarts per acre of a glyphosate herbicide is recommended. If undesirable grasses are expected to become a problem, apply imazapic (6–8 oz/acre) before undesirable plants emerge (April). If desirable plants do not emerge from the seedbank by the second growing season following spraying, it may be necessary to plant a mixture of native grasses and forbs. Burning and disking during subsequent years will be necessary to achieve the desired balance of native grasses, forbs, and shrubs.

GRASSLAND MANAGEMENT

TECHNICAL NOTE

Eradicating Tall Fescue and Other Nonnative, Perennial, Cool-season Grasses for Improved Early Successional Wildlife Habitat

Tall fescue (*Schedonorus phoenix*) is a perennial cool-season grass brought to North America from northern Europe sometime in the late nineteenth century. It was developed as a livestock forage, released in 1943 (KY 31), promoted widely, and planted as such through the 1950s and 60s. By the 1970s, tall fescue had become the most important cultivated pasture grass in the United States. Today, tall fescue is grown on more than 35 million acres (fig. 1). Without question, there is hardly a field from southern Pennsylvania to eastern Kansas, south to eastern Texas and over to northern Georgia that has not been invaded by or planted to tall fescue in the past 50 years. This has been detrimental for many wildlife species.

Problems with tall fescue

The primary negative effect of tall fescue for many wildlife species is the growth habit. The quality of early successional cover for wildlife is determined by plant composition and structure. Tall fescue, as well as other perennial nonnative, cool-season grasses, generally develops a dense, sod-forming structure near the ground. Upon senescence, the leaves droop to the ground and a deep thatch layer develops relatively quickly (fig. 2). For some birds, such as the eastern meadowlark (*Sturnella magna*), nesting structure in this environment is quite suitable. However, for other species, there are many limitations.

Dense growth near the ground and a deep thatch layer restrict mobility of several wildlife species, including young eastern wild turkey (*Meleagris gallopavo*) and northern bobwhite (*Colinus virginianus*) and ground-feeding songbirds such as field sparrows (*Spizella pusilla*) and grasshopper sparrows (*Ammodramus savannarum*), thus limiting the amount of usable area for these birds. Dense growth and thatch also suppress germination of

Figure 1. Millions of acres have been planted to tall fescue since the 1950s, much to the detriment of many wildlife species. (Photo credit Craig Harper)

Figure 2. The dense structure of tall fescue (top) and orchardgrass (Dactylis glomerata) limits mobility of ground-feeding birds and suppresses germination of the seedbank. (Photo credit Craig Harper)

the seedbank. Thus, more desirable plants, such as broomsedge (*Andropogon* spp.) and little bluestem (*Schizachyrium scoparium*), blackberry (*Rubus* spp.), American pokeweed (*Phytolacca americana*), native lespedezas (*Lespedeza* spp.), ticktrefoil (*Desmodium* spp.), partridge pea (*Chamaecrista fasiculata*), and ragweed (*Ambrosia* spp.), may not be present, and the resulting structure is dramatically different. Even when present, seed from many of these plants are unavailable to foraging birds if buried in deep thatch. In effect, suboptimal structure and reduced food resources limit the amount of usable space and reduce the carrying capacity of the property to support various wildlife species.

Other effects of tall fescue on wildlife are less obvious. An endophyte fungus found within tall fescue produces ergot alkaloids, which are highly toxic to livestock. Cattle consuming tall fescue (either grazing or as hay) often experience poor weight gains, reduced conception rates, intolerance to heat, failure to shed the winter hair coat, elevated body temperature, and loss of hooves. Problems with horses are more severe, especially 60 to 90 days prior to foaling. Fescue toxicity in horses often leads to abortion, prolonged gestation, difficulty with birthing, thick placenta, foal deaths, retained placentas, reduced (or no) milk production, and death of mares during foaling. Specific physiological effects of the endophyte on wildlife are less known. However, cottontail rabbits (*Sylvilagus floridanus*) gain less weight and produce smaller litters in tall fescue habitat, and when fed a diet of tall fescue seed, bobwhites exhibit cloacal swelling, which may ultimately lead to increased mortality.

Given the detrimental effects of tall fescue on many wildlife species, a concentrated effort to improve early successional cover is being spearheaded by the Northern Bobwhite Conservation Initiative (NBCI). A priority of the NBCI is conversion of non-native grass monocultures, including tall fescue, to more desirable plant communities for northern bobwhite, as well as a wide variety of other species dependent upon early successional habitats.

Research Treatments

To help provide accurate information related to eradicating tall fescue, researchers evaluated two herbicides (glyphosate and imazapic) applied (Pest Management, CPS Code 595) at different times of the year (spring (March) and fall (September)) with and without disking (Upland Wildlife Habitat Management, CPS Code 645, Early Successional Habitat Development/Management, CPS Code 647) in the season after application. They applied these treatments in three fields across Tennessee where tall fescue coverage exceeded 90 percent. Prior to herbicide application, fields were prepared for spraying by haying or grazing to remove all debris from the field. The tall fescue was allowed to regrow 6 to 12 inches before applying herbicides. To further evaluate seedbank response, half of the spring herbicide treatments were disked the following fall and half of the fall herbicide treatments were disked the following winter. A 10-foot offset disk was used to incorporate approximately 50 percent of the aboveground residue into the soil (fig. 3). Thus, the plots were not "lightly" disked.

Response to Treatment Applications

Fall applications of glyphosate (4-lb formulation at 2 qt/acre with surfactant) and imazapic (2-lb for-

Figure 3. Disking helps stimulate the seedbank after tall fescue has been eradicated with the appropriate herbicide application. (Photo credit John Gruchy)

mulation of imazapic at 12 oz/acre with surfactant), with and without disking, provided greater reduction in tall fescue coverage than spring applications, with and without disking. Two growing seasons following spring herbicide applications, tall fescue coverage exceeded 40 percent. Even when combined with disking, tall fescue coverage exceeded 20 percent on spring-sprayed plots the growing season following disking. Coverage of tall fescue was reduced to approximately 2 percent following fall applications of glyphosate, whereas fall applications of imazapic reduced tall fescue coverage to approximately 10 percent (fig. 4). Disking in March following fall herbicide applications did not further reduce tall fescue coverage.

Applying herbicides correctly with respect to field preparation, rates, and timing is critical. Burning, haying, or grazing prior to postemergence herbicide applications ensures herbicide contact with actively growing plants, instead of senescent stems and leaves; thus, effectiveness is increased (fig. 5). Cool-season grasses are actively growing in the fall and spring. However, during the fall, these grasses are translocating carbohydrates and other nutrients from the leaves to the roots in preparation for winter senescence. Thus, herbicide applications are more effective at killing perennial, cool-season grasses in the fall than during spring when these grasses are transporting nutrients from the roots upward.

Figure 5. It is important to prepare a field by burning, haying, or grazing prior to spraying to ensure the herbicide comes in contact with actively growing grass. (Photo credit John Gruchy)

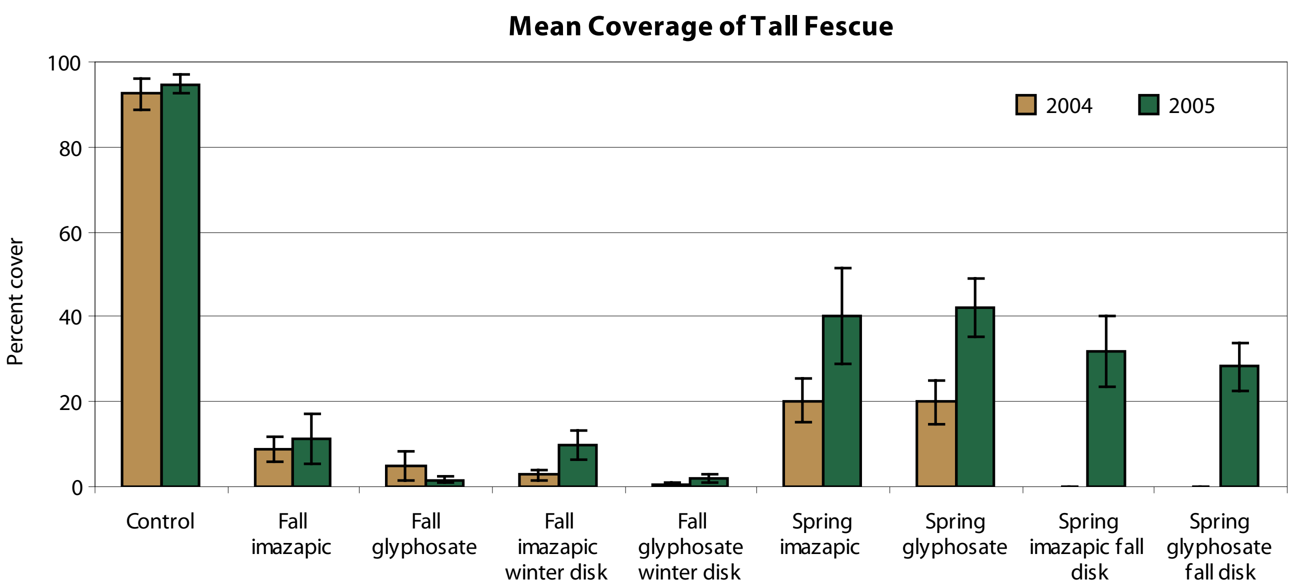

Figure 4. Fall sprayings were more effective than spring sprayings, regardless of herbicide and whether the site was disked the season after spraying.

Seedbank Response

It is not necessary to plant native grasses and forbs if desirable species are present in the seedbank. The sod cover of tall fescue and other nonnative perennial cool-season grasses act like a carpet over a field, preventing much of the seedbank from germinating (fig. 6). Once the carpet is removed, the seedbank can be evaluated.

Occassionally, undesirable species await release in the seedbank. It is quite common to kill tall fescue and find a layer of bermudagrass (*Cynodon dactylon*), johnsongrass (*Sorghum halepense*), and/or sericea lespedeza (*Lespedeza cuneata*) waiting underneath. This illustrates why it is most important to wait at least 1 year before planting native grasses and forbs. If desirable species are present, there is no need to plant. If undesirable species are present and planting is necessary, the undesirable species need to be controlled before planting. It can be difficult, if not impossible, to control some undesirable species (bermudagrass and sericea lespedeza are two good examples) after planting without killing desirable native grasses and forbs. Waiting 2 years after eradicating tall fescue before planting native grasses and forbs is recommended so an objective evaluation can be made as to whether planting is necessary.

Figure 6. Control plot at one of the research sites; tall fescue acts as a carpet over the field, suppressing much of the seedbank from germinating. (Photo credit John Gruchy)

In the study, species richness increased after all treatments, ranging from 35 (spring imazapic) to 94 (fall glyphosate, winter disk) percent. Some of these plants were desirable; some were not.

By the second growing season after treatment, coverage of native warm-season grasses increased after all fall herbicide applications, with or without disking, and after all spring herbicide treatments (fig. 7). Native warm-season grass coverage in the spring herbicide/fall disk plots was not as extensive because there had been only one growing season

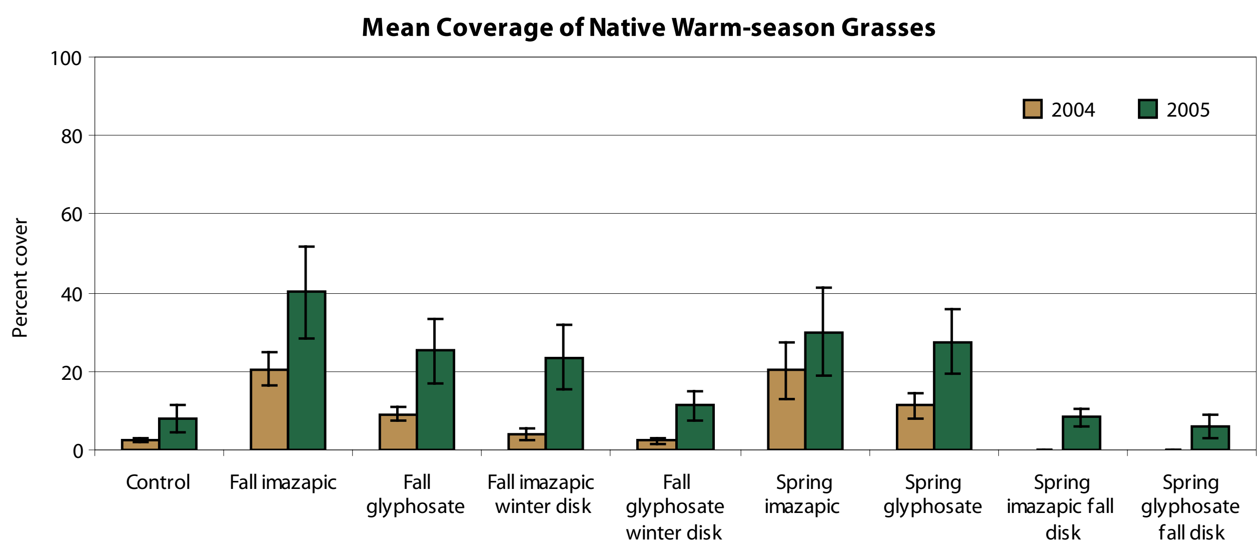

Figure 7. Desirable native warm-season grasses increased in the second growing season following treatments.

following the fall disking treatments when the data were collected. Perennial grasses require 2 to 3 growing seasons to become established from the seedbank following disking. This is evident in the increase of native warm-season grass coverage in all treatments from 2004 to 2005 (fig. 8).

Coverage of undesirable warm-season grasses, such as johnsongrass, crabgrass (*Digitaria* spp.), and broadleaf signalgrass (*Urochloa platyphylla*), also increased, or at least remained the same, following all treatments (figs. 9 and 10). Again, this illustrates the need to evaluate the seedbank before planting. If undesirable species can be removed with selective herbicides without harming desirable species germinating from the seedbank, there is no need to spend time and money planting.

Forb coverage increased dramatically following all treatments. Like the warm-season grass response, many of the forbs were desirable and some were undesirable. Nonetheless, food resources for northern bobwhite were increased following all treatments (figs. 11 to 13). Forb coverage, both desirable

Figure 8. This plot was sprayed with imazapic in fall 2003 and disked in March 2004. By August 2005, broomsedge bluestem is the dominant grass and several forbs have become established. (Photo credit Craig Harper)

Figure 10. This plot was sprayed with glyphosate in spring 2004. By August 2005, tall fescue remains in the understory and the dominant grass is johnsongrass. (Photo credit Craig Harper)

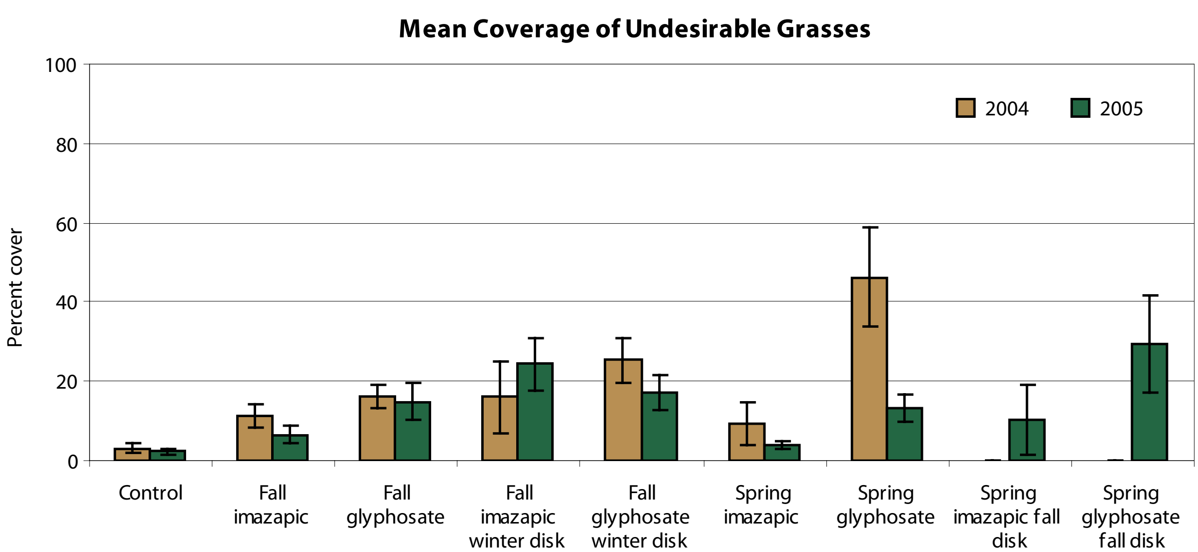

Figure 9. Undesirable warm-season grasses increased following treatments. Aggressive undesirable grasses, such as johnsongrass and crabgrass, may be controlled using selective herbicides.

and undesirable, tended to decrease in the second year after treatment. This illustrates the concomitant increase in perennial grasses with a decrease in forb coverage. Thus, management is necessary to maintain the appropriate balance between grass and forb coverage, which depends upon landowner objectives. Plant species composition in early successional communities should be managed by prescribed burning (CPS Code 338) and/or disking (CPS Codes 645 and 647). Timing of these practices influences plant composition.

Figure 12. Plot was sprayed with glyphosate in fall 2003 and disked in March 2004. By July 2004, ragweed is the dominant cover. (Photo credit John Gruchy)

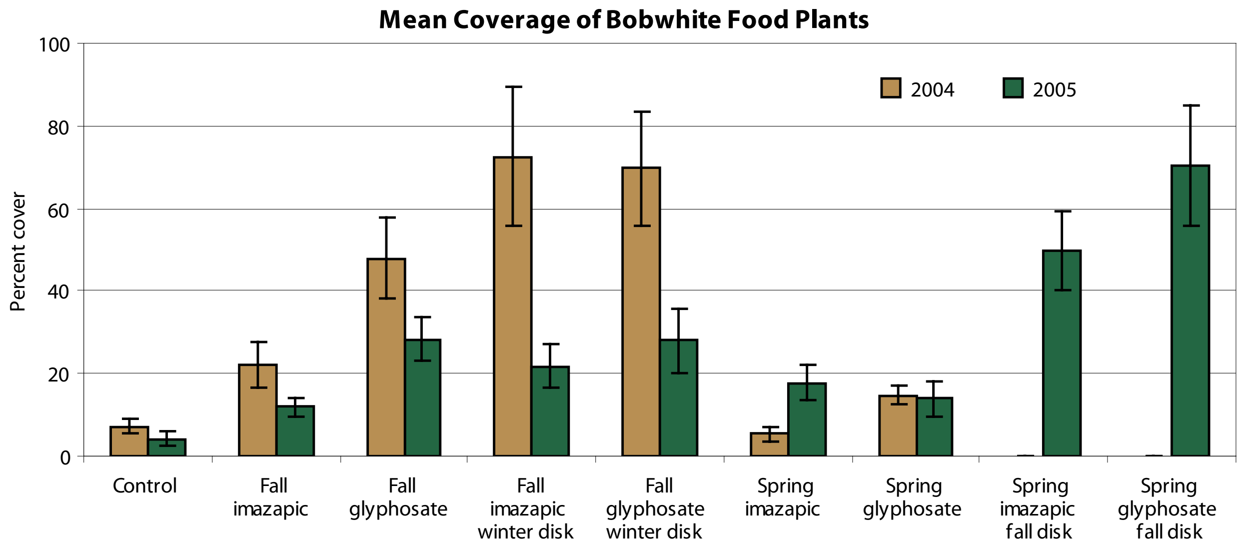

Figure 11. Fall herbicide applications reduced tall fescue cover and increased bobwhite food plants. Disking following herbicide applications resulted in a greater increase in food plants than herbicide application alone.

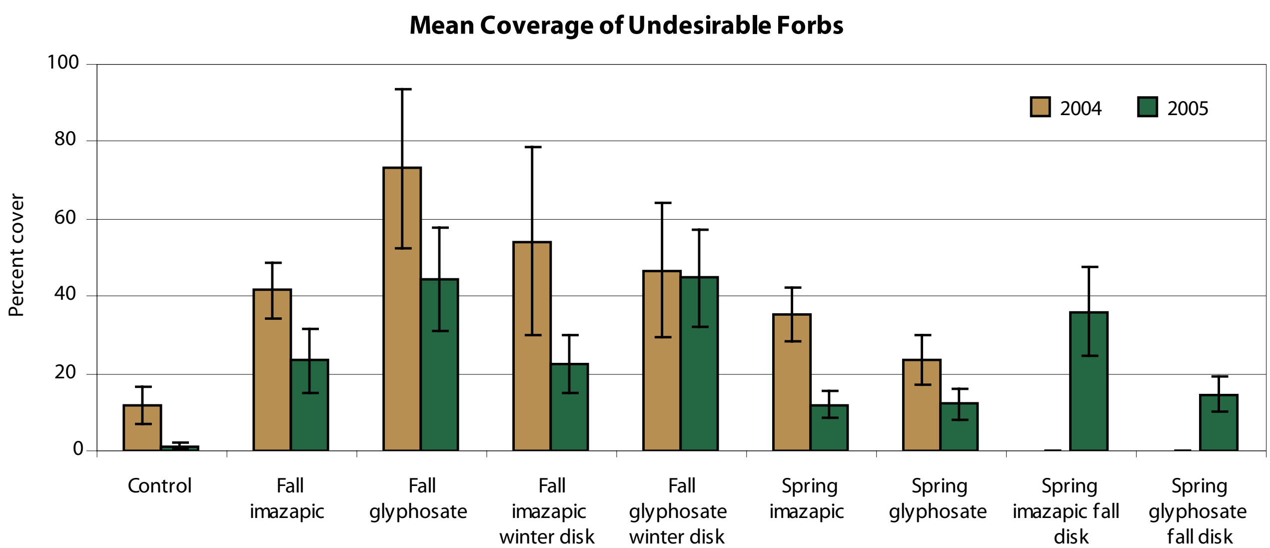

Figure 13. Undesirable forbs, such as narrowleaf plantain, pigweeds, and thistles, also emerged from the seedbank following tall fescue eradication. Undesirable forbs can be controlled using selective herbicides.

GRASSLAND MANAGEMENT

Effect on vegetation structure

In addition to a more favorable species composition, which improves nesting opportunities and food resources for many wildlife species, the structural characteristics of the field also improve dramatically following eradication of tall fescue. In the study, mean ground sighting distance was increased following all treatments, especially the disking treatments (fig. 14). This measurement directly relates to the ability of northern bobwhite and other ground feeding birds to travel throughout the field.

Vertical structure was increased following all treatments except for spring sprayings, which did not kill tall fescue as well as the fall spraying treatments (fig. 15). Increased vertical structure provides additional winter cover, as well as nesting cover for birds that nest aboveground in forbs, tall grass, and shrubs.

Does orchardgrass = tall fescue?

Orchardgrass is another perennial cool-season grass from northern Europe. It is not as aggressive as tall fescue, but its growth structure is similar. In fields where orchardgrass was present in the study, its

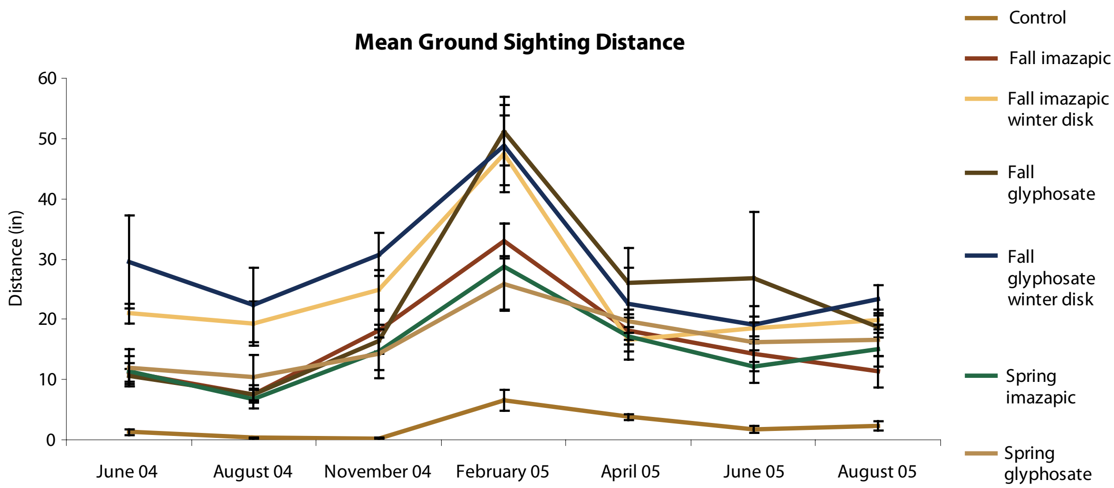

Figure 14. Ground sighting distance is the maximum distance a prone observer can see without being obstructed by vegetation. This measurement is used as an index of mobility for gamebird broods.

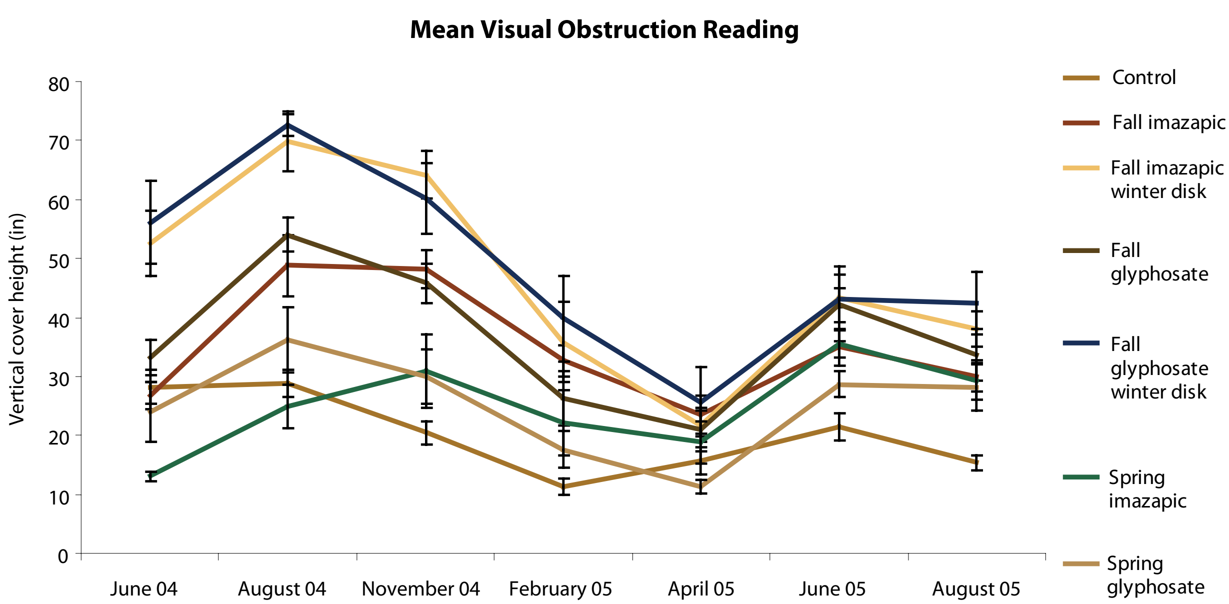

Figure 15. Visual obstruction reading is used as an index of vertical cover. All treatments increased vertical cover.

coverage increased dramatically when tall fescue was killed with imazapic (fig. 16). In plots containing orchardgrass, the mean ground sighting distance following fall applications of imazapic was equal to that in tall fescue control plots (fig. 17). The orchardgrass spread in the imazapic-sprayed plots because imazapic does not control orchardgrass. Thus, it was released. In plots sprayed with glyphosate in the fall, orchardgrass was killed along with the tall fescue (fig. 18). Spraying glyphosate in the spring was relatively ineffective at killing orchardgrass, similar to tall fescue.

Summary and Management Recommendations

It is clear and well documented that tall fescue does not provide suitable habitat for many wildlife species dependent upon early successional cover. Habitat is improved dramatically for those species and others when tall fescue is eradicated and the seedbank is allowed to respond.

Planting native grasses and forbs is not necessary when desirable species establish from the seedbank. Waiting 1 to 2 years after spraying tall fescue is often

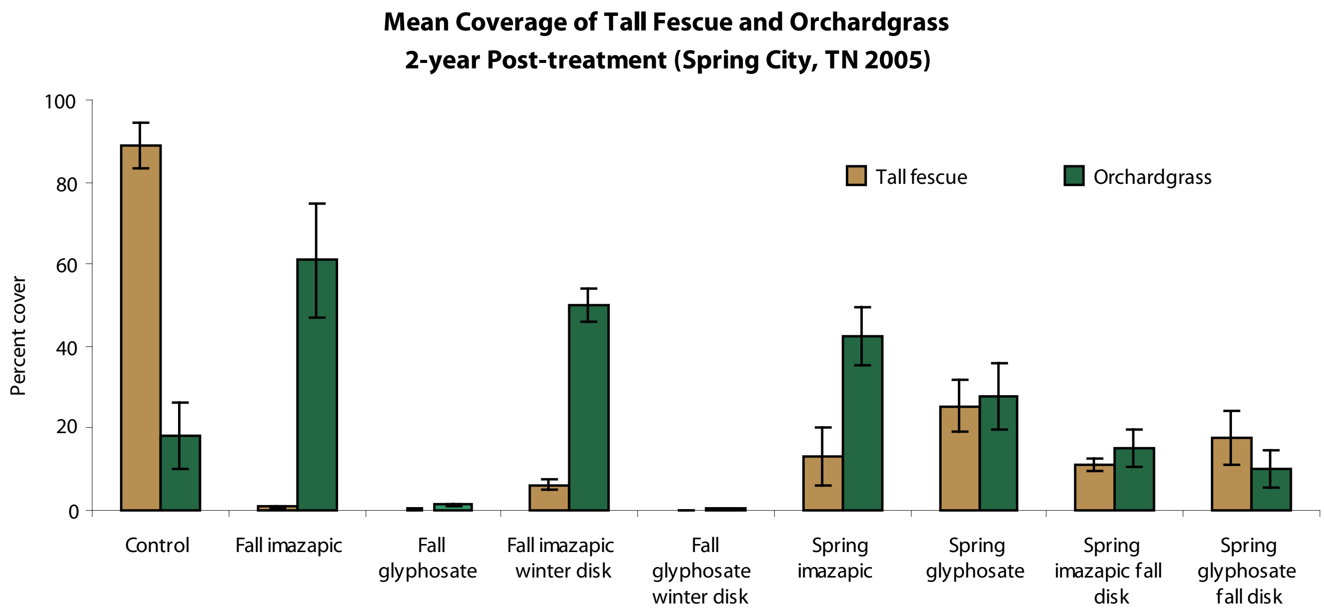

Figure 16. Orchardgrass was present in one field prior to treatment implementation. Only fall glyphosate applications reduced orchardgrass cover. Imazapic does not control orchardgrass.

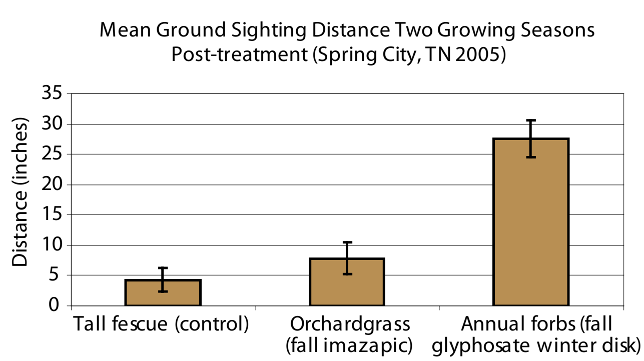

Figure 17. In areas where orchardgrass was released by fall imazapic applications, ground sighting distance was similar to tall fescue control.

a b c

Figure 18. Figure 18a shows the ground sighting distance in a tall fescue plot. Figure 18b shows the ground sighting distance in a tall fescue plot that was sprayed with imazapic the previous fall. The tall fescue was killed, but the orchardgrass was released. Figure 18c shows the ground sighting distance in a tall fescue plot that was sprayed with glyphosate the previous fall. The tall fescue and the orchardgrass were killed and the annual plant community germinated from the seedbank.

needed to evaluate the seedbank and/or control undesirable species germinating from the seedbank.

Further, it is important to realize a field dominated by native grass is not desirable for many wildlife species dependent upon early successional cover. In fact, no more than 20 to 30 percent coverage of native warm-season grasses is needed to provide adequate nesting opportunities for species such as northern bobwhite.

Arguably, to benefit the most wildlife species, the optimum plant composition would be approximately 50 percent native grasses and 50 percent native forbs with scattered shrub thickets well dispersed throughout the field.

Past research has shown tall fescue can be killed with several different herbicides. Researchers evaluated the effectiveness of two commonly used herbicides (glyphosate and imazapic) in different seasons with and without disking.

From the results, spraying tall fescue in the fall is recommended because researchers believe tall fescue should be completely eradicated instead of simply reduced to 20 to 40 percent coverage.

That being said, no single herbicide application will eradicate tall fescue from a field. As residual tall fescue seed in the seedbank germinates, spot spraying will be necessary 1 to 2 years after the initial application. Nonetheless, it much more efficient to treat 2 to 5 percent regrowth as opposed to 20 to 40 percent.

Data show that orchardgrass is structurally similar to tall fescue. Eradicating it just like tall fescue is recommended.

Thus, fall applications of glyphosate is recommended when orchardgrass is present with tall fescue.

In late winter (February–March) following fall spraying, burning is recommended to consume the dead vegetation, stimulate the seedbank, and kill undesirable winter annual weeds (such as chickweed, henbit, purple deadnettle, and wild garlic) that have germinated since spraying.

In late March/early April, a preemergence application of imazapic (such as 4–8 oz) will control undesirable warm-season grasses (such as johnsongrass, crabgrass, and broadleaf signalgrass).

Establishing favorable early successional habitat does not happen overnight. It is a process that may take a few years.

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Managing Early Successional Habitat

The plant communities often found in fields and forest openings are commonly referred to as early successional habitat. These types of habitats require some form of management, such as disking or burning, to keep the field plant community from becoming a forest plant community. The quality of early successional habitat is determined by the types of plants that are present and the structure of the vegetation at the ground level. Many species of wildlife thrive in early successional habitats made up of a diverse mixture of native grasses for nesting substrate, forbs to provide food, and shrubs for escape cover. Such plant communities are open at ground level with a dense canopy of vegetation at about waist high that allows small wildlife to move about easily without being exposed to predators or extreme weather conditions. Balancing the plant species composition and structure of early successional habitats can only be accomplished through habitat management. Prescribed burning removes litter, improves ground level vegetation structure, and stimulates desirable plants in the seedbank. Disking improves habitat structure and composition by incorporating litter, reducing ground level vegetation density, and stimulating desirable forbs. Research conducted in Tennessee suggests that the effects of disking and burning vary greatly based on the timing and frequency of disturbance and the local seedbank. Mowing (or bush hogging) is the least desirable practice for managing early successional habitats because it creates dense thatch at the ground level reduces cover and is not effective in controlling tree saplings. If other practices cannot be used, then mowing in late winter is recommended. Herbicides are particularly useful for controlling undesirable plants in early successional habitats. In some instances, herbicide applications result in a temporary loss of plant diversity; however, the long-term benefits of eliminating undesirable plants far outweigh any collateral damage. Selecting the proper herbicide, application method, and timing of application will maximize habitat benefits. Recommendations for managing early successional wildlife habitat are dependent upon landowner objectives. Burning during spring (March) on a shorter rotation (2–3 years) in larger blocks (50–100 acres) will promote a greater density of warm-season grasses ideal for grassland songbirds. Burning in September or spraying herbicides may be necessary in some years to control woody succession. Disking areas during the fall/winter (October–February) on a 3-year rotation will create better brood-rearing and feeding cover for bobwhites and other species. Breaking fields into smaller management units (5–10 acres) will create a more diverse array of cover types for a greater variety of species. Desirable shrubs provide important cover and should be protected. Maintaining quality early successional habitat requires active management. Landowners should be educated on the effects of various management practices, including their timing and application. It is critical that landowners think beyond their property boundaries and partner with neighbors to conserve, sustain, and increase populations of early successional wildlife.

Managing Early Successional Habitat

Establishing native grasses, forbs, and shrub cover is a common practice under many U.S. Department of Agriculture (USDA) Farm Bill conservation programs such as the Conservation Reserve Program (CRP), Wildlife Habitat Incentives Program (WHIP), and Environmental Quality Incentives Program (EQIP). Eradication and conversion of nonnative grasses and forbs, such as tall fescue (*Schedonorus phoenix*), bermudagrass (*Cynodon dactylon*), and sericea lespedeza (*Lespedeza cuneata*), to native species can have a dramatic impact on habitat quality for wildlife dependent upon early successional cover.

Advances in herbicide technology and knowledge concerning preparation, timing, and application of herbicides to eradicate various undesirable species has enabled landowners to manipulate vegetation composition to develop desirable plant communities, often without having to plant desirable species. Many of these same herbicide applications can be combined with improved technology in planting equipment, such as no-till drills with native grass seed box attachments, and knowledge of planting procedures to develop desirable plant communities even where the naturally occurring seedbank does not contain desirable species.

Once established, early successional plant communities become late successional plant communities relatively quickly, especially in the Eastern United States where average annual precipitation exceeds 40 inches per year (fig. 1). To maintain desirable cover for wildlife requiring early successional vegetation, recurring management is required.

Figure 1. Without management, early successional habitat can become mid-successional quickly. (Photo credit Craig Harper)

Options for Management

Early successional plant communities can be maintained through prescribed burning (CPS Code 338); mechanical disturbance (disking, mowing, and drum chopping); Upland Wildlife Habitat Management, CPS Code 645; Early Successional Habitat Development/Management, CPS Code 647; Brush Management, CPS Code 314; herbicide applications (Pest Management, CPS Code 595); and Prescribed Grazing, CPS Code 528. Most have advantages, and all have limitations.

Prescribed burning

Fire sets back succession, consumes vegetative material, and increases nutrient availability as nutrients from the ashes are moved via rainfall into the top couple of inches of soil. Burning also scarifies seeds, stimulates germination of desirable plants in the seedbank, and creates an open environment at the ground level that facilitates travel, loafing, and

What is succession and quality early successional vegetation?

Ecological succession is the systematic change in a plant community over time. Successional stage is defined by vegetation composition and is directly related to time since disturbance and environmental factors that influence colonization, growth, development, competition, and local extinction. Early successional vegetation is composed of species that are able to germinate, grow, and develop relatively quickly after a disturbance. This typically includes annual and perennial grasses and forbs and, on some sites, sedges and rushes. Some woody species also germinate or sprout relatively quickly after a disturbance. In the Eastern United States, a site becomes mid-successional as woody species begin to dominate, and as a forest or woodland develops, the site is classified as late succession.

Succession marches forward on some sites more quickly than others. Succession is typically faster in areas that receive abundant precipitation and where woody seed sources are nearby. Seed from wind-disseminated species, such as pines (*Pinus* spp.), maples (*Acer* spp.), boxelder (*Acer negundo*), ashes (*Fraxinus* spp.), sweetgum (*Liquidambar styraciflua*), elms (*Ulmus* spp.), and sycamore (*Platanus occidentalis*), are able to spread en masse faster and further than heavy-seeded species (i.e., oak, *Quercus* spp.). However, individual heavy-seeded species, such as oak and common persimmon (*Diospyros virginiana*), may be spread far from the parent tree by animals. Eventually, as distance from pioneering woody plant seed sources increases, occurrence of woody plants is near zero, and time since disturbance is less of a factor in maintaining a plant community dominated by herbaceous species. This phenomenon is exemplified in the few extant true prairies of the Midwest.

Quality early successional vegetation, as related to wildlife habitat, is determined by plant composition, species diversity, and the structure of cover provided. Plants that provide protective cover, nutritious food sources, and allow travel, feeding, and loafing within and under the cover are considered desirable. When many species of desirable plants are present, usable space for wildlife is typically high. Undesirable species provide suboptimal cover, seed, or forage that is not palatable and/or relatively indigestible and inhibit the mobility of small wildlife. When these plants dominate an area, usable space is limited and the number and species of wildlife present and the carrying capacity of the property may be relatively low.

feeding of gamebird broods, rabbits (*Sylvilagus floridanus*), and ground feeding songbirds. Prescribed burning may be implemented during the dormant season or during the growing season, depending on the objectives.

The effect of prescribed burning varies greatly with season of burning and fire return interval. Dormant-season burning typically maintains the existing vegetation composition, except that, over time, grass density usually increases, albeit slowly (fig. 2). Growing-season burning, if implemented repeatedly over time, may reduce percent cover of native

Figure 2. Ideally, dormant-season burning should be conducted just prior to spring green-up and used to maintain the existing plant composition. (Photo credit Craig Harper)

warm-season grasses and increase percent cover of forbs (fig. 3(a)). Growing-season burning, if implemented repeatedly, will virtually eliminate woody cover. Burning only once during the late growing season can be as or more effective at controlling woody encroachment than various herbicide treatments (fig. 3(b)). Burning on a short fire return interval (1–2 years) will promote an early successional plant community dominated by herbaceous species, whereas longer fire return intervals (3–5 years) will allow more woody plant development.

The effect of season of burning is related to nutrient balance and flow within the plant. Aboveground woody stems may be killed with either dormant-season or growing-season fire, but burning during the growing season is more effective at killing the entire plant because much of the plant's energy has been transported from the roots to the aboveground stem and leaves. This effect is pronounced by burning later in the growing season than earlier in the growing season. Burning in the dormant season and early growing season typically results in woody plants resprouting. This is a most important consideration when managing fields and manipulating plant species composition.

Plant response can also vary considerably with timing of burning within the dormant season. If problematic cool-season plants are in the seedbank, such as tall fescue, cheatgrass (Bromus tectorum), and field chickweed (Cerastium arvense), burning early in the dormant season (January–early March) will stimulate their release and growth. Burning later in the dormant season (late March–mid-April), after they have germinated or sprouted and begun seasonal growth and just prior to germination or sprouting of warm-season plants will help reduce coverage of cool-season plants and increase coverage of warm-season plants (fig. 3(c)). Treatments including dormant-season burning in March, applications of triclopyr (4-lb formulation at 5 qt/acre), imazapyr (4-lb formulation at 24 oz/acre), and glyphosate (4-lb formulation at 4 qt/acre) in July, mowing in August, and growing-season burning in September were applied to a CRP field dominated by sweetgum, red maple, and green ash. Late growing-season burning was as effective as applications of imazapyr and triclopyr at controlling woody cover, increased desirable legume cover, and reduced undesirable cool-season grass cover. Additionally, burning later in the dormant season is recommended to lessen the time between burning and spring green-up, thus reducing the loss of cover immediately following a fire (fig. 4).

The influence of season of burn is actually greater than fire intensity with regard to changing the species composition of early successional plant communities. A raging heading fire with flame heights exceeding 20 feet in February will not kill woody stems in a field as well as a relatively cool backing fire with 12-inch flame heights in late September. The aboveground stem of woody plants is killed once the cambium layer just inside the bark reaches 145 degrees Fahrenheit.

Growing-season fire can be used without disrupting nests. As mentioned, burning during the early growing-season is not much more effective at reducing woody species than dormant-season burning. Songbird nests in fields are typically initiated starting in late April/early May. Thus, burning through mid-April does not disrupt many nests. Although bobwhites may continue to nest into September, the vast majority of nests have hatched by late September and burning at this time will not have a deleterious effect on fall recruitment.

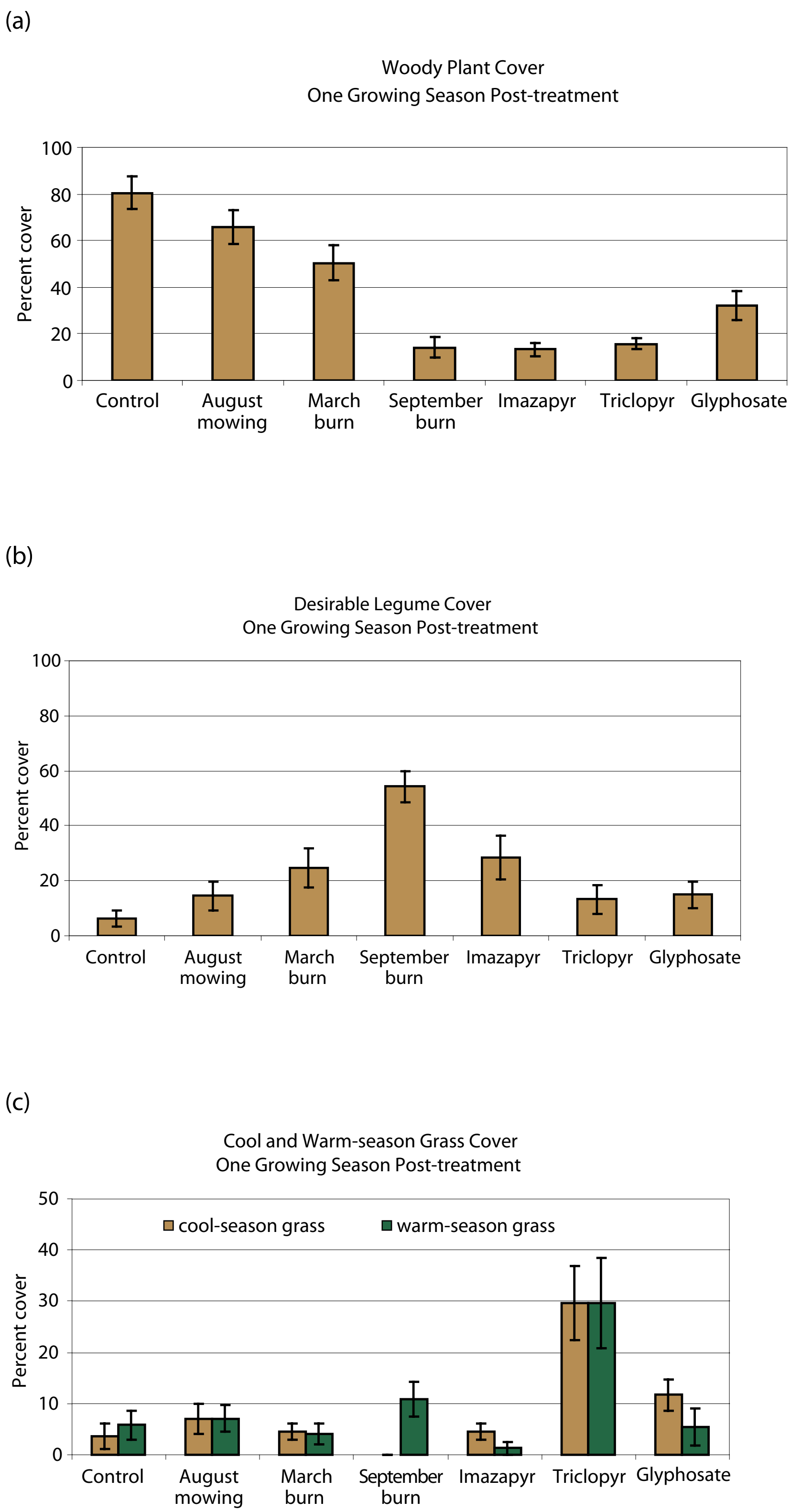

Figure 3. Although patches of woody cover provide important escape cover for bobwhites, fields dominated by undesirable woody plants do not provide adequate nesting or feeding habitat.

Figure 4. Burning late in the growing season (late September/early October) is very effective at reducing undesirable woody cover. (Photo credit John Gruchy)

Figure 5. Disking is the most effective practice to increase forb cover in a grass-dominated field, such as this switchgrass (Panicum virgatum) field. (Photo credit Craig Harper)

Mechanical disturbance

Disking, mowing, and drum chopping (roller chopping) are the three methods of mechanical disturbance most commonly used. Among the three, disking usually provides more favorable results with regard to plant composition and reduction of woody cover.

Disking

Disking not only sets back succession, but also incorporates much of the vegetative material, including thatch, into the upper soil layer (fig. 5). This provides an open structure at ground level and increases soil organic material, which is the primary source of nitrate nitrogen, phosphorus, sulfur, boron, and molybdenum for future plant growth. Increased forb cover provides better conditions for brood rearing by quail and turkeys, seed for various birds, and more forage for white-tailed deer (*Odocoileus virginianus*) (table 1 and fig. 6). Plants such as American pokeweed (*Phytolacca americana*), ragweed (*Ambrosia* spp.), partridge pea (*Chamaecrista fasciculata*), blackberry (*Rubus* spp.), hairy white oldfield aster (*Symphyotrichum pilosum*), native lespedezas (*Lespedeza* spp.), ticktrefoil (*Desmodium* spp.), and common sunflower (*Helianthus annuus*) are all highly desirable. It is important to note that although deer are selective in what they eat, plants are not necessarily eaten based on nutritional content. For example, deer did not browse all of the plants in the chart below. Although American pokeweed, hairy white oldfield aster, and prickly lettuce were browsed heavily, blackberry, partridge pea, ticktrefoil, annual ragweed, goldenrod, and Virginia three-seed mercury were only browsed moderately. For other species, such as passion flower and sericea lespedeza, there was no sign of browsing at all, even though crude protein and digestibility ratings were high. Deer density in this area was approximately 25 per square mile and quality forage was not lacking as there were plenty of soybean fields as well as warm- and cool-season food plots on the farm. Also shown is the relative value of these plants for wild turkeys and bobwhite quail.

Timing of disking, similar to season of burning, usually influences plant composition (figs. 7–10). Although preemergence herbicide applications often reduce the cover of desirable species as well, in many instances, it is worth the trade-off to control undesirable plants before they become a problem. Disking in the fall and winter reduces native warm-season grass dominance and promotes more favorable forb cover for wildlife than disking in the spring. Disking in the summer is not recommended because cover would be destroyed during the nest-

Table 1. Percent crude protein and acid detergent fiber for selected forbs and shrubs collected in June after burning an old field in April, McMinn County, TN.

Common name	Scientific name	CP[1]	ADF	Selectivity by deer	Value as brood cover	Seed value for birds
American pokeweed	*Phytolacca americana*	32.0	12.0	High	High	High
Hairy white oldfield aster	*Symphyotrichum pilosum*	23.3	30.7	High	Medium	None
Prickly lettuce	*Lactuca serriola*	21.7	21.2	High	Low	None
Blackberry	*Rubus* spp.	19.3	18.9	Medium	High	High
Partridge pea	*Chamaecrista fasciculata*	29.6	36.5	Medium	High	High
Tricktrefoil	*Desmodium* spp.	28.2	20.7	Medium	High	High
Annual ragweed	*Ambrosia artemisiifolia*	17.8	23.9	Medium	High	High
Sumac	*Rhus* spp.	23.1	12.5	Medium	High	Medium
Goldenrod	*Solidago* spp.	16.1	26.2	Medium	Medium	None
Virginia threeseed mercury	*Acalypha virginica*	24.7	16.7	Medium	Low	Medium
Japanese honeysuckle	*Lonicera japonica*	16.2	34.2	Low	Low	Low
Canadian horseweed	*Conyza canadensis*	32.9	19.8	Low	Low	None
Sericea lespedeza	*Lespedeza cuneata*	22.2	32.6	None	Low	Low
Purple passion flower	*Passiflora incarnata*	36.6	18.9	None	None	Low

[1]Forage samples contained leaves only because that was the part of the plants deer commonly ate. Stems were not included.

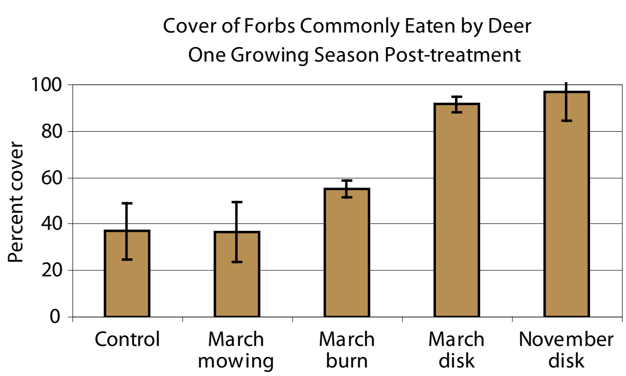

Figure 6. Disking and burning strips and/or sections within old-fields each year stimulates forbs favored by deer.

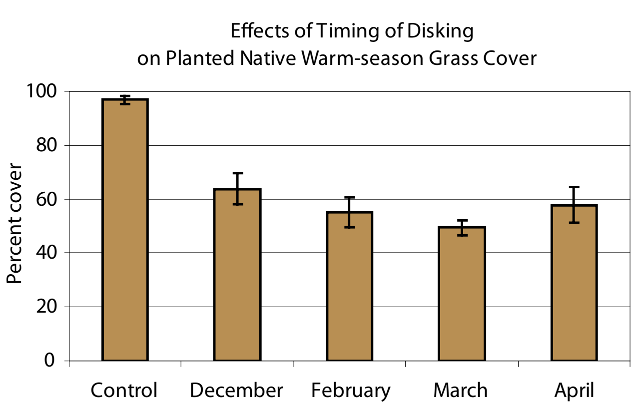

Figure 7. Three passes with a medium sized disk reduced the density of native warm-season grasses 50–60 percent one growing season following treatment, regardless of whether disking occurred in winter or spring.

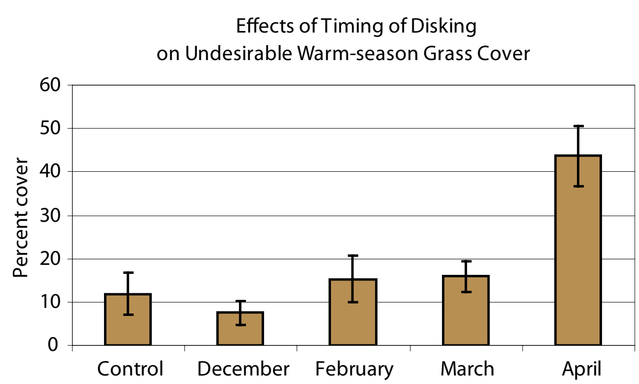

Figure 8. Disking in April resulted in increased cover of undesirable warm-season grasses, such as johnsongrass, crabgrass, goosegrass (Eleusine spp.), and broadleaf signalgrass.

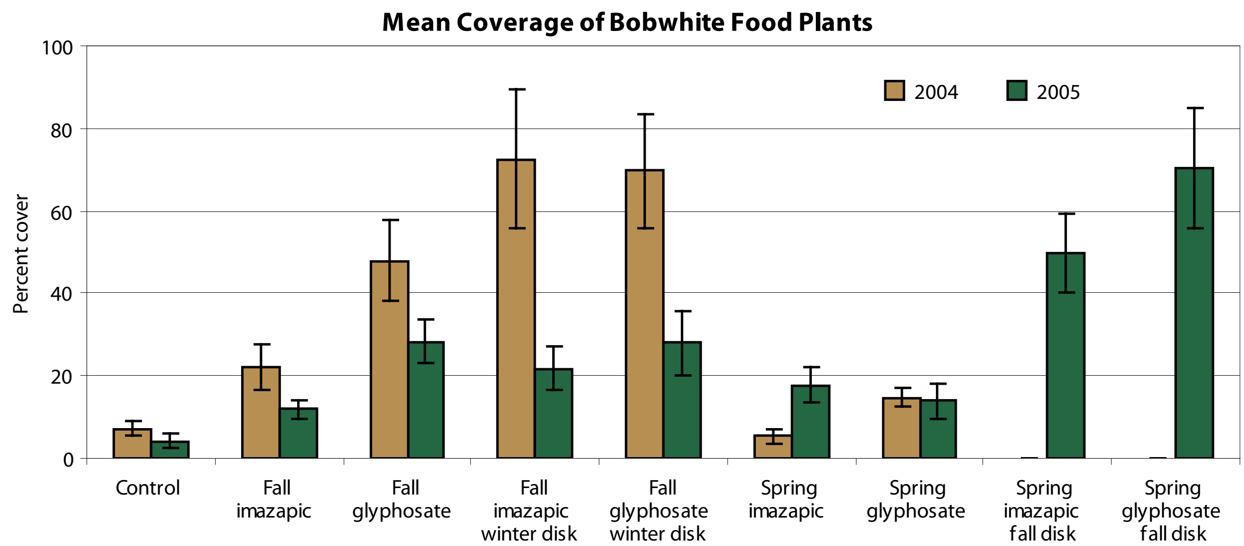

Figure 9. A preemergence application of imazapic (2-lb formulation at 12 oz/acre) controlled undesirable warm-season grasses, an important consideration if spring disturbance is necessary.

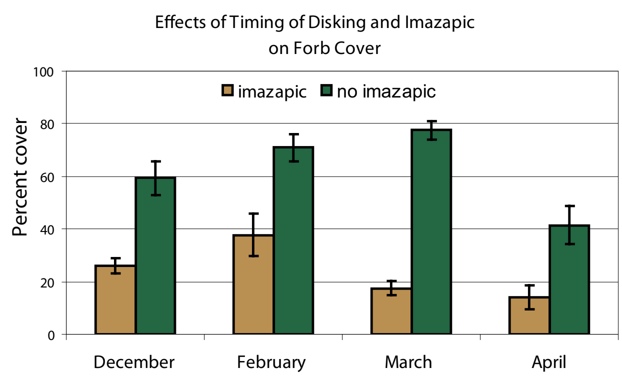

Figure 10. A preemergence application of imazapic (2-lb formulation at 12 oz/acre) also inhibited the germination of several species of forbs.

ing and brood-rearing season and because undesirable plant species may dominate. In the Deep South, disking should be completed by late February. In the Midsouth and further north, disking may be completed as late as March. Disking later than this tends to stimulate invasive nonnative warm-season plants, such as crabgrass (*Digitaria* spp.), johnsongrass (*Sorghum halepense*), broadleaf signalgrass *(Urochloa platyphylla*), sicklepod (*Arabis canadensis*), curly dock (*Rumex crispus*), common plantain (*Plantago major*), Canadian horseweed (*Conyza canadensis*), and sericea lespedeza (*Lespedeza cuneata*). Site-specific plant response is dependent upon the seedbank, which varies greatly from area to area and even among fields on a particular property. Seedbank composition and the best time for disking individual fields can be evaluated by disking a strip each month, November through March.

Intensity of disking is another consideration. In general, it is desirable to incorporate approximately 50 percent of the vegetative material into the top layer of soil. The amount of disking (or number of passes) necessary is determined by soil texture and moisture and the type of disk used. Light tandem disks do not work well, especially with dry clay soils. Heavier offset disks work best. Regardless, fewer passes will be necessary with sandy and clay loams and when soil moisture is adequate. Heavier disks and repeated passes are required if considerable woody cover is present and the objective is to reduce woody cover and promote more herbaceous cover.

According to the amount of vegetation on the field, mowing or burning may be necessary prior to disking, especially when using a light tandem disk, which will not cut through heavy vegetation (fig. 11). Burning in the dormant-season prior to disking makes disking with a light tandem disk much easier, especially if disking is conducted several days after a rain, which makes the soil easier to work and prevents the soot and ash of a recently burned field from blowing around the tractor. Burning prior to disking also creates the perfect seedbed for top-sowing forbs into a previously grass-dominated stand.

Mowing

Mowing (or bush hogging) is the least desirable method of setting back succession and managing early successional cover for wildlife. Although succession is set back following mowing, woody stems are not killed, only cut off a few inches aboveground, and where there was one stem, several arise the following growing season. Mowing accumulates

Photo credit Mike Hansbrough *Photo credit John Gruch*

Figure 11. If a heavy off-set disk is not available, burning or mowing prior to disking with a tandem disk may be necessary.

a tremendous amount of debris on the ground, which eliminates bare ground space and increases the thatch layer so that mobility of gamebird broods and ground feeding songbirds is limited. Furthermore, the seedbank is suppressed and any seed that might have been available as food is covered with debris and thus unavailable (fig.12).

If burning is not possible, no equipment is available to disk the field, and mowing is absolutely the only option, then mowing should be completed in late winter, just prior to spring green-up. This allows cover in the field to stand through the winter and does not disrupt nesting, fawning, or brood rearing.

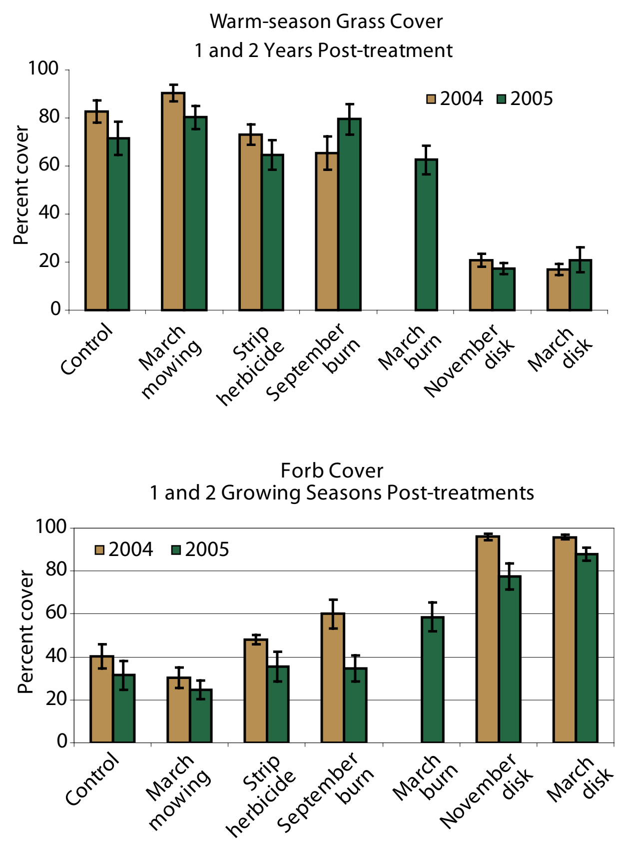

Figure 12. Treatments were applied to a field planted in native warm-season grasses in May of 2000. Disking in November or March was effective in reducing grass density and increasing forb cover. Burning in March increased forb cover one growing season following treatment and improved native grass growth and vigor. Mowing was not effective in improving vegetation composition or structure. Plots were disked 4 to 6 passes with an off-set disk.

Although mowing is disfavored as a management practice, that does not mean landowners should sell their rotary mowers. For fields dominated by forbs, mowing strips (no more than a fifth of the total field) in mid-July will increase grass cover (such as broomsedge bluestem (fig. 13)). This is an important consideration for nesting cover if bobwhites are an objective and if the field is managed with prescribed burning. Another use for rotary mowers is clearing a few strips in the fall to facilitate rabbit or quail hunting. Of course, this could also be accomplished by disking.

Drum chopping

Drum chopping, also called roller chopping, is accomplished by pulling a large drum roller with horizontal bars welded across the drum across the field with a bulldozer. This technique is most often used to set back succession where woody growth has grown too tall for disking and a closed canopy has reduced the herbaceous fine fuels to adequately carry a fire. Drum chopping is also used over large areas dominated by tall brush. A disadvantage of this technique is that extremely few landowners have access to such equipment. Additionally, drum chopping is always followed by substantial resprouting of hardwood stems. Late growing-season fire is much more effective and efficient where possible.

Herbicide applications

Herbicides are often necessary to reduce or eliminate undesirable species. Herbicides can be applied as broadcast applications, strip applications with every other or every third spray nozzle closed, or spot-spray applications (fig. 14). Dense native grasses should be sprayed before they reach approximately 12 inches or forb response from the seedbank will be suppressed by the thatch produced Broadcast applications are used when problem species are present throughout the field. Broad-spectrum or selective herbicides can be used, depending upon the plant(s) present. When undesirable herbaceous species are the target, it is important to prepare the field for spraying in the season prior to application. Spraying fields with thatch and senescent stems and leaves will limit herbicide contact to growing vegetation, which is necessary for all postemergence applications. Burning, haying, grazing, or repeated mowing in the season prior to spraying will clean the field and allow postemergence appli-

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Figure 13. Additional broomsedge bluestem has been stimulated for increased nesting structure for bobwhites and to facilitate burning in a field dominated by goldenrod and dewberry. (Photo credit Craig Harper)

Figure 14. Strip spraying is easily accomplished by closing off every other or every third nozzle on the spray boom. (Photo credits John Gruchy)

cations to come in contact with the problem plants. Preemergence applications are most effective following burning or disking (fig. 9). Applications to bare ground allow herbicide contact with seedlings of problem species as soon as they germinate. Preemergence herbicide applications (such as imazapic) following strip disking can be quite effective in reducing establishment of undesirable species.

Strip applications can be used to reduce native grass cover and allow increased forb cover to develop. This is not as effective as disking, but will increase forb cover if native grasses are sprayed before they reach about 12 inches in height (fig. 12). Strip applications to native grasses taller than 12 inches is not desirable because the dead native grass will produce a thatch layer in the sprayed strips that will inhibit germination from the seedbank. Another problem with this technique is that strip applications in late April and May may release many undesirable warm-season species. Expect bermudagrass, crabgrass, johnsongrass, broadleaf signalgrass, sicklepod, and sericea lespedeza to arise if they are present. This elucidates the absolute need to get rid of problem plants before planting native grasses and forbs. If undesirable plants are not eradicated before planting, they will arise sooner or later and become problems when the field is managed. Landowners should wait a minimum of 1 year (2 yr is better) after spraying nonnative grass cover to evaluate the seedbank. This is not necessary when planting unplanted fields that were previously row cropped.

Spot spraying is an excellent technique to control problem plants, such as some woody species, that are not widespread across the field (fig. 15). Imazapyr or triclopyr are excellent choices to control problem woody stems, such as sweetgum, locusts (*Gleditsia triacanthos*, *Robinia pseudoacacia*), maples (*Acer* spp.), or elms (*Ulmus* spp.), while retaining desirable woody species, such as plum (*Prunus* spp.), black elderberry (*Sambucus nigra*), southern crabapple (*Malus angustifolia*), and sumac (*Rhus* spp.). However, efficacy varies among species and herbicides.

For additional information about herbicides and applications for managing early successional communities, refer to Native Warm-season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South. This publication can be viewed, downloaded, and/or purchased (http://www.utextension.utk.edu/publications/wildlife/default.asp).

Grazing

Early successional plant communities throughout North America were historically maintained with fire and grazing. Of course, there are no longer vast herds of buffalo maintaining the oak savannas once present throughout much of the South; however, domestic cattle can serve the same purpose. Prescribed grazing (CPS Code 528) by rotating cattle among paddocks has been promoted for some time. The intention is to prevent overgrazing and keep native grass height no lower than about 12 inches. This strategy is now being questioned in favor of a new practice being developed in Oklahoma, Missouri, and Kansas—patch-burn grazing.

Figure 15. Spot spraying undesirable woody species is easily accomplished with a tractor-mounted sprayer. This is an effective management practice during the growing season and much more sensible than recreational mowing. (Photo credit Craig Harper)

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Patch-burn grazing allows cattle access to a relatively large area (perhaps 100-400 acres). A third to a fourth of the area is burned each year. Cattle graze preferentially on the recently burned area, without being fenced out of the rest of the area. Stocking rates are adjusted so that the cattle can intensively graze the burned area throughout the growing season. The cattle then are removed. The following winter/spring, another quarter of the area is burned. Cattle then are allowed back into the area and preferentially graze the most recently burned area throughout the growing season. This pattern continues such that a 3- to 4-year burning rotation is established.

Wildlife respond beautifully to patch-burn grazing. Gamebirds nest in the areas not burned recently, but move to the recently burned area with the cattle to raise broods. Songbirds nest in the areas not previously burned, yet feed abundantly in the burned area with the cattle. This entire system mimics the natural historic pattern of buffalo as they would intensively graze areas recently burned because the vegetation was more palatable and contained increased nutrition. It is important to note the areas open to grazing are not necessarily dominated by grasses. An abundance of forbs are present throughout.

The logistics of this system and its applicability to private lands are being worked on now. There appears no reason that cattle cannot be allowed throughout an area that includes brushland and woodland, along with open areas of grasses and forbs. Ideally, the entire property can be fenced along the perimeter and sections burned within. Cattle preferentially graze and manage the vegetation. Although stocking rates may not be as high as the intensive grazing practices on nonnative grasses today, the system may have great benefit for landowners also interested in wildlife.

Management Recommendations

Recommendations for managing early successional wildlife habitat are dependent upon landowner objectives. Strategies for managing fields specifically for grasshopper sparrows (*Ammodramus savannarum*) and eastern meadowlarks (*Sturnella magna*) differ from those for managing fields specifically for bobwhites (*Colinus virginianus*), indigo buntings (*Passerina cyanea*), or white-tailed deer. That does not mean habitat needs for a variety of wildlife species cannot be met within a particular field. Nonetheless, it is important for a landowner to identify goals and objectives in a management plan before implementing management strategies.

For more information on farm-scale conservation planning for early successional wildlife, see Creating Early Successional Wildlife Habitat through Federal Farm Programs: An Objective-Driven Approach with Case Studies (http://www.whmi.nrcs.usda.gov/technical/fieldborder.html).

Considerations for plant species composition
Matching plant species composition with the desired wildlife species is an important initial consideration. Grassland songbirds, such as Henslow's sparrows (*Ammodramus henslowii*) and eastern meadowlarks, prefer grass-dominated fields with a forb component. Grasses may constitute 70 to 90 percent of the plant cover, with 10 to 30 percent forbs (fig. 16). Presence of woody structure is not preferable, and may preclude presence of some grassland bird species, depending on the amount of woody cover present. Other early successional songbirds, such as field sparrows (*Spizella pusilla*) and dickcissels (*Spiza americana*), and wild turkeys (*Meleagris gallopavo*) prefer fields of approximately 50 percent grass, 50 percent forbs with scattered shrubs/brush in the field. The scrub/shrub songbirds, such as yellow-breasted chats (*Icteria virens*) and indigo buntings (*Passerina cyanea*), use fields of grass and forbs with considerable woody cover throughout the field. This stage is also preferable for

Figure 16. Grassland songbirds prefer fields composed primarily of grass with a reduced forb component (perhaps 30%). This type of cover can be maintained with late dormant-season fire alternated with growing-season fire. (Photo credit Craig Harper)

bobwhites, rabbits, and white-tailed deer. The shrub cover is extremely important for winter cover, and various shrubs, such as plum, crabapple, elderberry, and sumac, also provide a food source.

Timing of disturbance

To maintain a grass-dominated field for grassland songbirds, burning on a 3-year fire return interval is recommended. A 3-year interval allows a slight accumulation of litter, which is desirable for grassland birds. Disking encourages too many forbs and mowing allows woody species to become problematic. To control undesirable woody species, growing-season fire should be used as needed, according to plant response. Two late dormant-season fires followed by a growing-season fire, each 3 years apart, should perpetuate a grass-dominated field and control undesirable woody growth. Undesirable forbs can be controlled with a forb-selective herbicide. Triclopyr also can be used to control undesirable woody growth and problem forb plants.

To maintain a mixture of grasses and forbs with scattered shrub cover, burning on a 2- to 4-year fire return interval is recommended. Additional forb cover can be stimulated by disking if needed.

Maintaining a mixture of grass and forb cover with considerable shrub cover requires burning every 3 to 5 years. This interval also allows maximum soft mast production. Spot spraying and/or growing-season fire will reduce problematic species and woody cover.

Pattern of disturbance and arrangement of habitat

A common mistake of many landowners is to disturb all available habitat in 1 year. It is critical to disturb only a portion of available habitat each year and leave other portions for various cover requirements. This is especially true when a landowner is managing a single field.

Disturbance patterns

When only a single field is being managed, the field should be divided into sections. Ideally, the number of sections should be divisible by the intended fire return interval or strip-disking interval. For example, if a 4-year fire return interval is intended, a 12-acre field could be separated into four 3-acre sections (fig. 17). If the field is managed by disking, strips not less than 50 feet wide should be disked and alternated so that each strip is disked every 2 to 4 years.

Figure 17. This field is being managed with prescribed fire on a 2- to 4-year fire return interval. Various sections are burned at different times to provide a mosaic of composition and structure across the field, thus benefiting many wildlife species dependent upon various stages of early successional habitat. (Photo credit Craig Harper)

A 2-year disking interval would alternate between two adjacent strips. A 4-year disking interval would alternate between four adjacent strips. Each strip could represent a quarter of the field (this may actually be blocks rather than strips), or a number of four-strip sections could be established across the field.

For more information on rotational disking, see Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old Fields: Wildlife Benefits and Erosion Potential, NRCS Technical Note No. 190–32 (ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/pdf/tn_b_32_a.pdf).

Is it best to disk a rectangular field lengthwise or widthwise? Research has not compared these techniques with regard to movements and survival of wildlife, but disking widthwise would increase interspersion across the field and may be beneficial for some species such as northern bobwhite.

When managing several fields in proximity, disturbing entire fields may be an option. However, depending upon the focal species for management, larger fields still should be separated into sections for management. Management blocks for grassland songbirds may be as large as 50 to 100 acres, whereas management blocks for quail, rabbits, and deer may be 5 to 10 acres or smaller.

Habitat arrangement

Grassland songbirds are able to find all of their habitat requirements in a relatively homogenous grassland complex. However, other species require more habitat diversity and depend on multiple cover types within a relatively small area. Interspersion of different plant communities that meet different habitat requirements may reduce unnecessary movements and home range size, thereby increasing annual survival. Northern bobwhite, for example, may use different cover types for nesting, raising broods, loafing, and escaping predators. Native grasses may be used for nesting, patches of annual forbs may be used for brood-rearing, a sumac motte may be used for loafing, and a blackberry thicket may be used for escaping predators and harsh winter weather. All of these cover types may be well interspersed within a field. Or, these cover types may be available separately, but in close proximity, as small fields, hedgerows, field borders, etc. The best case scenario is for them to be well interspersed within a given field, but populations will respond well if all necessary cover types are at least present and relatively close together.

Regardless, habitat arrangement on one property may be a moot point if that property is surrounded by nonhabitat. Grassland songbirds may not be found in a field with the perfect composition and structure if there are few other suitable grassland fields in the surrounding landscape. Likewise, bobwhite populations may become stagnant and decline on a property with ideal cover types and arrangement if the surrounding properties cannot support quail. It is critical that landowners think beyond their property boundaries and partner with the neighbors to conserve, sustain, and increase populations of early successional wildlife.

Conclusions

Early successional habitats are dynamic. Landowners cannot simply create or establish early successional wildlife habitat and expect it to stay that way. With just a little time, early successional plant communities become late successional plant communities. With that change in plant species composition and structure comes a change in the associated wildlife species. Maintaining early succession requires recurring management. Managing early successional plant communities requires effort and persistence. Knowledge of the various effects of various management practices, including their timing and application, is important to create desirable habitat conditions for wildlife. Landowners should realize all of these factors when identifying goals and objectives.

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University of Tennessee
Early Successional Habitat Field Day
June 22, 2006

Dr. Craig Harper (associate professor and extension wildlife specialist) and John Gruchy (graduate research assistant) of the University of Tennessee (UT) hosted a USDA NRCS Bobwhite Restoration Project Field Day on June 22, 2006, in McMinn County, Tennessee, at one of seven study sites used in their research evaluating early successional habitat management for wildlife. The Early Successional Habitat Field Day featured morning and afternoon tours, technical sessions, and vendor booths. More than 150 natural resources professionals and private landowners were in attendance (fig. 1). Topics included bobwhite biology, prescribed fire as a tool for managing grasslands and old fields (fig. 2), native warm-season grass (NWSG) establishment and management (figs. 3 and 4), and release of native plant communities from existing seed banks. Vendor booths from Roundstone Native Seed, Turner Seed, BASF, Tekota Land Clearing and Vermeer Equipment Co. (Gyro Tracs), Quail Unlimited, Tennessee Wildlife Resources Agency, and the NRCS showcased the latest technologies and information for managing quail habitat. The Field Day was attended by 40 private landowners from Tennessee, Kentucky, Georgia, South Carolina, Arkansas, and Mississippi. Also attending were 24 NRCS personnel and 92 resource professionals from 14 agencies and institutions.

Figure 1. More than 150 natural resource professionals and private landowners attended the Early Successional Habitat Field Day hosted by UT.

Attendance	
Private landowners	**40**
NRCS personnel	**24**
North Carolina Division of Wildlife Management	**16**
Kentucky Dept. of Fish and Wildlife Resources	**13**
Tennessee Division of Forestry	**13**
Georgia Division of Natural Resources	**8**
Tennessee Valley Authority	**8**
National Parks Service	**7**
USDA Forest Service	**6**
University of Tennessee / Extension	**6**
Tennessee Wildlife Resources Agency	**4**
Private consultants	**3**
Georgia Forestry Commission	**2**
Oak Ridge National Laboratory	**2**
Fort Loudon Electric Cooperative	**2**
Mississippi State University	**2**
Total	**156**

Evaluation

Overall value

Survey participants were asked if they learned new information by attending the Field Day, if they would like to attend more UT/NRCS Field Days like this one and rank the overall value of this Field Day on a scale of 1 (lowest) to 5 (highest).

	Learned new information	**Attend more UT/ NRCS Field Days**	**Overall Value**				
			1	**2**	**3**	**4**	**5**
Landowners	100	100	0	0	9	18	73
NRCS personnel	96	100	0	0	5	27	68
Resource management professionals	97	100	0	0	0	48	52
Mean	98	100	0	0	5	31	64

Figure 2. Dr. Craig Harper describes the benefits of prescribed fire in creating quality early successional habitat.

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Scope of impact

Survey participants were asked how many acres they owned/managed and on how many acres they planned on implementing management practices discussed in the Field Day. Mean results are presented along with an extrapolated estimate of the total amount of acreage potentially impacted by the Field Day obtained by multiplying the mean acres impacted by the total number of participants from each demographic (n).

	Mean acres managed	**Mean acres impacted**	**Mean % impacted**	**n**	**Total acres impacted**
Landowners	700	170	25	40	6,800
NRCS personnel	5,000	220	5	24	5,280
Resource management professionals	28,000	520	2	90	46,800
					58,880 acres

Figure 3. John Gruchy describes techniques used to establish and manage NWSG to provide optimum bobwhite habitat.

Future information

Survey participants were asked by which means they would like to receive information about future UT/NRCS project results. Mean responses are presented. More than half of the participants reported they would like to receive information about future projects through additional workshops, newsletters, e-mail, and fact sheets.

Figure 4. Mike Hansborough (NRCS–TN) discusses the "5-Star Hotel" philosophy of bobwhite management.

	Work-shop	**News-letter**	**E-mail**	**CD ROM**	**Fact sheet**	**Other**	**None**
Landowners	73	55	91	64	73	0	0
NRCS personnel	55	45	36	0	55	5	0
Resource management professionals	48	65	77	26	65	10	6
Mean	59	55	68	30	64	5	3

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

August 2009

Responses of Bobwhite, Vegetation, and Invertebrates to Three Methods of Renovating Monotypic Conservation Reserve Program Grasslands in South-central Illinois

GRASSLAND MANAGEMENT

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Responses of Bobwhite, Vegetation, and Invertebrates to Three Methods of Renovating Monotypic Conservation Reserve Program Grasslands in South-central Illinois

The U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) has greatly influenced grassland wildlife conservation in the United States. However, an early assessment of CRP in Illinois failed to distinguish a link between northern bobwhite abundance and the amount of CRP grasslands acreage. In Illinois, more than 93 percent of the original CRP plantings were seeded to exotic cool-season grasses, primarily tall fescue. Moreover, low bobwhite abundance and poor brood-rearing conditions have been linked to a high percentage of fields planted to fescue. It appears that whereas the decline in bobwhite numbers is not correlated with the amount of CRP, it may be related to the quality of these grass stands within the agricultural landscape. Provisions of the 2002 Farm Bill promoted implementation of active management of grasslands enrolled in CRP using a suite of conservations practices designed to create and maintain early successional habitat. Researchers evaluated the effectiveness of three commonly used conservation practices to increase bird use, improve habitat conditions for bobwhites, increase arthropod availability, and increase foraging efficiency of imprinted bobwhite chicks. Thirty fields were treated with strip disking (n = 10) strip herbicide (glyphosate) application (n = 10), or strip herbicide (glyphosate) application and interseeding (n=10). Strip disking and herbicide application were conducted in October 2005 to 2006. Herbicide application included 1.4 quarts of glyphosate and 1.2 kilograms of ammonium sulfate per 56 liters of water. Selected herbicide seeded strips were drill planted with 87 percent Korean lespedeza and 13 percent partridge pea in April 2006 to 2007. Herbicide treatments effectively decreased grass cover, whereas disking was ineffective at decreasing grass cover and increasing bare ground for more than one growing season. Despite the rapid succession in these grassland communities, avian relative abundance and species richness responded positively to all three treatment types during the first 2 years of the study. Bobwhite abundance was nearly six times greater in sprayed and spray/seeded fields than disked and untreated fields in 2006 and 2007. The study suggests an increased use of managed CRP fields by bobwhites and other grassland songbirds during the breeding season. Researchers suspect that the foraging efficiency of bobwhite broods will increase as chicks can more effectively maneuver through the vegetation in search of prey. CRP Management has the potential to create desirable habitat conditions for avian grassland wildlife; however, the effectiveness of CRP Management to enhance grassland conditions depends on a multitude of factors including landowner cooperation.

TECHNICAL NOTE

Responses of Bobwhite, Vegetation, and Invertebrates to Three Methods of Renovating Monotypic Conservation Program Reserve Grasslands in South-central Illinois

GRASSLAND MANAGEMENT

The wildlife value of many grasslands enrolled in the U. S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) is diminished by advanced plant succession and the prevalence of tall fescue (*Schedonorus phoenix*). Agricultural producers can enhance wildlife habitat conditions in CRP fields by implementing recurring management practices during the life of the 10-year contract. Under CRP midcontract management, supplemental cost-share assistance is available to implement cover disturbance practices such as disking (Early Successional Habitat Development/Management, CPS Code 647), herbicide application (Pest Management, CPS Code 595), interseeding (Conservation Cover, CPS Code 327), or prescribed burning (CPS Code 338). Midcontract management provides environmental benefits (e.g., alters energy, nutrient, and moisture relationships in the soil through the removal of detritus), while improving habitat conditions for multiple grassland birds, such as northern bobwhite (*Colinus virginianus*). Conservation practices can be implemented in a manner that simultaneously enhances habitat quality while retaining the erosion controlling objectives of the CRP (Greenfield et al. 2002). By applying midcontract management practices, producers can improve nesting and foraging conditions for ground nesting and foraging birds such as the northern bobwhite (fig. 1).

In 2003, the USDA recognized the importance of active management of CRP lands and required all CRP enrollments after the 26th signup (May/June 2003) to implement an approved conservation cover disturbance regime at least once during the life of the contract (fig. 2). Furthermore, midcontract management practices are optional for CRP grassland contracts enrolled prior to the 26th signup.

Figure 1. Northern bobwhite chicks leave their nest site within hours of hatching in search of food, primarily insects.

Figure 2. Field voluntarily enrolled in and treated with CRP Management in the fall of 2005.

Management activities are to be applied outside of the primary breeding season and to only a third of a field per year for 3 consecutive years between years 4 and 7 of the 10-year contract.

Each State developed a list of approved management activities that were specific to various conservation practices. Midcontract management activities were to be included in the CRP Conservation Plan of Operation and conducted in accordance with appropriate Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPS). A variety of management practices might, to varying degrees, enhance CRP for grassland birds. The objectives were to evaluate the effectiveness of three conservation practices in enhancing wildlife habitat quality for grassland birds during the primary breeding season (May–August) in tall fescue-dominated CRP fields.

Study Design

This research encompasses 1,580 acres of tall fescue-dominated CRP grasslands located in Wayne County, Illinois (38°22′N, 88°21′W), and adjoining counties. Landowners and producers voluntarily enrolled 30 CRP fields, encompassing 940 acres of grasslands (contracts enrolled prior to the 26th signup), into CRP midcontract management for the efforts of this study. The remaining 640 acres (30 fields) of CRP enrollments included in this research are untreated control fields that serve solely for comparison purposes. Conservation practices evaluated in this research included strip disking, herbicide (glyphosate) application, and herbicide (glyphosate) application with legume interseeding. Management and maintenance of the 60 experimental CRP fields were conducted by Quail Unlimited and two local agricultural service agencies. Producers were prohibited from manipulating the experimental treatment plots by means of mowing or any other farming practice throughout the duration of this study. Experimental conservation management practices were applied to fields in accordance with NRCS CPS Early Succession Habitat Development and Management Practice Standards (CPS Code 647).

According to CRP midcontract management guidelines, management activities are to be applied outside of the primary breeding season and to only a third of a field per year for 3 consecutive years. Therefore, each field was assigned a single treatment type that was applied in a series of alternating strips. Strip disking was applied during October to November, and multiple passes were performed until approximately 50 percent residue remained. Herbicide was applied in October at a rate of 1.4 quarts of glyphosate and 1.7 pounds of ammonium sulfate per 100 gallons of water per acre. Annually, 58 percent (133 of 230 acres) of the herbicide-treated fields were drilled with a legume seed mixture consisting of 87.5 percent Korean lespedeza and 12.5 percent partridge pea, at a total rate of 3 pounds per acre during the following April. The interseeding of legumes is intended to provide additional seeds for ground foraging species during the winter months when conditions are harsh and food is often scarce.

Vegetation Response to CRP Management

During this study, plant communities in managed CRP fields in Illinois were more diverse than unmanaged fields. During the first 2 years of this research, 127 taxa of plants were detected in experimental CRP fields. This increase in plant species richness is likely attributable to reduction in tall fescue coverage and subsequent release from the seed bank of previously suppressed species. Tall fescue cover was reduced in glyphosate-treated (70%) and glyphosate-treated/interseeded (90%) fields during 1 and 2 years post-treatment. However, disking was relatively ineffective at decreasing tall fescue coverage after one growing season (figs. 3 and 4).

In the study, conservation practices tended to increase percentage bare ground and decrease percentage litter cover (fig. 4). However, herbicide spraying alone increased litter cover as dead vegetation laid on the ground, thus creating more detritus and litter buildup. Prevalence of bare ground and the lack of litter are important components of bobwhite brood-rearing cover as precocial chicks leave the nest within hours of hatching in search of food (primarily insects and weed seeds). Therefore, management effects that result in increased plant species richness, reduced litter, and increased bare ground will be more effective in creating quality brood habitat conditions for ground nesting and foraging birds such as the northern bobwhite.


Figure 3. Disked strips applied to tall fescue field in October of 2005 and 2006; photo taken in late summer 2006. Arrows from left to right represent experimental management strips that have not yet been treated, treated in fall 2005, and treated in fall 2006, respectively.

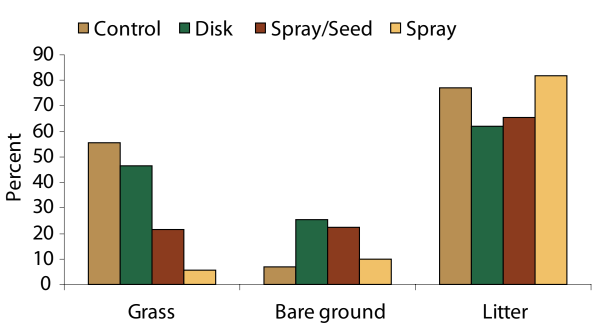

Figure 4. Vegetation structure characteristics by treatment type 1 year post-treatment in 2006.

Breeding Bird Response to CRP Management

Researchers used systematic, time-constrained area searches to estimate grassland bird abundance and diversity in CRP fields during the 2006 and 2007 breeding seasons. Each survey consisted of a 30-minute bird count, in which two observers moved collectively through the field, stopping and moving to investigate sightings and calls. They were interested in the effect of different CRP management practices on grassland bird use during the primary breeding season (May–August).

Grassland songbird response

Researchers recorded 46 grassland bird species in managed and unmanaged fields during the 2006 and 2007 breeding seasons. Of 4,695 individual birds, the seven most abundant species were red-winged blackbird (20%), dickcissel (17%), field sparrow (13%), indigo bunting (9%), eastern meadowlark (7%), American goldfinch (7%), northern bobwhite (6%), and common yellowthroat (5%).

The number of birds detected per acre was greater in managed than in unmanaged fields (fig. 5). During the study, the abundance of birds per acre increased as the percent of the field that had been managed increased. In particular, dickcissel abundance increased 39 percent overall in man-

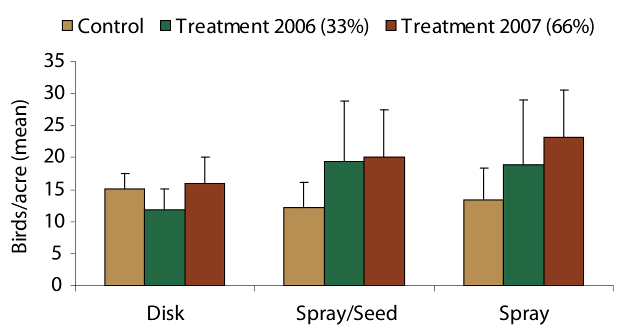

Figure 5. Avian relative abundance by treatment type and the percent of each field managed. Treatment 2006 and 2007 represents bird survey data from fields that had 33 percent and 66 percent of each field treated at the time of the survey, respectively.

aged fields relative to unmanaged fields during the first 2 years of this study. However, dickcissel abundance decreased in disked fields relative to the unmanaged fields by 7 percent, while increasing in herbicide and herbicide/interseeded fields by 19 percent and 24 percent, respectively. According to the Breeding Bird Survey, Illinois, dickcissel populations have declined 2 to 3 percent per year for the past 40 years and are currently listed as Species of Conservation Concern by a multitude of organizations. The researchers believe that many species of grassland songbirds, including the dickcissel, will directly benefit from enhancing and maintaining CRP grasslands that are otherwise unsuitable for nesting birds.

Overall, bird species richness was greater in managed fields than in unmanaged fields, regardless of treatment type (fig. 6). Moreover, the number of bird species per acre increased in managed fields as the percent of each field treated increased. The study suggests that the conservation practices implemented under midcontract management provided a more diverse plant structure and ultimately led to a greater total number of individual birds and species that utilized CRP fields throughout they study site.

Northern bobwhite response to CRP management
Researchers recorded 161 and 107 northern bobwhite in bird surveys during the 2006 and 2007 breeding seasons, respectively. The mean number of bobwhites detected was greater in managed fields than in unmanaged fields (fig. 7). Moreover, the mean abundance was greatest in herbicide-sprayed fields during the first 2 years of the study. The study suggests that fields managed with the herbicide and herbicide with legume interseeding management options are being used by bobwhites during the breeding season.

Over the 2-year study, researchers observed 18 bobwhite broods in study fields; 1, 7, and 10 broods in disked, glyphosate treated/seeded and glyphosate treated fields, respectively (fig. 8). Of the 18 broods detected during surveys, none was observed in unmanaged fields. The number of bobwhite broods detected during the 2006 and 2007 breeding seasons was greater in CRP fields managed with herbicide or herbicide/interseeding than in disked

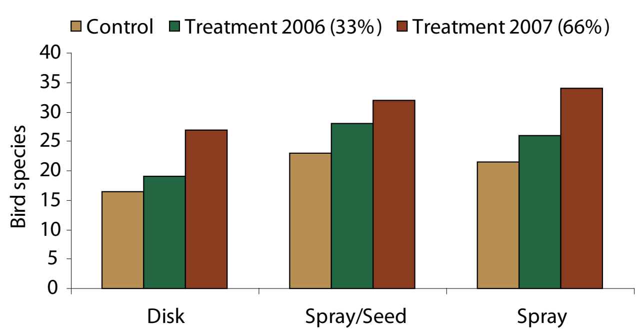

Figure 6. Avian species richness by treatment type and percent of the field managed.

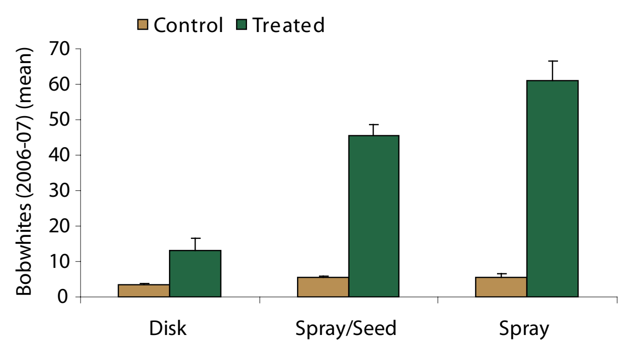

Figure 7. Bobwhite abundance (mean number of birds detected per survey yr) by treatment type.

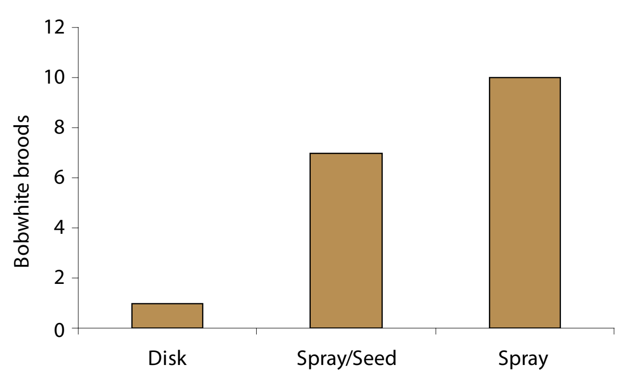

Figure 8. Number of bobwhite broods detected in managed fields during the 2006 and 2007 breeding seasons (years and sites pooled). No broods were found in unmanaged fields.

fields. Although disking provided altered management strips in CRP fields during the early growing season, tall fescue cover persisted in these strips while annual weed seeds from the soil bank were not stimulated to germinate. Therefore, researchers speculate that herbicide and herbicide with legume interseeding are the most effective CRP management practices of the three that were evaluated in increasing bobwhite use of tall fescue-dominated CRP fields during the breeding season.

Bobwhite nests are generally located within 50 to 65 feet of early successional areas that provide a variety of perennial grasses, annual weeds, and bare ground. Nests are almost always located in areas with overhead cover from standing vegetation of less than 18 inches tall that provide protection from extreme weather conditions and overhead predators. CRP fields actively managed with effective conservation practices can provide beneficial nesting and brooding areas for bobwhites.

Summary

The technological advances and economic pressures that led to intensive monocultural row crop farming have had detrimental effects on native grassland bird populations over the past 3 decades. Overall, the CRP has greatly influenced grassland wildlife conservation and is currently the primary source of grassland bird habitat across Illinois. Unfortunately, not all grasslands provide quality habitat, and good habitat can quickly become unsuitable for nesting birds. Active management of CRP grasslands may be the link between unsuitable and quality nesting and foraging habitat for many species. The availability of actively managed CRP fields may increase bird abundance by enhancing nesting conditions during the breeding season.

Although this research effort was limited to Wayne County, Illinois, researchers suspect that the implications of CRP management to tall fescue-dominated CRP fields could perform similarly in other areas. The data suggest an increase in bird use of managed CRP fields dominated by cool-season forage grasses. Increased use of managed fields by various species of conservation concern, including dickcissel and bobwhite, were detected. Dickcissels, along with other songbird species, benefited as CRP management reduced tall fescue cover and taller vegetation created nesting structures more suitable for producing young.

Researchers suspect that the availability of bobwhite nesting sites will increase by implementing CRP management regimes of alternating strips as the amount of edge habitat adjacent to early successional habitats increases. The vegetative structure in managed CRP fields provide good foraging conditions for broods in search of arthropod prey. Insects in managed strips may be more accessible to chicks as they can maneuver through the vegetation more effectively. Bobwhite broods were observed using managed fields during the breeding season and it is believed that they will continue to forage in these fields through the winter months due to a greater density of seed producing plants.

The effectiveness of CRP management (fig. 9) to enhance grassland habitats for birds during the

Figure 9. CRP management, Wayne County, IL.

primary breeding season is dependent on the acceptance and cooperation of local producers and landowners. With proper management, producers will continue to see the environmental benefits of CRP and an increase in bird use of these fields throughout the duration of the contract. Moreover, researchers expect CRP management to become more popular with producers and landowners as the additional land management practices continue to create quality wildlife habitat.

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Southern Illinois University
Cooperative Wildlife Research Laboratory
Illinois Landowners' Quail Management Workshop
September 16, 2006

Dr. Donald Sparling (associate professor) and Douglas Osborne (graduate research assistant) of the Southern Illinois University (SIU), Cooperative Wildlife Research Laboratory hosted the first of two USDA NRCS Bobwhite Restoration Project field days on September 16, 2006, in Wayne County, Illinois. The Illinois Landowners' Quail Management Workshop was held at two farms used in research evaluating bobwhite, songbird, and vegetation response to CRP management and included four morning presentations and a field tour of five management sites included in the research study. Topics included bobwhite habitat requirements, Farm Bill programs, Acres for Wildlife, Quail Unlimited habitat projects, CRP management, native grasses/forbs, food plots, fence row management, cool-season grasses/legumes, and prescribed fire. The Field Day was attended by 90 landowners and 15 natural resource professionals (fig. 1). State and Federal natural resource professionals included attendees from the Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), Illinois Department of Natural Resources (IL–DNR), and university faculty and students.

Figure 1. John Cole (IL–DNR) and Doug Osborne explain the importance of management of early successional habitat for bobwhite and grassland wildlife and provide preliminary results from the research on CRP management.

Southern Illinois University
Cooperative Wildlife Research Laboratory
Resource Professional CRP Management Workshop
April 12, 2007

Dr. Donald Sparling (associate director of the Cooperative Wildlife Research Laboratory (CWRL) and Douglas Osborne (graduate research assistant) of the Southern Illinois University (SIU), CWRL hosted the second of two USDA NRCS Bobwhite Restoration Project field days on April 12, 2007, in Wayne County, Illinois. The Resource Professional CRP Management Workshop was attended by 26 natural resource professionals from IL–DNR, NRCS, FSA, Quail Unlimited, and university faculty and students. The event featured a morning presentation from Doug Osborne introducing SIU's involvement in the USDA NRCS Bobwhite Restoration Project (fig. 1). Topics included an introduction to the grant and project objectives, Illinois CRP management options, methods of research, and preliminary results from the 2006 field season (fig. 2). The field tour included visits to four fescue-dominated CRP fields that have been enrolled in CRP for more than 8 years and are now having a variety of midcontract management practices being applied as part of this research project.

Attendance	
Illinois Department of Natural Resources	**9**
Natural Resource Conservation Service	**6**
Farm Service Agency	**4**
Southern Illinois University	**3**
Quail Unlimited	**2**
WEW Quail Unlimited Chapter	**2**
Total	**25**

Evaluation

The following list was generated from attendee comments of addition topics that they would have liked to have seen covered:

- Alternative herbicide combinations and tillage implements for strip disking
- Spraying/tilling in different seasons
- Other seeding options for quail cover and food
- Seeding with forbs
- Quail response 5 years later
- Food plots

Figure 1. Doug Osborne describes one CRP management technique involving herbicidal eradication of fescue and legume interseeding to increase arthropod abundance and provide a winter food source for bobwhites.

Figure 2. From left to right, Dr. Don Sparling, John Cole (IL–DNR), and Don King (IL– FSA) discuss the lack of visual results from strip disking practices in established fescue sod.

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Response of Bobwhite Populations and the Associated Avian Community to Landscape-level Management in Arkansas

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Photos were provided by Richard J. Baxter, Department of Biological Sciences, Arkansas State University; Kevin C. Labrum, Department of Biological Sciences, Arkansas Tech University; and Ron Howard, Jonesboro, AR.

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Fisheries and Wildlife

ARKANSAS STATE UNIVERSITY

MISSISSIPPI STATE UNIVERSITY

Response of Bobwhite Populations and the Associated Avian Communities to Landscape-level Management in Arkansas

Population decline of northern bobwhite (*Colinus virginianus*) throughout the species' range has resulted in the development of the Northern Bobwhite Conservation Initiative (NCBI). Based on this initiative and concern within the State, the Arkansas Game and Fish Commission has established two focal areas, one each in Fulton and Searcy Counties, with the primary objective of managing bobwhite populations on private lands. These focal areas are also used in research examining the effectiveness of management practices on restoration of bobwhite populations in Arkansas. The objective was to monitor the response of bobwhite and the associated avian community to the application of different management practices in these focal areas. To examine the response of the avian community to bobwhite management practices, researchers conducted point counts in 2005 to 2007 at 68 points in Fulton County and 60 points in Searcy County. Half of the points in each focal area were located on private lands subject to management, and half were in reference areas. They also established two Breeding Bird Survey (BBS) routes in both counties: one within each focal area and another nearby in similar habitat. The BBS data allowed us to examine landscape-level responses by the avian community to management. Bobwhites radio-tagged to determine habitat use in the managed area of Fulton County. Data were analyzed to assess the effectiveness of various management practices. Researchers found significantly higher densities of all songbirds in managed areas (0.96 birds/acre) than reference areas (0.59 birds/acre) in Fulton County during 2005. Birds classified as early successional species exhibited a similar response in 2005, with significantly higher densities in managed areas (0.18 birds/acre) than reference areas (0.06 birds/acre). In 2006, managed areas again supported significantly higher total bird densities (4.09 birds/acre) than reference areas (2.95 birds/acre). Early successional species were also more abundant in managed areas (0.42 birds/acre) than in reference areas (0.18 birds/acre) in Fulton County in 2006, although this last trend was not significant. In Searcy County, densities of all birds (1.78 birds/acre) and early successional birds (0.41 birds/acre) were slightly higher in managed areas than in reference areas (1.51 birds/acre, 0.38 birds/acre, respectively) in 2005. The patterns were similar in 2006 with slightly more total birds (1.97 birds/acre) and early successional birds (0.35 birds/acre) detected in managed areas than in reference areas (1.89 birds/acre, 0.32 birds/acre, respectively). None of the trends in bird density between managed and reference areas were statistically different in Searcy County. Species diversity was greater on the Fulton and Searcy County focal area BBS routes (89 and 77 species, respectively) than the reference routes (82 and 75 species, respectively). Bobwhites were also detected more frequently on the managed area routes compared to the reference area routes each year. Prescribed burning and strip disking were the most beneficial practices for quail and songbirds. There was also a noticeable positive response by some songbirds, especially prairie warbler (*Dendroica discolor*) and yellow-breasted chat (*Icteria virens*), to thinning and burning of woodlands. In this study, researchers demonstrate farm and landscape-level response by bobwhite and an assemblage of early successional songbirds to targeted delivery of a suite of conservation practices across county-level focal areas in northern Arkansas. The response by bobwhite and other birds was more pronounced in Fulton County than Searcy County, and this may be due to the fact that a greater proportion of the Fulton County focal area has been managed (>20%) compared to the Searcy County focal area (<10%). Clearly, the suite of conservation practices available under Federal Farm Bill conservation programs have the potential to accomplish broad-scale population recovery of declining wildlife species when deployed in a targeted, concentrated, and strategic fashion.

Response of Bobwhite Populations and the Associated Avian Communities to Landscape-level Management in Arkansas

Rangewide decline in northern bobwhite (*Colinus virginianus*) populations has led to the development of the Northern Bobwhite Conservation Initiative (NBCI) (Dimmick et al. 2002) and the Arkansas Game and Fish Commission's (AGFC) Strategic Quail Management Plan (SQMP). Both plans focus on habitat recovery to restore northern bobwhite populations to historical levels observed during the 1980s. In response to National and State-level restoration initiatives, the Arkansas Quail Committee (AQC) was formed to synthesize and implement a quail recovery plan in Arkansas (fig. 1). The AQC includes representatives from the AGFC, U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (FS), University of Arkansas (ASU) Cooperative Extension Service, Quail Unlimited, Farm Service Agency (FSA), timber companies, private consultants, and academia.

Figure 1. Arkansas Quail Committee logo.

The AQC's initial objective was to develop focal areas in Fulton and Searcy Counties, comprised of privately owned lands that are managed for quail. Approximately 90 percent of Arkansas is privately owned; therefore, quail management efforts in the State are primarily focused on private lands. These focal areas will serve as demonstration sites to promote effective management practices. Research conducted within these sites will help determine which management practices are most effective in restoring quail populations in Arkansas.

The Fulton County quail management focal area is the first site that has been widely managed to improve habitat for northern bobwhite and associated birds in Arkansas. As of this date, approximately 14,000 acres have been managed or are enrolled for future management. Management practices that have been implemented include fencing to keep cattle out of certain areas to provide a buffer of undisturbed habitat (NRCS Conservation Practice Standard (CPS) Code 382); strip disking (fig. 2), Early Successional Habitat Development/Management, CPS Code 647); thinning of woodlands (Forest Stand Improvement, CPS Code 666); Prescribed Burning (CPS Code 338), edge/hedgerow development (CPS Code 647 and Hedgerow Planting, CPS Code 422) (e.g., *Lespedeza* spp. planting); fescue eradication (Pest Management, CPS Code 595), and establishment of native warm-season grasses (Upland Wildlife Habitat Management, CPS Codes 645 and 647) (fig. 3). The objectives were to study the response of bobwhite and other early successional birds at quail management sites and across the entire landscape.

Study Area

The Fulton County focal area was approximately 50,000 acres, but has recently expanded to encompass 164,000 acres. Currently, approximately 14,000 acres are under contract for management related to restoration or improvement of habitat for northern bobwhite. Most of the management has been applied in the original 50,000-acre focal area. The Fulton County focal area is composed of a mix of oak/hickory woodlands and open areas, such as unplanted fields and pastures. About half of the area is used as recreational land, primarily for deer (*Odocoileus virginianus*) and wild turkey (*Meleagris gallopavo*) hunting, whereas the remainder is used for cattle and hay production. The landscape of Fulton County is best described as rocky hills, with a prevalence of thin low-fertility soils. The soil and terrain are not suitable for row-crop farming, which has likely allowed a moderate-sized bobwhite population to persist in this area. In the open areas, oak (*Quercus* spp.), hickory (*Carya* spp.), and common persimmon (*Diospyros virginiana*) are the most common tree species. The most common native grasses are broomsedge bluestem (*Andropogon virginicus*), purpletop tridens (*Tridens flavus*), big bluestem (*Andropogon gerardii*), and little bluestem (*Schizachyrium scoparium*). Common forbs in include common ragweed (*Ambrosia artemisifolia*), Indianhemp (*Apocynum cannabinum*), rice button aster (*Symphyotrichium dumosus*), wooly croton (*Croton capitatus*), ticktrefoil (*Desmodium* spp.), and lespedeza (*Lespedeza* spp.).

Songbird Sampling

Researchers sampled the bird community by establishing breeding season point counts at 68 locations. These point count locations were sampled twice (once in May and once in June) in both 2005 and 2006. Half of the point count locations were in managed treatment sites and half were in unmanaged reference sites. Sampling at each point involved recording all birds observed during a standardized 10-minute period (Hamel et al. 1996). Data were pooled into two categories for analysis: all birds and early successional species, or species that occupy similar open or mixed habitat to bobwhite.

Figure 2. A disked strip in unplanted field. (Photo credit Richard J. Baxter, ASU)

Figure 3. Maturation of native warm-season grass 1.5 years after prescribed burn. (Photo credit Richard J. Baxter, ASU)

Researchers classified borthern bobwhite, blue-winged warbler (*Vermivora pinus*), prairie warbler (*Dendroica discolor*), yellow-breasted chat (*Icteria virens*) (fig. 4), field sparrow (*Spizella pusilla*), dickcissel (*Spiza americana*), indigo bunting (*Passerina cyanea*), and eastern meadowlark (*Sturnella magna*) (fig. 5) as early successional species. Distance-based methods were used to estimate bird density from point counts (Buckland et al. 2001).

Additionally, researchers set up two Breeding Bird Survey (BBS) routes in Fulton County. One BBS route was established in the focal area and another outside the focal area in generally similar habitat. The surveys were conducted during the first week of June in 2005 and 2006. BBS surveys are roadside surveys that involve fifty 3-minute stops every half mile, and all birds detected are recorded. Each of the 50 stops on the routes were a half mile apart to ensure auditory independence.

Point Count Results

Overall bird densities were higher in both managed and reference areas in 2006 than 2005 in Fulton County. The managed areas in Fulton County supported higher densities of birds in 2005 and 2006 than reference areas. In 2005, the density of all birds was 61 percent higher (0.96 birds/acre) at managed points than at reference points (0.59 birds/acre) (fig. 6). In 2006, managed sites had 38 percent higher densities (4.09 birds/acre) than reference areas (2.95 birds/acre). Early successional species were also more abundant in managed areas (0.18 birds/acre in 2005; 1.03 birds/acre in 2006) than in reference areas (0.06 birds/acre in 2005; 0.18 birds/acre in 2006) (fig. 7). Moreover, several species of conservation concern, including blue-winged warbler, prairie warbler, yellow-breasted chat, and bachman's sparrow, were detected in the areas where management was implemented.

Frequency of bobwhite detections were greater in managed areas (50 detections) than in refer-

Figure 4. Yellow-breasted Chat. (Photo credit Ron Howard)

Figure 5. Eastern Meadowlark. (Photo credit Ron Howard)

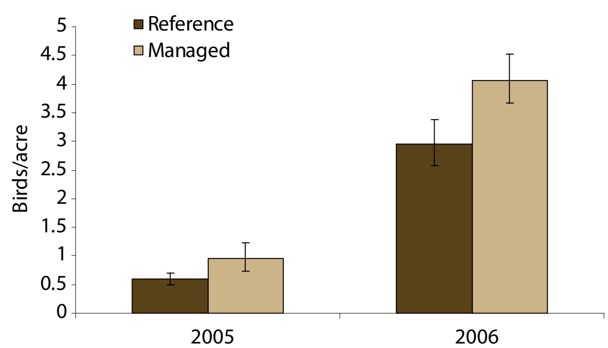

Figure 6. Densities (birds/acre +/- 95% CI) of all birds in managed and reference areas.

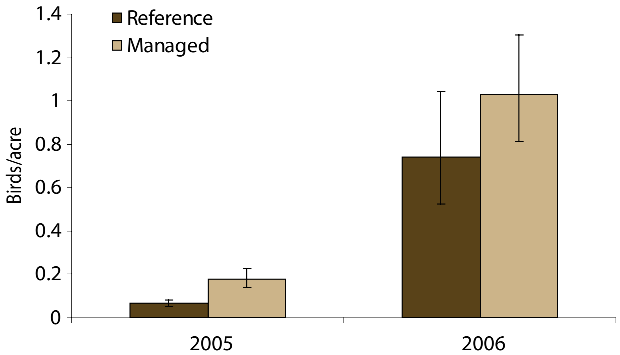

Figure 7. Densities (birds/acre +/- 95% CI) of early successional birds in managed and reference areas.

ence areas (27 detections) in 2005. However, in 2006, bobwhite were detected more frequently in reference areas (40 detections) than in managed areas (31 detections). Yellow-breasted chats were detected more frequently in managed areas (46 detections in 2005; 54 detections in 2006) than in reference areas (14 detections in 2005; 27 detections in 2006). Frequency of eastern meadowlark detections increased in managed areas from 20 in 2005 to 25 in 2006. Field sparrows also exhibited a positive response to management with numbers increasing from 60 detections in 2005 to 98 detections in 2006. Field sparrows showed an opposite pattern in reference areas with 48 detections in 2005 falling to 42 detections in 2006.

Breeding Bird Survey Results

In Fulton County 2005, researchers recorded 758 individual bird detections comprising 65 species on the focal area BBS route. They tallied 656 detections comprising 57 species on the reference BBS route (fig. 8). Sampling in the focal area yielded 35 northern bobwhite detections compared to 13 detections in the reference area (fig. 9). Twenty-nine yellow-breasted chats were detected in the focal area, compared to 9 chats in the reference area. More eastern meadowlarks were detected on the focal area route (46) than on the reference route (17). However, more indigo buntings (69) were detected in the reference area than in the focal area (59).

In 2006, 1,166 individuals of 71 species along the Fulton County focal area BBS route and 1,142 individuals of 72 species on the reference BBS route were detected. Species diversity and abundance was greater in 2006 along both Fulton County routes than in 2005, a pattern consistent with the point count sampling of birds. In 2006, sampling in the focal area yielded 46 northern bobwhite detections compared to 20 detections in the reference area. Also detected were 39 yellow-breasted chats in the focal area, compared to 29 chats in the reference area. In addition, more eastern meadowlarks (47 detections) were detected in the focal area than in the reference area (14).

Summary

Stand, field, and property-level response by bobwhite and songbirds to prescribed fire, disking, herbicide application, and other early successional

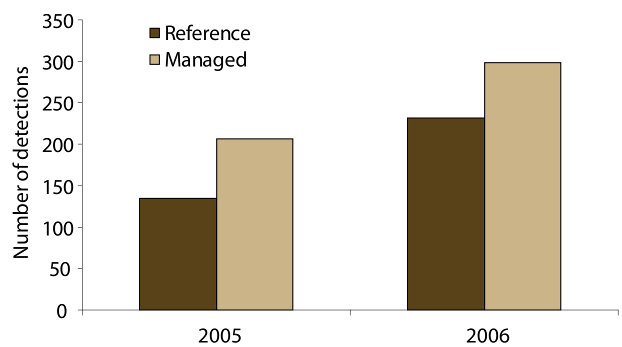

Figure 8. BBS early successional bird results graph.

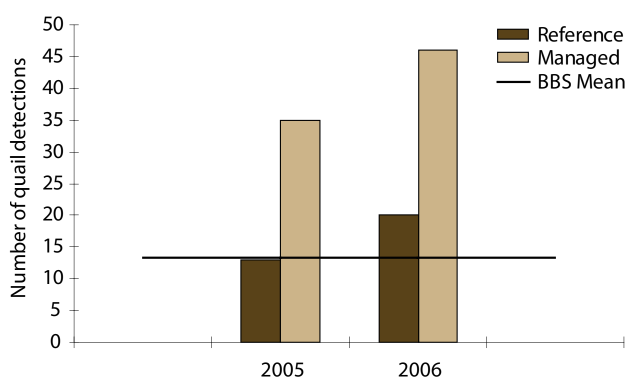

Figure 9. BBS quail detections graph with BBS mean for the previous 15 years for the Ozark-Ouachita Plateau.

management practices has been well documented (Wilson et al. 1995; Artman et al. 2001; Greenfield et al. 2003). However, what is conspicuously lacking in the literature is clear documentation of population-level responses to landscape-level implementation of a suite of conservation practices as advocated under the NBCI, Arkansas SQMP, and other regional conservation initiatives. In this study, researchers demonstrate farm and landscape-level response by bobwhite and an assemblage of early songbirds to targeted delivery of a suite of conservation practices across the Fulton County focal area in northern Arkansas. Clearly, the suite of conservation practices available under Federal Farm Bill conservation programs have the potential to accomplish broad-scale population recovery of declining wildlife species when deployed in a targeted, concentrated, and strategic fashion.

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Bobwhite Production and Brood Ecology in Response to Habitat Restoration in Arkansas

To assess the effects of habitat restoration on habitat use, growth rates, and survival of northern bobwhite broods, researchers compared bobwhite response on two habitat restoration areas to adjacent unrestored tall fescue fields from the spring of 2005 to the summer of 2007. Management activities for restoration areas included burning, disking, eradication of fescue with chemical herbicides, planting native warm-season grasses, fencing borders of pastures, and land clearing. Researchers captured 90 bobwhites and fitted them with radio transmitters, which were used to locate nests and follow broods. Broods were captured within a couple of days of hatching, and all chicks within a brood were weighed and individually marked upon capture. Broods were captured again after 7 to 12 days and reweighed. Missing chicks were assumed to have died. Broods were intensively monitored to assess habitat use and movement patterns. Bobwhite brood-rearing habitat was characterized, and comparisons were made among brood-rearing and nesting habitat and random locations. Moderately grazed fescue pastures were the most frequently used habitat for nesting. Nesting habitat in fescue fields consisted of dense stands of tall fescue with moderate litter accumulation, little bare ground, and few forbs. In contrast, brood-rearing habitat contained more forbs, shorter sparse grass, and more open ground. The researchers found that the habitats used by broods did not differ between restored areas and nonrestored areas. However, brood-rearing habitat did differ in comparison to most randomly located habitat samples. The best conservation practices included those that created some bare ground, promoted development of forbs and also supported a variety of grass species. For example a combination of disking, burning, fescue eradication and planting of native grasses produced a habitat structure that was similar to habitats used by bobwhite broods. Bobwhite chicks that used restored habitat in Fulton County survived better in restored areas than chicks that used unrestored areas in both Searcy and Fulton Counties. However, chicks grew substantially faster in nonrestored areas. Arthropod biomass was greater in unrestored than restored areas, which probably accounts for the difference in mass gain in unrestored areas. Bobwhite chicks moved more slowly in unrestored areas which may indicate better habitat for foraging. During the first 2 years after establishment, conservation practices in Searcy County did not yet produce nesting habitat for breeding bobwhite; however, they did use these areas during winter. Radio-marked birds in Searcy County tended to leave managed areas at the beginning of the breeding season and seldom returned. However, the analyses indicate that the habitat is improving and will eventually develop into suitable habitat for breeding quail.

Bobwhite Production and Brood Ecology in Response to Habitat Restoration in Arkansas

Population declines throughout the range of the northern bobwhite (*Colinus virginianus*) have prompted the development of bobwhite recovery plans such as the Northern Bobwhite Conservation Initiative (NBCI) (Dimmick et al. 2002) and the Arkansas Game and Fish Commission's (AGFC) Strategic Quail Management Plan (SQMP). Both plans focus on habitat recovery to restore northern bobwhite populations to historical levels. The SQMP was centered on development of privately owned focal areas (>19,000 acres) throughout Arkansas to serve as demonstration areas and to determine which conservation practices are most effective. Privately owned land is the target for habitat restoration efforts because private landowners control 90 percent of the land base in Arkansas. Under the SQMP, two focal areas were established in Fulton and Searcy Counties, Arkansas.

Types of Restoration

The focus of the SQMP is broad implementation of conservation practices designed to establish/enhance northern bobwhite nesting and brood-rearing habitat (fig. 1). Restoration practices promoted within the focal areas included: fencing (for cattle exclusion), strip disking, prescribed burning, timber thinning, combinations of thinning and burning, edge/hedgerow development such as planting *Lespedeza* spp., and establishment of native warm-season grasses in conjunction with removal of tall fescue (*Schedonorus phoenix*). Conservation practices were prescribed in accordance with the following U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPS): Early Successional Habitat Development/Management (CPS Code 647), Fence (CPS Code 382), Upland Wildlife Habitat Management (CPS Code 645), Prescribed Burning (CPS Code 338), Forest Stand Improvement (CPS Code 666), Firebreak (CPS Code 394), and Hedgerow Planting (CPS Code 422). Conservation practices were implemented from 2004 to 2006. The primary funding mechanism for habitat management efforts in these focal areas has been the NRCS Wildlife Habitat Incentives Program (WHIP).

Figure 1. Bobwhite chick. (Photo credit Kevin Labrum, Arkansas Tech University)

Study Specifics

The landscape in Searcy County includes rolling hills covered by fields of tall fescue, bermudagrass (*Cynodon dactylon*), and orchardgrass (*Dactylis glomerata*) interspersed with small woodlots. Cattle and hay crop production are the primary land uses in Searcy County. The landscape in Fulton County consists of rolling hills with rocky shallow soils covered by a mix of shrubs, forbs, and grasses intermittently used for cattle production. Whereas most landowners in Searcy County make their living by farming, most landowners in Fulton County use their land to supplement their income or for recreational purposes. Approximately 1.4 percent and 4.7 percent of the land area in Searcy and Fulton Counties, respectively, is enrolled in WHIP contracts to improve bobwhite habitat.

From 2005 to 2007, researchers evaluated nesting success and productivity of bobwhites, along with survival, growth, habitat use and movements of bobwhite chicks in relation to habitat restoration efforts in Arkansas. WAdult bobwhites were equipped with radio transmitters and used the transmitters to locate nests and broods. To evaluate survival and growth rates of chicks, researcher captured, marked, and weighed entire bobwhite broods twice within 13 days of hatching; once between hatch and 4 days and a second time between 7 and 13 days (fig. 2). The researchers then compared survival and daily growth rate of chicks between restoration and nonrestoration areas. In addition, they intensively tracked foraging bobwhite broods and measured vegetation characteristics in the foraging habitat that they used. Adults and broods in restoration areas and adjacent (<1 mile away) nonrestoration areas in Searcy and Fulton counties were monitored from winter 2005 through summer 2007, concentrating on the spring and summer months (May–August). Researchers evaluated the effect of restoration in terms of production of habitat suitable for brood rearing and nesting bobwhite. The conclusions were based on comparisons of habitat structure between known brood rearing/nesting sites and restoration areas.

Habitats Used for Nesting and Brood Rearing

In contrast to expectation, bobwhites in Searcy County nested in tall fescue fields more often than other available habitats. In fact, 17 of 18 nests were located in moderately grazed, tall fescue-dominated pastures and were constructed from tall fescue litter (fig. 3). Whereas tall fescue fields had denser vegetation and more litter to build nests, managed areas

Figure 2. Fence placed around a bobwhite brood before capture. (Photo credit Kevin Labrum, Arkansas Tech University)

Figure 3. Bobwhite nest with grass canopy. (Photo credit Kevin Labrum, Arkansas Tech University)

generally lacked adequate grass cover and litter. During this study, recently established native grass plantings were not used by nesting bobwhites, most likely because they did not provide the combination of perennial grass cover with adequate litter cover (fig. 4) in close proximity to abundant foraging habitat. Compared to brood and random locations, nest sites had more overhead cover (77% cover), more litter (35% cover), more grass (66% cover), taller vegetation (26 in), few forbs (9% cover), less bare ground (3% cover) and less open space 0 to 2 inches and 2 to 6 inches above the ground surface (25% and 30%, respectively). During the first day posthatch broods moved less than 100 yards, emphasizing the need for brood-rearing cover in close proximity to nesting areas. Areas used by bobwhite broods for foraging tended to have more bare ground, more forbs, less grass, more open space 2 inches above the ground surface, less litter, and less overhead cover than nests or random locations (fig. 5). These habitat features likely provided foraging opportunities and promoted arthropod abundance.

Arthropods are an essential component in the diets of breeding females and chicks. Arthropods were less abundant in restored areas in both Searcy and Fulton Counties than in unrestored areas (fig. 6). The difference in insect abundance may explain the tendency of bobwhite to vacate restoration areas during the breeding season. Habitat restoration also seemingly affected bobwhite brood foraging movements. Bobwhite broods moved faster (1.84 ft/min) and further in restoration areas than nonrestored areas. Longer animal movements are often associated with more widely dispersed resources.

Differences in arthropod abundance and movements rates may have influenced growth rate of chicks. Chicks that foraged in restoration areas grew more slowly (0.034 oz/d) than those in unrestored areas (0.047 oz/d). However, these differences in arthropods, movements, and growth rates did not translate to differences in survival. Broods in man-

Figure 4. Typical nesting habitat in Searcy County, AR, looking into the nest (center). (Photo credit Kevin Labrum, Arkansas Tech University)

Figure 5. Typical foraging habitat used by broods. (Photo credit Kevin Labrum, Arkansas Tech University)

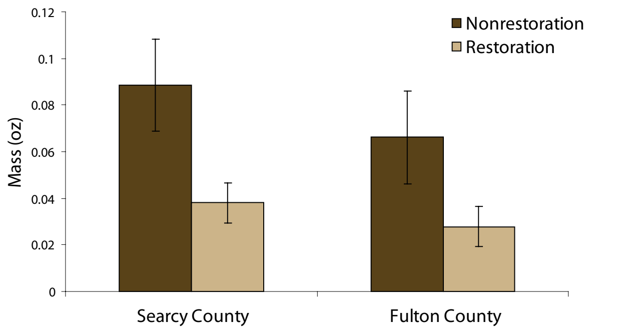

Figure 6. Average invertebrate biomass (oz +/- SE) in restoration and nonrestoration areas in Fulton and Searcy Counties.

LANDSCAPE-LEVEL MANAGEMENT

agement areas had higher survival than did broods in unrestored areas.

Restoration efforts were evaluated by comparing the structure of resulting habitat to habitat that was actually used for nesting and brood rearing. Management efforts produced variable results. Table 1 illustrates the percentage of random points in 14 different restoration sites that had vegetation structure consistent with nesting and brood-rearing habitat in 2007. The practices implemented were more likely to produce brood habitat than nesting habitat during the first 1 to 3 years following implementation. Recently disturbed sites and recently established native warm-season grass (NWSG) stands had not yet developed the vegetation structure used for nesting. Best management practices for bobwhite should produce a patchy mixture of nesting habitat in proximity to large areas of brood-rearing habitat and should persist for more than 1 year (fig. 7).

Figure 7. Switchgrass field border (right portion of photo), patches of bare ground (lower left), and patches of nesting habitat interspersed. (Photo credit Kevin Labrum, Arkansas Tech University)

Table 1. Percentage of samples classified by discriminant function modeling as brood-rearing and nesting habitats in each restoration area and the associated management prescription.

Habitat treatment 2007	Brood (%)	Nest (%)	Habitat management practice
Ashley Top	67	7	Land clearing and fire lanes 10/1/2003, burning 4/2/2004, native grass planting 5/20/2005
David Treat	40	7	Burning 2/8/2006
Holstead Switch	27	20	Land clearing 9/8/2003, burning 4/8/2004, switchgrass planting 6/3/2004, strip mowing 9/7/2004
Lower Shannon	7	60	Burning 2/23/2005
Milikan	73	7	Land clearing and fire lanes 9/29/2004, burn 2/18/2005, native grass planting (little bluestem) 4/11/2005, disking 8/7/2006
S.W. Treat	27	20	Fescue eradication 11/17/2004, disking 1/24/2006, burn 1/30/2006, native grass and legume planting 5/26/2006
Shannon Cemetery	40	7	Burning 10/15/2005
Ashley Lower 2	73	0	Fescue eradication 11/2005, burning 4/2006, native grass planting (little bluestem, switchgrass, big bluestem) 5/2006
Holstead Borders	73	0	Land clearing 9/8/2003, burning 2/1/2006, native grass planting (switchgrass, little bluestem) 6/3/2004, strip mowing 9/7/2004
Milikan Borders	89	0	Land clearing and fire lanes 9/29/2004, burn 2/18/2005, native grass planting (little bluestem) 4/11/2005, disking 8/7/2006
Parks Borders	50	7	Disking 3/26/2006, native grass planting 5/11/2006, disking 10/1/2006.
Ratchford Borders 2006	67	0	Land clearing and fire lane 1/26/2004, fertilizer and lime 3/11/2004, burning and disking 4/9/2004, fescue eradication 8/10/2006
Ratchford Borders 2007	67	13	Land clearing and fire lane 1/26/2004, fertilizer and lime 3/11/2004, burning and disking 4/9/2004, fescue eradication 8/10/2006
Treat Borders	47	0	Land clearing 10/29/2005, burning 1/30/2007, native grass planting 4/11/2005, disking 8/8/2006

Habitats Used During Winter

Restoration areas were used heavily by bobwhite during the winter. In general, winter habitat had more shrub growth than breeding habitat. Bobwhites established a covey headquarters in large shrub patches that were 4 to 6 feet tall and 10 to 20 feet in diameter (fig. 8). Structurally dense restoration areas likely provide critical escape cover and shelter from low temperatures during the harshest times of year. Fencing out cattle, planting of shrub thickets, and hedgerow establishment all created plant communities that, through time, will provide winter habitat for bobwhite.

Although bobwhites in Searcy County used restoration areas during the winter, these areas did not produce habitat that was used for nesting by bobwhite during the study. Bobwhites left restoration areas at the beginning of the breeding season and did not return during the breeding season. In the spring, most radio-marked bobwhites in Searcy County used tall fescue-dominated fields that were lightly to moderately grazed. Researchers did not observe, nor capture, bobwhites in tall fescue-dominated fields that were either heavily grazed or ungrazed. Thus, moderate grazing may create conditions that are suitable for bobwhites in tall fescue-dominated fields that would otherwise be uninhabitable.

Figure 8. Bobwhite winter habitat. (Photo credit Kevin Labrum, Arkansas Tech University)

Effects of Management on Wintering, Nesting, and Brood-rearing habitat

Some management practices produced a mixture of brood-rearing and nesting habitat. For example, land clearing (i.e., converting woodlands into habitat borders, usually by bulldozing) or disking, followed by spring burning and planting a mixture of NWSG and forbs generally produced brood habitat during the first several years after establishment. These conservation practices produced habitats that were structurally similar to habitats used by bobwhites for rearing chicks (~70% coverage) and nesting (7-13% coverage).

Two practices did not produce brood-rearing and nesting habitat. Tall fescue eradication that released bermudagrass did not allow for establishment of NWSG and produced a vegetation structure that provided neither nesting nor brood-rearing habitat. Well-established "improved pastures" often host a myriad of exotic forage grasses from years of pasture management. Eradication of a dominant exotic (i.e., tall fescue), will often release a vigorous stand of an equally invasive exotic (i.e., bermudagrass) that had simply been suppressed. Once the NSWG have been planted, bermudagrass reinvades the understory, rendering them unsuitable as bobwhite habitat. This common occurrence illustrates the importance of taking two or more growing seasons to ensure all exotic grasses are completely eradicated before planting of NWSG. Second, planting a monoculture of NWSG, such as switchgrass (*Panicum virgatum*), did not produce brood-rearing or nesting habitat. Stands of mixed NWSG with native forbs and legumes will provide a vegetation structure and composition that is much more consistent with nesting and brood-rearing habitat.

As expected, vegetation structure and composition changed over time, following initial implementation of conservation practices. Some restoration areas initially developed relatively large areas of brood habitat, but had little to no nesting habitat during the first year post restoration (table 1). In the second year, more nesting habitat was present, but the field still provided predominantly brood habitat. Consequently, such areas may be developing into suitable habitat for breeding, but may not achieve the appropriate mix of nesting and brood-rearing habitat until the third or fourth year. At this point, it will be necessary to introduce planned disturbance to periodically set back succession and maintain desired structure. In contrast, stands treated with only prescribed burning initially developed a good mix of brood-rearing habitat (40% coverage) and nesting habitat (7% coverage), but 3 years after the burn provide virtually no brood-rearing habitat. Retaining a desirable mixture of nesting and brood-rearing cover will require periodic prescribed burning on a 2- to 3-year fire return interval. Restoration efforts that eradicated tall fescue followed by burning and establishment of NWSG were better at producing large areas of brood-rearing habitat with small areas of nesting habitat that persisted over 3 years.

Management Recommendations

The following series of treatments is recommended as the most effective for producing a balance of habitat types: clearing (converting woodlands into early successional habitat, usually by bulldozing) or disking (fig. 9) followed by spring burning in conjunction with planting a mix of NWSG and forb species. In the study areas, these treatments produced habitats dominated by forbs interspersed by bare ground that were structurally similar to habitats used by bobwhite broods. When patches of native bunchgrass (i.e., perennial grass species that grow in discrete bunches or clumps) are absent, complete eradication of tall fescue will eliminate all nesting cover for a short period of time (2–3 years), thus other undisturbed cover should be maintained in the immediate vicinity to provide nesting cover during the stand establishment phase. In addition, eradication of tall fescue when bermudagrass was present resulted in development of a relatively pure pasture of bermudagrass, which was not used by bobwhites (fig. 10). In these situations, efforts will have to be made to then eradicate bermudagrass prior to planting native grasses. Finally, establishing a monoculture of switchgrass was also ineffective in producing bobwhite breeding habitat because it

Figure 9. Disked strip produced habitat used by foraging broods. (Photo credit Kevin Labrum, Arkansas Tech University)

Figure 10. A bermudagrass monoculture resulted when the dominant grass was misidentified. Tall fescue was eradicated, which allowed even greater dominance by bermudagrass. (Photo credit Kevin Labrum, Arkansas Tech University)

quickly became too dense and, thus, inhospitable for bobwhite foraging, nesting, and brood rearing (fig. 11). Consequently, establishing switchgrass monocultures is not recommended, except as bobwhite wintering habitat.

Prescribed burning of unplanted fields dominated by broomsedge bluestem (*Andropogon virginicus*) produced habitats structurally similar to those used by broods. However, burn-only treatments on tall fescue fields produced moderate amounts of appropriate habitat but such treatments are too short lived to be of value. In contrast, prescribed burning of tall fescue fields coupled with herbicidal eradication of tall fescue and planting of a NWSG/forb mix can have longer term affect and is more effective than burning alone.

Native grasses may take more than 1 year to become established. Therefore, large areas should not be converted to NWSG within one season because doing so may eliminate all cover for the resident bobwhite population. When large properties are enrolled for restoration, Managing several smaller restoration plots with management activities alternated between years in adjacent areas to maintain structurally distinct habitats for nesting and brood-rearing activities is recommended. If these recommendations are followed, nesting habitat should be available 2 to 3 years after disturbance and brood-rearing habitat within 1 to 2 years.

Figure 11. A monoculture of switchgrass did not exhibit structural characteristics of brood foraging and nesting habitat. Bobwhite adults did not use these habitats. (Photo credit Kevin Labrum, Arkansas Tech University)

The suite of conservation practices deployed in the Searcy County focal area can clearly provide habitat that is structurally and floristically consistent with the seasonal habitat requirements of bobwhite. When appropriate structure is created, bobwhite will colonize and use these habitats to meet seasonal life requisites. However, the habitat value of a specific implementation of a conservation practice will vary over time in relation to successional processes, disturbance regimes, seasonal biological processes, and the manner in which the practice was deployed. Moreover, the scale of conservation implementation will affect the magnitude of population response. Delivery of conservation practices in the Searcy County focal area impacted only about 1.4 percent of the landscape, less than the 4.7 percent in Fulton County and well short of the 6 to 7 percent prescribed in the NBCI. These differences may account for the greater population response in Fulton County.

Technical Reference

Dimmick, R.W., M.J. Gudlin, and D.F. McKenzie. 2002. The northern bobwhite conservation initiative. Miscellaneous publication of the Southeastern Association of Fish and Wildlife Agencies, SC. 96 pp.

Arkansas Game and Fish Commission, Arkansas State University, and Arkansas Tech University
Quail Focal Area Field Day
September 5, 2007

Bradley Carner (Turkey/Quail Program Coordinator with Arkansas Game and Fish Commmission), Steven Fowler (Quail Program Coordinator with AGFC), Dr. Jim Bednarz (Professor of Wildlife Ecology at Arkansas State University), and Dr. Chris Kellner (Professor of Biology at Arkansas Tech University) hosted a USDA NRCS Bobwhite Restoration Project Field Day on September 5, 2007. The Quail Focal Area Field Day featured a morning educational session held at the pavilion at Southfork Resort in Saddle, Arkansas, and included a scheduled afternoon field tour of three properties within the Fulton County quail focal area, which unfortunately was rained out. There were 68 natural resource professionals and private landowners in attendance from three States (fig. 1). The main focus of the Field Day was to educate landowners and natural resource professionals about the research occurring in the Fulton and Searcy Counties quail focal areas in northern Arkansas. Researchers evaluated habitat use and nesting success of northern bobwhite and density and abundance of all grassland birds on managed and unmanaged sites within the Fulton and Searcy Counties focal areas. Presentations during the morning session included an introduction to bobwhite basics (fig. 2) and bobwhite focal areas, presentations of results from the bobwhite and songbird research conducted by Arkansas State University, and a presentation of results from the bobwhite research conducted by Arkansas Tech University in Fulton and Searcy Counties. In lieu of the field tour, attendees participated in a question and answer session covering many topics including the use of prescribed fire and the effects of grazing on bobwhite populations. The day ended with a landowner's perspective, where a local landowner shared his experiences with enrolling his land in conservation practices (fig. 3 and 4).

Attendance	
Private landowners and producers	**31**
NRCS	**10**
AR Game & Fish Commission	**9**
AR Forestry Commission	**4**
Fulton Co. Conservation District	**3**
Arkansas State University	**2**
Arkansas Tech University	**2**
The Nature Conservancy	**2**
Searcy Co. Conservation District	**1**
MO Dept. of Conservation	**1**
Mississippi State University	**1**
USFWS	**1**
Quail Unlimited	**1**
Total	**68**

Figure 1. It was a great turnout for the Quail Focal Area Field Day in Fulton County, AR. Participants gather under the pavilion at Southfork Resort in Saddle, AR, for presentations by USDA NRCS Bobwhite Restoration Project researchers.

Figure 2. Steven Fowler begins the Field Day with an introduction to quail biology and a discussion of the declining trend in quail populations in AR.

Figure 3. Gary Mullins (landowner and Arkansas Game and Fish Commission) shares his experience with implementing conservations practices on his farm in Fulton County, AR.

Figure 4. An example of the type of quality quail habitat that is produced by active management under federally and State-funded conservation programs in Fulton County, AR.

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Evaluation of Four Conservation Management Practices for Bobwhites and Grassland Songbirds

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Acknowledgments

Information in this publication was adapted from the MS research of W. Cory Heaton, working under the direction of Dr. Greg K. Yarrow, Professor Wildlife Ecology, Clemson University and Dr. Ernie P. Wiggers, Executive Director, Nemours Wildlife Foundation. Funding for this project was provided by the USDA NRCS Agricultural Wildlife Conservation Center (AWCC) and Nemours Wildlife Foundation.

Photos were provided by Ernie P. Wiggers and staff at Nemours Wildlife Foundation.

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Evaluation of Four Conservation Management Practices for Bobwhites and Grassland Songbirds

Early successional habitats are important to a variety of game and nongame wildlife species. Early successional habitats are disturbance dependent and can be maintained with practices, such as prescribed burning and disking, that are designed to set back succession. In the absence of these types of disturbances, open areas quickly become reforested causing further declines in this important habitat. A myriad of U.S. Department of Agriculture (USDA) conservation programs, including the Wildlife Habitat Incentive Program (WHIP), Environmental Quality Incentives Program (EQIP), and the Conservation Reserve Program (CRP), provide cost-share and incentives for creating and maintaining early successional habitats. Under USDA programs, management practices are implemented in accordance with the USDA Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPS) that provide guidance for applying the conservation technology on the land. This study examined vegetative response to early successional management practices recommended by the NRCS. Researchers evaluated vegetation response to prescribed fire (CPS Code 338) and disking (CPS Code 647) during three seasons (spring, summer, winter) and at different frequencies (1-, 2-, or 3-yr intervals) in former agricultural fields. Management practices were evaluated on 14 fields comprising 250 acres on Nemours Plantation in Beaufort County, South Carolina. Each field was divided into treatment plots and each plot (n=109) was randomly assigned a treatment type (prescribed burning or disking) (winter (November–February), spring (March–April), or summer (May–October)), and frequency (annually, every 2 years, or every 3 years). Each treatment combination was replicated at least three times. Treatment applications began in January 2000. Vegetation in the burned and disked plots was monitored for 6 years (2000–2006) to document changes in ground cover and species composition. Forb cover was greater than grass cover in all treatment plots whether burned or disked and regardless of season or frequency. Mean percent forb cover ranged from (49–71%) and was greatest in winter disking treatments conducted every 2 or 3 years. Mean percent grass cover ranged from (16–40%) and was greatest in annually burned treatment plots. Mean percent bare ground was low (≤11%) across all treatments, but was greatest in treatment plots that were disked annually in winter or summer. Disking was more effective in preventing woody stem growth if conducted in the spring every 1 or 2 years. Frequency of the treatment application was more effective for both treatment types than the season of application. Agricultural pest plants or otherwise undesirable species, including crotalaria and dewberry, were more dominant than desirable species in many treatment plots. Desirable plant species included grasses such as broomsedge and bluestems and seed producing forbs including ragweed and partridge pea. Broomsedge and other native grasses responded best to plots burned in winter and spring every 2 or 3 years. Ragweed and partridge pea were not widespread and occurred in isolated plots. Where a seed bank existed, these forages responded best in plots disked in the winter. Successful establishment of early successional habitat relies heavily on the existing seed bank. It is recommended that managers first evaluate their seed

bank by disking a test strip during the fall and winter and observing response of plant species. Establishment of quality habitat may require eradicating undesirable species and planting desirable species if they are not present in the seed bank. Maintenance of this habitat requires frequent disturbance of no less than every 2 to 3 years.

Evaluation of Four Conservation Management Practices for Bobwhites and Grassland Songbirds

Early successional habitats are important to a variety of game and nongame wildlife species. Changes in land use practices over the past several decades have caused the widespread loss of early successional habitat, resulting in the decline of many wildlife species, including northern bobwhite (*Colinus virginianus*). A myriad of U. S. Department of Agriculture (USDA) conservation programs, including the Wildlife Habitat Incentive Program (WHIP), Environmental Quality Incentives Program (EQIP), and Conservation Reserve Program (CRP), provide cost-share and incentives for creating and maintaining early successional habitats. Early successional habitats are disturbance dependent and can be maintained with practices, such as prescribed burning and disking, that are designed to set back succession. In the absence of these types of disturbances, open areas quickly become reforested causing further declines in this important habitat.

Under USDA programs, management practices are implemented in accordance with USDA Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPS). Practice standards provide guidance for applying conservation technology on the land. Practice standards are based on sound science and periodically reviewed to incorporate new technology. The purpose of this study was to provide the science that informs the practice standards for early successional habitat. Researchers examined vegetative response to early successional management practices recommended by the NRCS. Researchers evaluated prescribed burning (CPS Code 338) and disking (Early Successional Habitat Development/Management, CPS Code 647) during three seasons (spring, summer, and winter) and at different frequencies (1-, 2-, or 3-yr intervals) in former agricultural fields. Vegetation in the burned and disked plots was monitored for 6 years (2000–2006) to document changes in ground cover and species composition.

Field Management Practices

Researchers evaluated 14 fields ranging in size from 1 to 47 acres within a 250-acre study area on Nemours Plantation in Beaufort County, South Carolina. Fields were known to have been cropped or grazed for the past 3 decades and were likely used in agricultural practices for the past several centuries. Prior to the abandonment of agriculture, the fields had been used for row cropping (corn/soybean) and pasture for dairy cattle. Each field was subdivided into smaller treatment plots, and each plot (n=109) was randomly assigned a treatment combination. Treatment combinations included treatment type (burning or disking), season (winter (November-February), spring (March-April) or summer (May-October)) and frequency (annually, 2- or 3-yr intervals). Treatment combinations were assigned to at least 3 of the 109 possible plots. Treatment applications began in January 2000. Field borders, 100 feet in width, were retained around the edges of fields and subdivided treatment plots within large fields. Field borders were maintained with periodic prescribed burning and spot treatment with herbicide to manage woody encroachment.

Vegetation Monitoring

Vegetation monitoring was conducted to determine response of vegetative structure and composition to each treatment combination. Monitoring was conducted in late summer (2000–2006) at four points along randomly located transects in each treatment plot. At each point, species composition and percent cover of grasses, forbs, woody stems, debris and bare ground were measured within two separate 5.38-square foot quadrats. Woody stem density was also measured in a 26.25-foot-radius circular plot around each point.

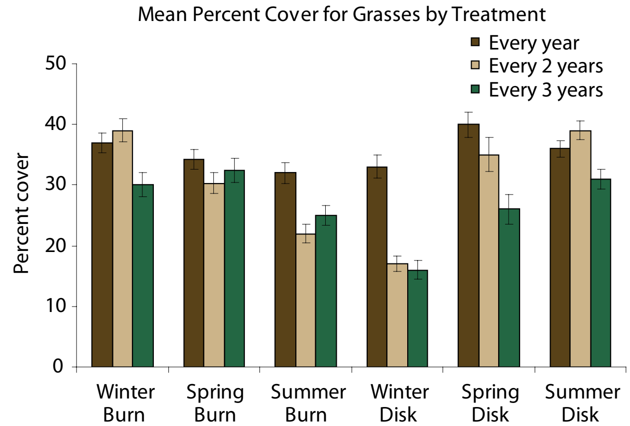

Figure 1. Mean percent cover (+/- SE) for grasses by treatment.

Vegetation Response to Disturbance

Mean percentage grass cover (annual and perennial grasses) ranged from 16 to 40 percent and tended to be greatest in annually burned or annually disked treatment plots (fig. 1). Forb cover (annual and perennial forbs) was greater than grass cover in all plots regardless of treatment and frequency (fig. 2). Mean percentage forb cover ranged from 49 to 71 percent and was greatest in winter disking treatments conducted every 2 or 3 years.

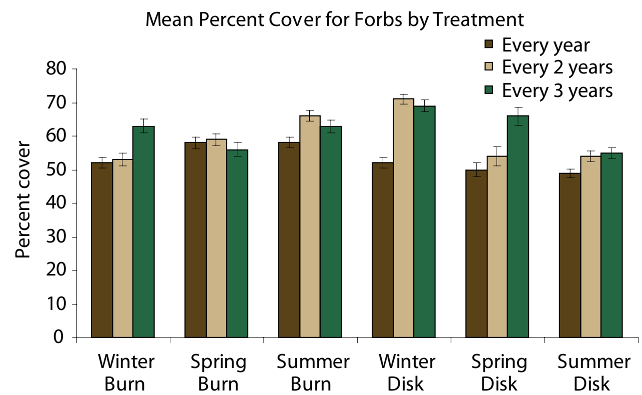

Figure 2. Mean percent cover (+/- SE) for forbs by treatment.

Bare ground, in combination with herbaceous overstory cover, is an important habitat component for ground nesting and foraging wildlife. Bare ground is a key characteristic of early successional habitat and is particularly important to northern bobwhite. Mean percent cover for bare ground was low (≤11%) across all treatments (fig. 3), but was greatest in treatment plots that were disked annually in winter or summer.

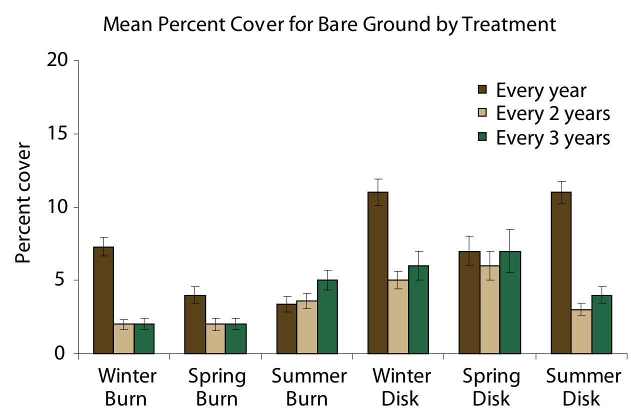

Figure 3. Mean percent cover for bare ground by treatment.

Although shrubs and other low woody cover are an important habitat component for many early successional species, encroachment of woody plants is a constant threat to early sucessional habitat. Therefore, researchers evaluated the ability of disturbance treatments to inhibit regeneration of woody stems. Disking was slightly more effective in preventing woody stem encroachment, particularly when conducted annually or biannually in the spring (figs.

4 and 5). Effectiveness of treatments at preventing growth of woody species was more dependent on frequency of the treatment than the season of application.

On these former agricultural sites, agronomic pest plants or otherwise undesirable species were more dominant than desirable species in many treatment plots. For example, rattlebox (*Crotalaria* spp.), an exotic plant that was introduced as a nitrogen-fixing soil builder with little value to wildlife, was very prevalent in the seed bank and was released by both disking and prescribed fire. However, rattlebox was reduced by summer disking at 1-, 2- or 3-year frequencies (fig. 6) and winter burning at 1- or 3-year frequencies (fig. 7). Rattlebox was most prevalent in plots disked in winter or spring every 3 years (fig. 6) and in annual spring burn plots (fig. 7).

Another common undesirable species on the study area was garden dewberry (*Rubus* spp.). Although dewberry produces a fruit similar to a blackberry and is a preferred forage for white-tailed deer (*Odocoileus virginianus*), it forms dense mats which exclude desirable plant species and can make travel for ground nesting and foraging birds difficult. Annual winter burns (fig. 8) and annual winter and

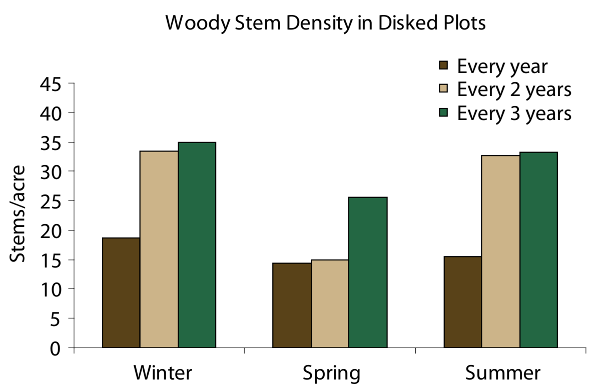

Figure 4. Woody stem density in disked plots.

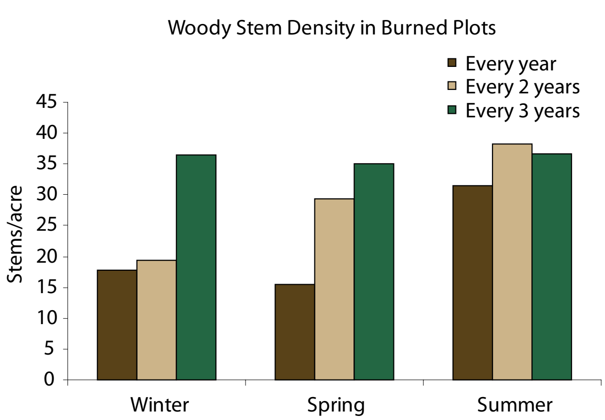

Figure 5. Woody stem density in burned plots.

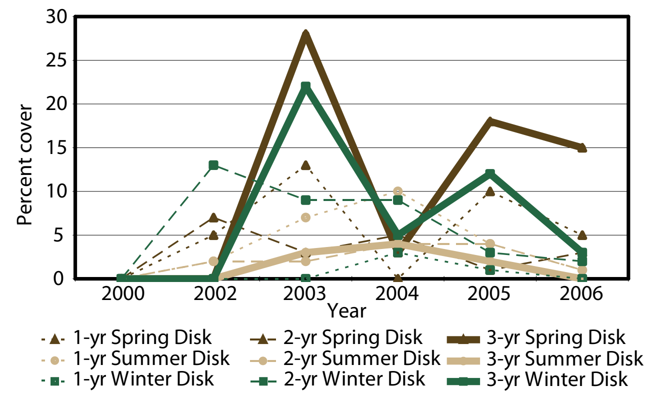

Figure 6. Response of Crotalaria spp. to disking.

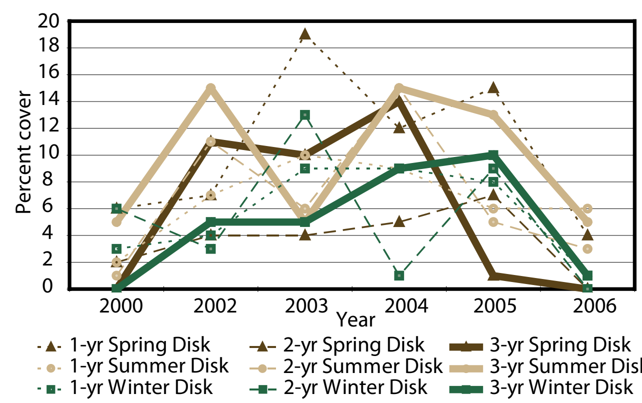

Figure 7. Response of Crotalaria spp. to prescribed burning.

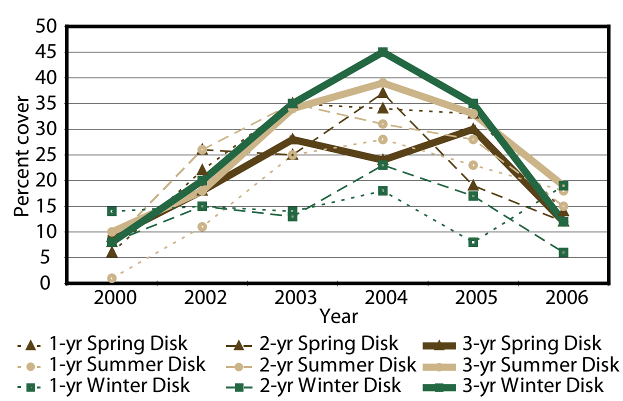

Figure 8. Response of garden dewberry to prescribed burning.

summer disking (fig. 9) produced the least cover of dewberry. Dewberry tended to increase as frequency of disturbance treatments decreased (every 2 to 3 years). Other undesirable species that responded positively to the treatment combinations included bermudagrass (*Cynodon dactylon*), johnsongrass (*Sorghum halepense*), sicklepod (*Arabis canadensis*), Vasey's grass (*Paspalum urvillei*) (figs. 10 and 11), and sericea lespedeza (*Lespedeza cuneata*). These species were not as widely occurring as crotalaria and dewberry, but tended to be locally problematic in specific fields. This suggests past use of fields and subsequent effects on the seed bank strongly influences vegetative response to disturbance regimes. On some former agricultural sites, herbicidal control of specific agronomic invasive exotics may be necessary before a desired plant community response can be achieved with disturbance regimes.

Desirable plant species that provide cover and food for wildlife include native warm-season grasses, such as broomsedge bluestem (*Andropogon virginicus*) and bluestems (*Andropogon* spp., *Schizachyrium* spp.), and seed producing forbs including ragweed and partridge pea. Broomsedge and other native grasses responded best to prescribed fire during winter and spring on a 2- or 3-year rotation (fig. 12). Disking during all seasons maintained broomsedge cover below 10 percent and required 2 to 3 years to recover to predisked levels (fig. 13). Spring disking was most detrimental to broomsedge cover. Coverage by these grasses increased after 3 years. Ragweed and partridge pea were not widespread and occurred in isolated plots. Where a seed bank existed, these forages responded best to winter disking (fig. 14) and winter or spring prescribed burning (fig. 15).

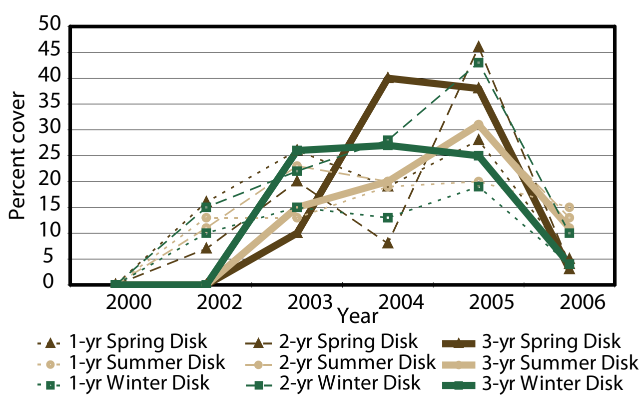

Figure 9. Response of garden dewberry to disking.

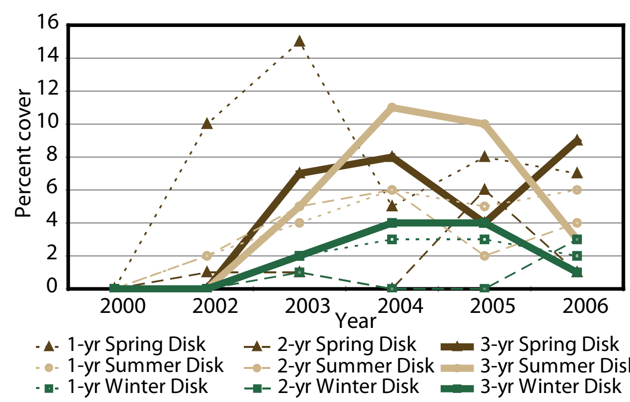

Figure 11. Response of Vasey's grass to disking.

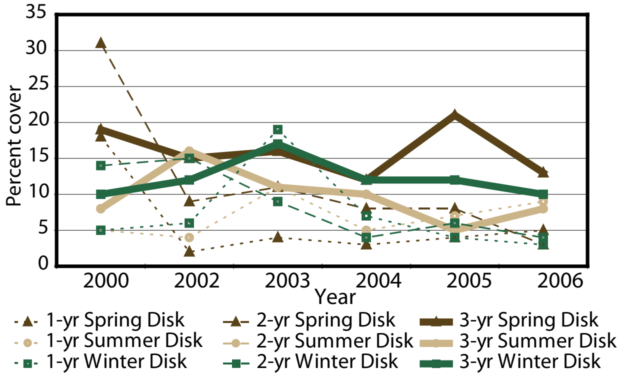

Figure 10. Response of Vasey's grass to prescribed burning.

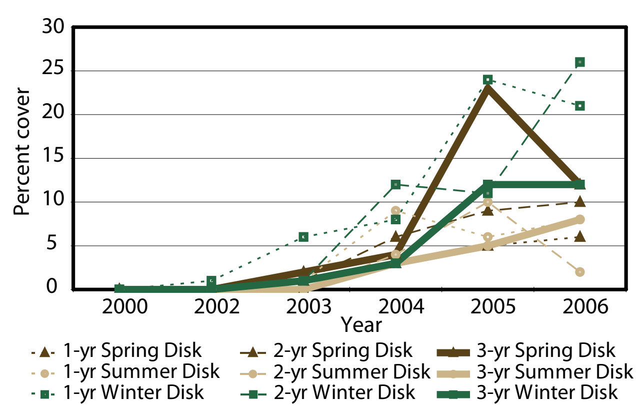

Figure 12. Response of broomsedge bluestem to prescribed burning.

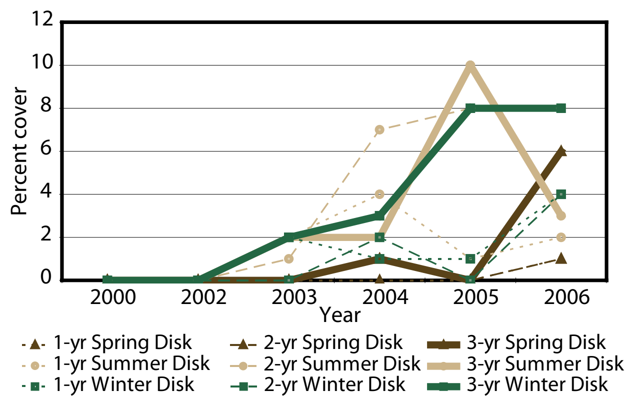

Figure 13. Response of broomsedge bluestem to disking.

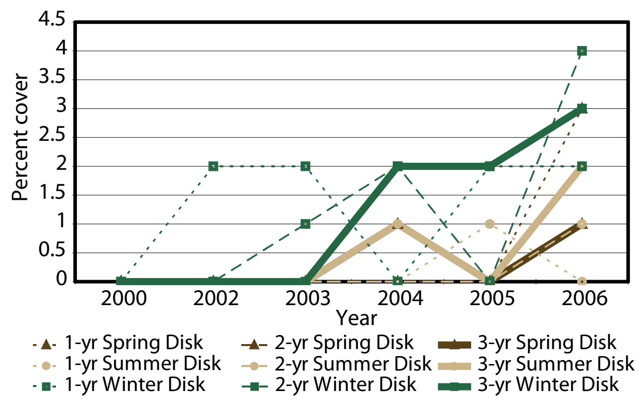

Figure 14. Response of ragweed to disking.

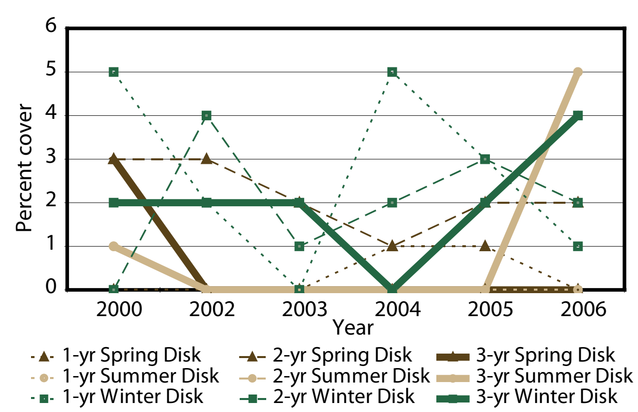

Figure 15. Response of ragweed to prescribed burning.

Summary and Recommendations

In the study, early successional habitats dominated by grasses and forbs were created and sustained by disking or prescribed burning. Species composition was altered depending upon the treatment frequency and season. However, the most important factor influencing the outcome was the associated seed bank. Treatment plots were in abandoned agricultural fields that had been in crop or pasture production for several decades. The chronic manipulation of these fields, particularly the use of increasingly effective herbicides, likely reduced or eliminated desirable native species from the seed bank. Therefore, rather than a response by desirable native species, early successional management on the study sites released undesirable, exotics or other nuisance plant species. This release of undesirable species reduced habitat suitability for target wildlife species such as the northern bobwhite.

It is recommended that managers first evaluate their seed bank by disking or burning a test strip during the fall and winter and observing response of plant species. The quality of the seed bank may differ among sites based on previous land uses, and the presence of undesirable species or absence of desirable species may add complexity to management regimes. In this situation, burning and disking alone may not be adequate to achieve the desired result. To reestablish the desired plant community in a reasonable amount of time, it may be necessary to eradicate undesirable plants using selective herbicides and establish the desired native grasses and forbs through planting.

Once established, early successional habitats require continuous attention to sustain. As succession progresses, woody plants will quickly invade, and the site will rapidly transition to a forest without proper management. None of the treatment combinations in the study were effective at eradicating 100 percent of the woody invaders; however, disking controlled woody encroachment better than prescribed burning. Disking is, however, an expensive option and may not always be practical. Another tool managers should consider is using selective herbicides (Pest Management, CPS Code 595). Selective herbicides can be applied to individual stems of undesirable species without adversely impacting desirable species. Frequency of treatment application is also an essential component to maintaining early successional habitat. The Coastal Plain of the Southeast enjoys a relatively long growing season and receives adequate precipitation. Consequently, woody invaders can quickly overtake a site. Therefore, frequency of management practices to sustain early successional habitat not exceed 3-year intervals is suggested. Maintenance of some level of cover (5–25%) of preferred woody species (e.g., plum (*Prunus* spp.) and sumac (*Rhus* spp.)) is desirable and meets specific seasonal habitat requirements of bobwhite and other early successional species. However, if left unchecked, old fields will succeed to young forest eliminating essential herbaceous cover.

Technical References

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U.S. Department of Agriculture Natural Resources Conservation Service. 2001. Bird use of longleaf pine restoration. Technical Note No. 190–33. Washington, DC.

Nemours Wildlife Foundation and Clemson University Managing Grasslands for Wildlife Field Day October 11, 2007

Dr. Ernie Wiggers (executive director of Nemours Wildlife Foundation) and Dr. Greg Yarrow (Professor of Wildlife Ecology at Clemson University Department of Forestry and Natural Resources) hosted a USDA NRCS Bobwhite Restoration Project Field Day on October 11, 2007, at Nemours Plantation in Seabrook, South Carolina. The Managing Grasslands for Wildlife Field Day featured an educational field tour on research sites within Nemours Plantation, a nearly 10,000 acre tract in coastal South Carolina that is operated by the Nemours Wildlife Foundation (fig. 1). The researchers evaluated bobwhite and grassland songbird response to various practices often used under Federal Farm Bill conservation programs. The field tour included a visit to one of the project's study sites and presentations on the effects of prescribed burning, disking, and herbicide application on vegetation and bird abundance. Other topics during the field tour included the importance and management of native warm-season grasses (fig. 2), upland habitat buffers, and available cost share programs for establishing conservation practices. There were nearly 30 natural resources professionals and private landowners in attendance from more than four States.

Figure 1. Dr. Ernie Wiggers provides a summary of the vegetation response to various conservation practices.

Figure 2. Featured presenter Dr. Craig Harper (University of Tennessee) discusses methods of establishment and management of native warm-season grasses and their benefits for wildlife populations.

Figure 3. Management of native vegetation for wildlife at Nemours Plantation resulting in a diverse mix of grasses, forbs, and interspersed shrubs.

Evaluation

Below is a summary of attendee responses to evaluation form questions.

1) Was the purpose for attending to learn information you can apply to land you own or manage, or to use in your capacity as a public resource management professional?

68 percent—to apply information to their own land

32 percent—to use in their capacity as a resource management professional

2) Was the format of the Field Day suitable (topics covered, sites visited, timing, etc.)?

100% Yes

3) Will the information presented in the Field Day be useful to you?

100% Yes

4) Please rank the overall value of this workshop in increasing your knowledge

Mean score = 4.5 (out of 5)

5) Would you like the Nemours Wildlife Foundation to hold more of these events?

100% Yes

6) What other topics of natural resources management are you interested in?

Prescribed fire, ducks, doves, woodcocks, longleaf habitat management, rice field management, herbicides for wildlife management, native foods for wildlife, understory management for wildlife, quail management

United States Department of Agriculture

Natural Resources Conservation Service

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Evaluation of the U.S. Department of Agriculture Farm Bill Conservation Practices for Wildlife

LANDSCAPE-LEVEL MANAGEMENT

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Acknowledgments and disclaimer

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Herbaceous Conservation Buffers: Filter Strips and Field Borders as Wildlife Habitat

Conservation buffers are noncrop strips of permanent vegetation that can be integrated into agricultural production systems to provide specific environmental benefits such as reducing soil erosion, improving water quality, and providing wildlife habitat. Two of the more commonly implemented conservation buffers are filter strips and field borders, also known as upland habitat buffers. Depending on plant material selection, both filter strips and field borders can produce many of the same environmental benefits, although they are installed under different standards and specifications to address different specific resource concerns. Filter strips are linear areas of herbaceous vegetation (grasses and other perennial nonwoody plants) that are established between cropland, range land, or disturbed land (including forests) and environmentally sensitive areas. Field borders are defined as linear areas of herbaceous vegetation (grasses and other perennial nonwoody plants) that are established along edges of crop fields to reduce the invasion of woody plant succession and provide natural food and cover for wildlife. Although filter strips are generally designed to achieve water quality, soil erosion, and agrichemical retention objectives, they may produce wildlife habitat with careful selection of plant materials. Similarly, although field borders, or upland habitat buffers, are generally designed to address wildlife habitat objectives, they can also produce water quality and erosion benefits with selection of appropriate plant materials. If designed and managed properly, the plant composition and structure within either type of conservation buffer can provide an abundance of herbaceous vegetation that produces cover, seeds, forage, and a variety of insects consumed by a host of wildlife species. The objective of this study was to characterize plant community composition and structure in filter strips and field borders established using either planted native warm-season grasses or natural revegetation in accordance with U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPS). Planted and unplanted filter strips and field borders supported diverse plant communities that provided structure (i.e., cover) appropriate for nesting, brood-rearing and roosting bobwhite, and other early successional wildlife species. During the third year after establishment, both planted and unplanted buffers were characterized by a moderately dense mixture of grasses and broadleaf weeds with an interspersion of bare ground. Planted buffers had greater grass coverage and less bare ground than unplanted buffers, but otherwise were structurally similar to unplanted buffers.

Herbaceous Conservation Buffers: Filter Strips and Field Borders as Wildlife Habitat

Conservation buffers are noncrop strips of permanent vegetation that can be integrated into agricultural production systems to provide specific environmental benefits such as reducing soil erosion, improving water quality, and providing wildlife habitat. Two of the more commonly implemented conservation buffers are filter strips (Conservation Practice Standard (CPS) Code 393) and field borders (CPS Code 386), also known as upland habitat buffers. Depending on plant material selection, both filter strips and field borders can produce many of the same environmental benefits, although they are installed under different standards and specifications to address different specific resource concerns.

Filter strips are linear areas of herbaceous vegetation (grasses and other perennial nonwoody plants) that are established between cropland, rangeland, or disturbed land (including forests) and environmentally sensitive areas (NRCS eFOTG 2006) (http://www.nrcs.usda.gov/technical/efotg/). Filter strips are generally established on the down slope margin of a field or stand that has potential to produce nonpoint source pollution. Filter strips serve a variety of purposes including reducing sediment, particulate organics, and sediment adsorbed contaminant loadings in runoff and surface irrigation tailwater; reducing dissolved contaminant loadings in runoff; serving as buffers in riparian areas to protect water quality and aquatic habitat; providing herbaceous plant habitat for wildlife and beneficial insects; and maintaining and enhancing watershed functions and values.

Field borders are defined as linear areas of herbaceous vegetation (grasses and other perennial nonwoody plants) that are established along edges of crop fields to reduce the invasion of woody plant succession and provide natural food and cover for wildlife (NRCS eFOTG 2006). Field borders can also support beneficial arthropods that may reduce pest insects in crops and can be used to replace low yielding portions of the field with a conservation practice. In contrast to filter strips, field borders may be established around an entire field perimeter, instead of just on the down slope margin. In addition to wildlife benefits, field borders may help reduce soil erosion, and protect water quality.

Numerous studies have documented the value of vegetated borders in providing wildlife habitat in agricultural landscapes (Rodenhouse et al. 1995; Premo 1995; Marcus et al. 2000; Bromley et al. 2002; Murphy 2003; Smith et al. 2005 a, b; Burger et al. 2006, Conover et al. 2007). Although filter strips are generally designed to achieve water quality, soil erosion, and agrichemical retention objectives, they may produce wildlife habitat with careful selection of plant materials. Similarly, although field borders, or upland habitat buffers are generally designed to address wildlife habitat objectives, they can also produce water quality and erosion benefits with selection of appropriate plant materials. If designed and managed properly, the plant composition and structure within either type of conservation buffer can provide an abundance of herbaceous vegetation that produces cover, seeds, forage and a variety of insects consumed by a host of wildlife species.

As part of the U.S. Department of Agriculture (USDA) Wildlife Habitat Incentives Program (WHIP), the South Carolina State Office of the Natural Resources Conservation Service (NRCS) developed a provision for providing cost-sharing and technical assistance to landowners who wish to establish filter strips (CPS Code 393) or field borders (CPS Code 386; Early Successional Habitat Development/Management, CPS Code 647) to enhance wildlife habitat concurrent with their agricultural operations. This study demonstrated and evaluated current NRCS filter strip and field border practices and guidelines to provide wildlife habitat in an agricultural setting. The objective of this study was to characterize plant community composition and structure in filter strips and field borders established using either planted native warm-season grasses or natural revegetation in accordance with NRCS CPS.

Figure 1. Filter strips on borders of agricultural fields (shown in yellow).

Filter strips were established and evaluated in two agricultural fields at the Clemson University Pee Dee Research and Education Center in the Coastal Plain region of South Carolina (fig. 1). Each filter strip was planted and left unplanted in alternating sections to compare vegetative composition and structure between planted and unplanted sections (fig. 2). In one filter strip, planted or unplanted sections (n = 7 each) were 820 feet long, whereas in the second filter strip, individual sections (n = 6 of each planted and unplanted) were 680 feet long. Filter strips were prepared for planting by first eradicating existing vegetation (primarily bahiagrass (*Paspalum notatum*) and bermudagrass (*Cynodon dactylon*)) with glyphosate (32 oz/acre) using a 50-foot boom sprayer mounted on a tractor. Areas were then disked using a 13-foot disc harrow, deep-tilled using a subsoiler/paratiller and cultipacked 3 weeks prior to planting (late March 2004). Planted filter strip sections were composed of mixtures of big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), eastern gamagrass (*Tripsacum dactyloides*), Indiangrass (*Sorghastrum nutans*), bitter panicgrass (*Panicum*


Figure 2. Filter strip after establishment.

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amarum), Kobe lespedeza (*Kummerowia striata*), broomcorn millet (*Panicum miliaceum*), sunflower (*Helianthus* spp.), dixie signalgrass (*Urochloa ramosa*), sorghum (*Sorghum bicolor*), and shyleaf (*Aeschynomene americana*). Unplanted filter strip sections were left unplanted following site preparation. Both filter strip sites were planted April 14–17, 2004, using a cyclone seed spreader followed by lightly covering seeds with a 64-inch roller cultipacker.

Filter strips were maintained using light disking on a rotational basis (a third of the area annually) during October and November in accordance with NRCS guidelines (CPS Code 393, Filter Strips). In addition, mowing (to a height of 10 in) was also used periodically to reduce competition from noxious weeds such as sicklepod (*Arabis canadensis*), slim amaranth (*Amaranthus hybridus*), and other invasive plants that had a tendency to overtake filter strips and compete with plantings. Mowing reduced the ability of weeds to reestablish and helped distribute seeds of native plants throughout filter strips.

Field Border Establishment

Field borders were also established and evaluated at the Clemson University Pee Dee Research and Education Center in the Coastal Plain region of South Carolina. Five field borders were established on edges of agricultural fields ranging in size from 0.8 to 2.1 acres (fig. 3). Average border width was 45 feet. Field borders were alternatively planted and left unplanted (natural revegetation) in equal-sized sections (512–675 ft in length) to compare vegetative composition and structure between planted and unplanted field borders.

Field borders were first prepared for planting by eradicating existing vegetation, which was primarily bahiagrass and bermudagrass, with glyphosate (32 oz/acre) using a 50-foot boom sprayer mounted on a tractor. Areas were then disked thoroughly with a 13-foot disk harrow, deep-tilled with a subsoiler/paratiller and cultipacked 3 weeks prior to planting. Field borders were planted with a slightly different mixture of native warm-season grasses with legumes depending on soil type of each field (table 1). Field borders were planted April 14–17, 2004, using a cyclone fertilizer spreader followed by lightly covering the seed (figs. 4 and 5).

Field borders were maintained by lightly disking a third of the area on a rotational basis annually in accordance with NRCS guidelines (CPS Code 386, Field Borders). In addition, mowing (to a height of 10 in) was also used periodically to reduce competition from noxious weeds, such as sicklepod, slim amaranth, and other invasive plants, that had a tendency to overtake field borders and compete with planted species. Disking reduced the regrowth of bahiagrass and bermudagrass in field borders; however, slim amaranth and sicklepod reemerged

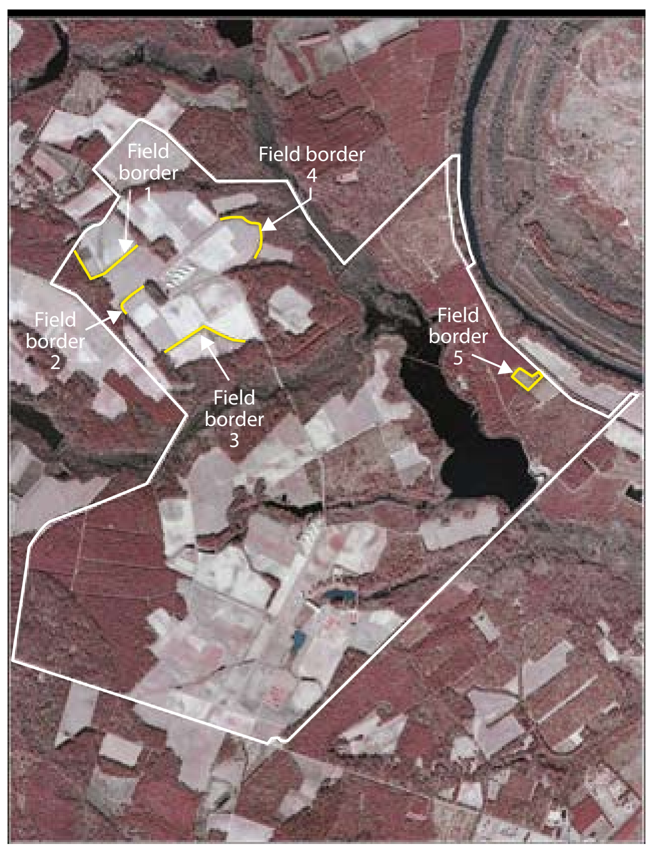

Figure 3. Five field borders adjacent to agricultural fields.

Table 1. Seed mixtures (based on approved local NRCS criteria) planted in field borders and filter strips

Field border (FB) and filter strips (FS)	Seeds planted	Seed rates (lb/acre)
FS1	Little bluestem *(Schizachyrium scoparium)*	2
	Switchgrass *(Panicum virgatum)*	1.5
	Bitter panicgrass *(Panicum amarum)*	1.5
	Japanese lespedeza *(Lespedeza striata)*	8
	Eastern gamagrass *(Tripsacum dactyloides)*	2
	Shyleaf *(Aeschynomene americana)*	8
	Broomcorn millet *(Panicum miliaceum)*	3
FS2	Big bluestem *(Andropogon gerardii)*	2
	Indiangrass *(Sorghastrum nutans)*	2
	Switchgrass *(Panicum virgatum)*	1.5
	Bitter panicgrass *(Panicum amarum)*	1.5
	Japanese lespedeza *(Lespedeza striata)*	8
	Buckwheat *(Fagopyrum esculentum)*	3
	Sorghum *(Sorghum bicolor)*	3
FB1	Big bluestem *(Andropogon gerardii)*	2
	Indiangrass *(Sorghastrum nutans)*	2
	Bitter panicgrass *(Panicum amarum)*	1.5
	Eastern gamagrass *(Tripsacum dactyloides)*	2
	Shyleaf *(Aeschynomene americana)*	8
	Broomcorn millet *(Panicum miliaceum)*	3
FB2	Little bluestem *(Schizachyrium scoparium)*	2
	Indiangrass *(Sorghastrum nutans)*	2
	Bitter panicgrass *(Panicum amarum)*	1.5
FB3	Japanese lespedeza *(Lespedeza striata)*	8
	Eastern gamagrass *(Tripsacum dactyloides)*	2
	Shyleaf *(Aeschynomene americana)*	8
	Broomcorn millet *(Panicum miliaceum)*	3
FB4	Big bluestem *(Andropogon gerardii)*	2
	Little bluestem *(Schizachyrium scoparium)*	2
	Indiangrass *(Sorghastrum nutans)*	2
	Bitter panicgrass *(Panicum amarum)*	1.5
	Japanese lespedeza *(Lespedeza striata)*	8
	Buckwheat *(Fagopyrum esculentum)*	3
	Sorghum *(Sorghum bicolor)*	3
FB5	Big bluestem *(Andropogon gerardii)*	2
	Little bluestem *(Schizachyrium scoparium)*	2
	Indiangrass *(Sorghastrum nutans)*	2
	Switchgrass *(Panicum virgatum)*	1.5
	Shyleaf *(Aeschynomene americana)*	8
	Buckwheat *(Fagopyrum esculentum)*	3
	Sorghum *(Sorghum bicolor)*	3
	Broomcorn millet *(Panicum miliaceum)*	3

Figure 4. Planting mixtures of grasses and legumes in filter strips and field borders using a cyclone seed spreader.

Figure 5. A 64-inch roller to compact seeds after planting in filter strips and field borders.

in the freshly disked areas. Mowing reduced the reestablishment of these weeds and also distributed seeds of native plants throughout the field borders. It did not, however, reduce the reestablishment of bahiagrass and bermudagrass in field borders. Mowing and disking were conducted as a maintenance practice in October and November of each year.

Vegetation Measurements

Evaluation of filter strips and field borders was based on a modified version of the Carolina Vegetation Survey (CVS) (Peet et al. 1998). Researchers measured vegetation during May and June 2007, in the third year after planting, when vegetation was well established. A transect line was placed through the center of each filter strip. Each filter strip section (planted and unplanted/unplanted areas) was evaluated using three vegetation sampling plots: a sample plot in the exact center of each filter strip section, a sample plot 33 feet from the edge of field borders, and a sample plot 33 feet away from cropped areas of agricultural fields. Sampling plots were 3.3 by 3.3 square feet, and all plants inside the sampling frame were counted and identified according to genus (and where possible, species) to evaluate plant composition. Vertical structure was also evaluated using a density board.

Both planted and unplanted filter strips contained forbs (broadleaf herbaceous plants) and grasses that produced seed and cover for northern bobwhite and other early successional wildlife species. A total of 34 plant species were identified in planted filter strips, as compared to 29 in unplanted filter strip sections. Planted sections of filter strips contained all of the plant species found in unplanted strips, in addition to most of the mixtures of legumes and grasses that were planted. The majority of plant species identified in both planted and unplanted sections were composed of eight species. Three of these plants, slender goldentop (*Euthamia caroliniana*), swampdock (*Rumex verticillatus*) and dogfennel (*Eupatorium capillifolium*), were common in both planted and unplanted filter strip sections. Slender goldentop was most prevalent (more than 90% occurrence) in both planted and unplanted filter strips.

Coverage of plant life forms was relatively similar between planted and unplanted filter strips. With the exception of grasses, which were more prevalent in planted filter strips, there were no significant differences between planted and unplanted filter strips for major plant categories (fig. 6). The increased prevalence of grasses in planted filter strips was expected, as grasses were a major component of the seed mixture applied to planted areas. Noticeably lacking, however, in both planted and unplanted filter strips were native legumes (e.g., *Lespedeza* spp., *Desmodium* spp.) and native grasses (e.g., *Panicum* spp., *Paspalum* spp.) whose seeds are highly preferred by quail, seed-eating songbirds, small mammals, and other wildlife. It is possible that seeds of these plants were not present in the seedbank, or that filter strips did not receive sufficient disturbance (intensity and timing) to stimulate germination of these important wildlife plants.

Planted sections of filter strips contained many of the same native plant species as unplanted sections (fig. 7). This is probably a result of stimulation of native seeds in the seedbank resulting from the disturbance associated with site preparation. The majority (>50%) of plants found in unplanted filter strips had a greater value for cover than food for bobwhite quail and other wildlife.

Planted and unplanted filter strips also provided plant structure (i.e., cover) for nesting, brood-rearing

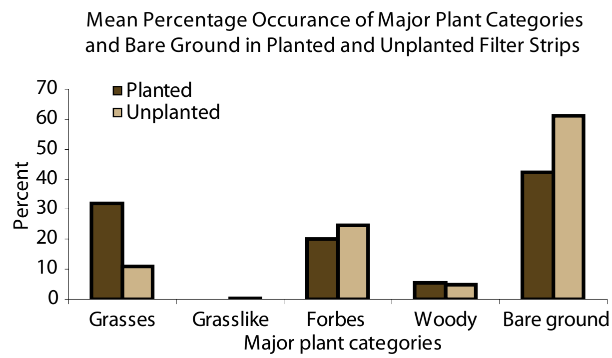

Figure 6. Mean percentage of frequency of occurrence of major plant categories and bare ground in planted and unplanted filter strips.

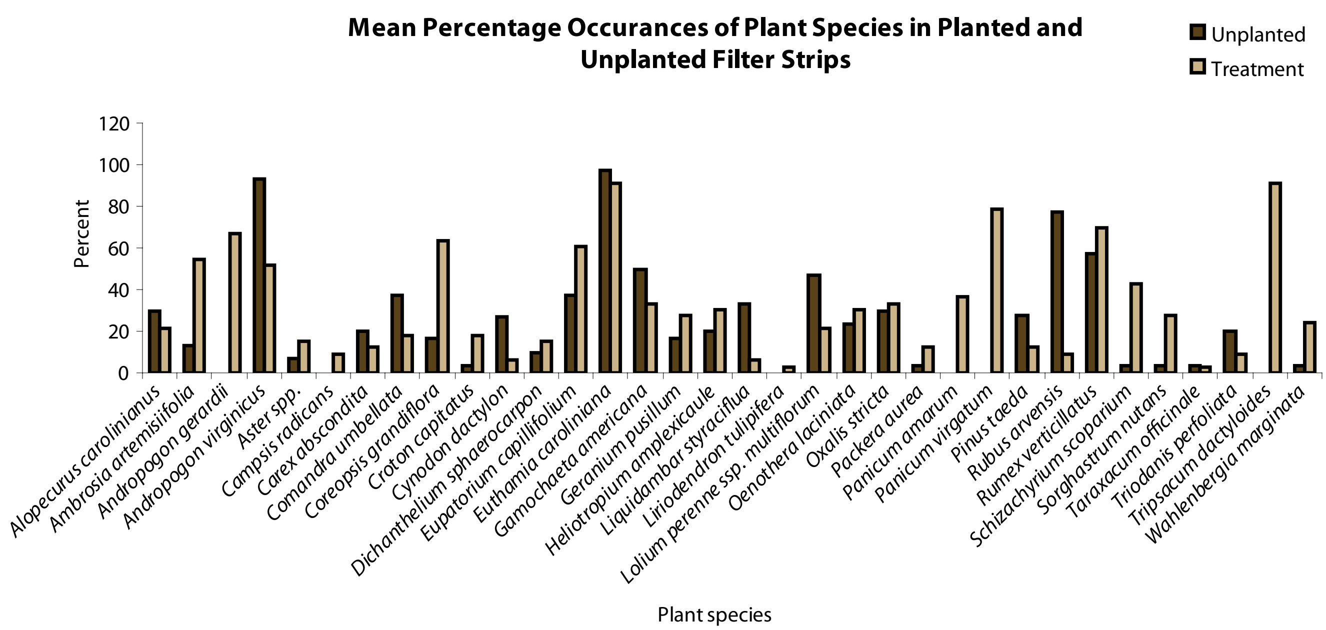

Figure 7. Mean percentage occurrence of plant species in planted and unplanted filter strips.

and roosting bobwhite and other early successional wildlife species. Both provided moderately dense mixtures of grasses and broadleaf weeds with an interspersion of bare ground. The grass coverage in planted strips was consistent with bobwhite nesting habitat (31.9%), whereas, after 3 years of succession unplanted filter strips were just beginning to provide nesting cover (10% grass cover). Forb canopy cover in both planted (20.2%) and unplanted (24.7%) filter strips was consistent with brood-rearing habitat when in combination with sufficient bare ground. Bobwhite require approximately 20 percent to 50 percent bare ground to locate food and travel through vegetation. The bare ground component is particularly important for chicks that cannot negotiate dense litter. Planted filter strips provided adequate bare ground (42% bare ground) for feeding and movement; whereas, unplanted filter strips provided more bare ground than needed for quail (60.1%) and may have been too open.

Planted and unplanted field borders both contained forbs (broadleaf herbaceous plants) and grasses that produced seed and cover for northern bobwhite and other early successional wildlife species (figs. 8 and 9). A total of 35 plant species were identified in planted field borders, as compared to 33 in unplanted field border sections. With the exception of grasses, which were more prevalent in planted field borders, there were no substantive differences between planted and unplanted borders for major plant categories (grasses, grass-likes, forbs, woody plants) (fig. 10). Like filter strips, the increased prevalence of grasses in planted field borders is expected since grasses were a major component of the seed mixture applied to planted areas. Also similar to filter strips, native legumes (e.g., *Lespedeza* spp., *Desmodium* spp.) and native grasses (e.g., *Panicum* spp., *Paspalum* spp.) were lacking in both planted and unplanted field borders.

Planted sections of field borders contained all but one of the native plant species occurring in unplanted sections in addition to the mixture of legumes and grasses that were planted (fig. 11). This is probably a result of stimulation of native seeds in the seedbank resulting from the disturbance associated with site preparation. Big bluestem, bitter panicgrass, Indiangrass, and eastern gamagrass were more prevalent in planted field borders; whereas, broomsedge, bermudagrass, primrose, and loblolly pine were more abundant in unplanted

Figure 8. Composition and structure of vegetation in planted field borders (October 2007).

Figure 9. Composition and structure of vegetation in unplanted field borders (October 2007).

field borders. Of the eight dominant plant species identified in field borders (fig. 11), four species, (slender goldentop, swampdock, American everlasting (*Gamochaeta americana*), and common dandelion (*Taraxacum officinale*)), were common in both planted and unplanted sections, while slender goldentop was most prevalent (>90%) in the unplanted field borders, and bitter panicgrass was most prevalent in planted field borders.

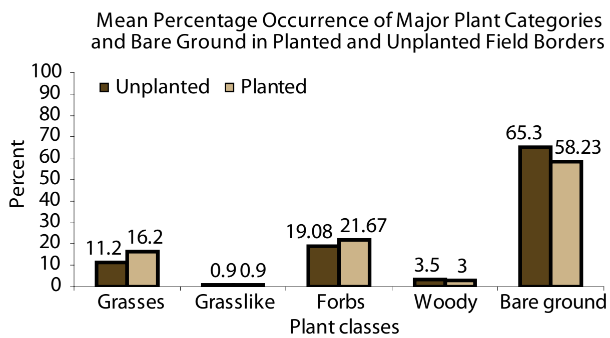

Figure 10. Mean percentage occurrence of major plant categories and bare ground in planted and unplanted field borders.

Planted and unplanted field borders also provided plant structure (i.e., cover) important for nesting, brood rearing, and roosting of quail and other early successional wildlife species. Both areas provided moderately dense mixtures of grasses and broadleaf weeds with an interspersion of bare ground. Both planted and unplanted borders had grass canopy coverage (11–16%) that was beginning to approach that of bobwhite nesting cover. Vegetation in planted field borders was significantly denser than unplanted borders and may provide more cover for ground nesting/dwelling birds and small mammals. Both planted and unplanted borders exhibited forb canopy cover (19–22%) consistent with brood-rearing habitat. Bare ground in planted (58%) and unplanted (66%) field borders in this study provided adequate open ground for feeding, but exceeded what is normally preferred by bobwhite.

Recommendations

In this study, planted and unplanted filter strips and field borders provided habitat for early successional wildlife species such as bobwhite. Planting herba-

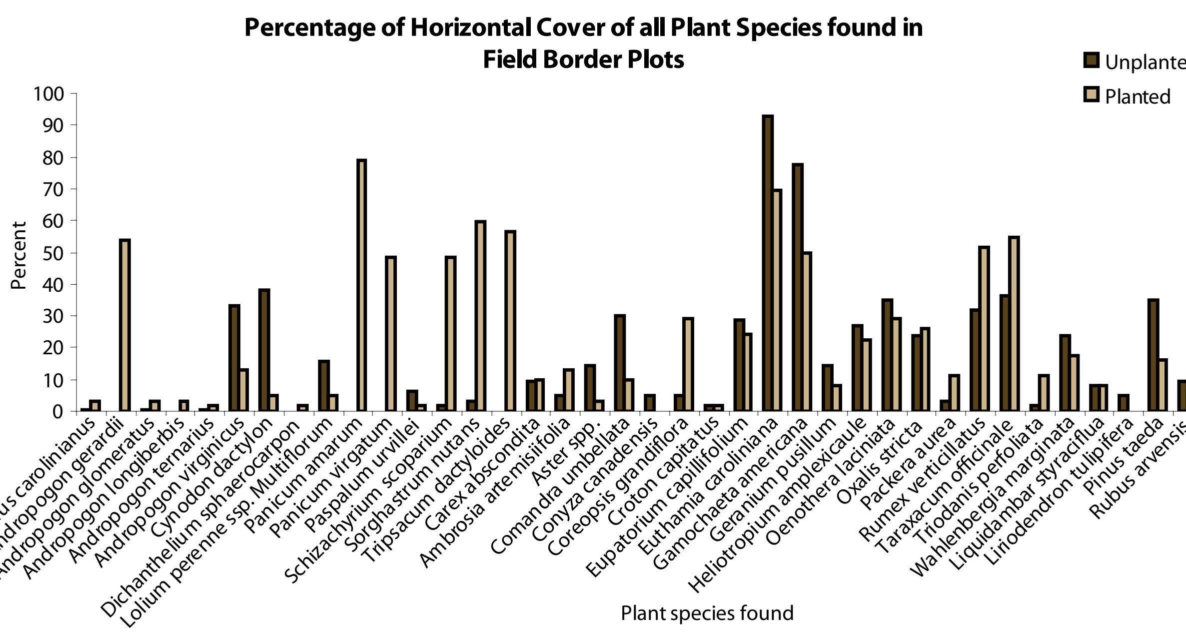

Figure 11. Mean percentage occurrence of plant species in planted and unplanted field borders.

ceous conservation buffers ensures that grasses and forbs important to quail will become established, in addition to native seeds already present in the soil. In the absence of prior knowledge regarding presence or absence of native seeds in the seedbank, or observations of native grasses and forbs growing in close proximity to buffer, planting to a grass/forb mixtures is recommended. Unplanted buffers did provide habitat for bobwhite; however, the value (plant composition and structure) of these areas for quail and other early successional wildlife species could have been improved with different forms of periodic management (e.g., prescribed burning).

The structural characteristics (% bare ground, % grass, and % forb cover) of planted and unplanted buffers in this study indicated that by the third full growing season, these buffers were just beginning to provide the combination of nesting and brood-rearing habitat desired for bobwhite. Recurring management practices (e.g., disking, CPS Code 647 and Prescribed Burning, CPS Code 338), other than competition control (Pest Management, CPS Code 595), were likely not needed prior to the fourth growing season, but would be appropriate thereafter. NRCS guidelines should allow landowners the flexibility to retain unplanted areas as herbaceous conservation buffers and manage these sites for native wildlife plants.

The following should be considered when establishing and managing herbaceous conservation buffers for wildlife:

- Determine the most appropriate areas for herbaceous buffer establishment with the greatest benefit to wildlife.
- Consider a mixture of planted and unplanted buffers.

Planted Filter Strips:

- Where possible, select native plants adapted to local geographic and soil conditions.
- Select a mixture of native grasses, legumes, and forbs.
- Select perennials and reseeding annuals.
- Follow planting guidelines for soil tests, seedbed preparation, fertilization and liming rates, planting depths, planting rates, and maintenance practices.

Unplanted Filter Strips:

- In areas that were previously cultivated or prepared for planting, allow buffer strips to remain unplanted for 1 year and evaluate for native plant response and weed competition.
- Spot treat unwanted weeds, as needed, with appropriate herbicides.
- Beginning in the third or fourth year after establishment, maintain unplanted buffers by periodic (every 1–3 years) disking during fall—winter or prescribed burning in late winter or early spring. Leave two-thirds of area undisturbed to provide cover.

It is important to monitor planted and unplanted buffers over time as each site is different and results may vary between areas. Records should be kept on the response of vegetation (plant composition and structure) to various management practices such as those recommended above or others that may be incorporated into the management plan. These observations are invaluable when developing specific and customized management approaches to best provide wildlife habitat in filter strips.

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Prescribed Burning to Improve Wildlife Habitat in Forest Systems

Prescribed burning is the intentional use of controlled fire to accomplish land and wildlife management objectives. Prescribed burning mimics the natural process of wildland fire and is an essential management practice in fire-dependent systems (i.e., pine/grasslands, prairie, savanna, glades, etc.). Fire alters the competitive balance among plant species and improves wildlife habitat by setting back plant succession, controlling undesirable vegetation, stimulating germination of desirable plants, and reducing wildfire hazards. Prescribed burning to enhance wildlife habitat value is cost-shared under a myriad of U.S. Department of Agriculture (USDA) conservation programs including the Wildlife Habitat Incentives Program (WHIP), Environmental Quality Incentives Program (EQIP), and Conservation Reserve Program (CRP). Prescribed burning under USDA conservation programs is conducted under the Natural Resource Conservation Service (NRCS) Conservation Practice Standard (CPS) Code 338, Prescribed Burning. This project created public demonstration areas to illustrate the benefits of prescribed burning and evaluated current NRCS guidelines for prescribed burning and burning conducted in combination with forest thinnings and openings for providing wildlife habitat. Prescribed burning was conducted in three treatment combinations during February 2004 and 2005 following NRCS guidelines. Treatment combinations included prescribed burning (PB) in four distinct forest stands, prescribed burning in a precommercially thinned (chipped) forest stand (PBT), and prescribed burning in two separate forest stands that were subject to clearing of forest openings and commercially thinned (BPTO). Prescribed burning and burning in combination with thinnings and creation of forest openings dramatically improved forest habitat for early successional wildlife species such as northern bobwhite. Stands subjected to prescribed burning in combination with forest openings and commercial thinning (PBTO) had nearly three times more herbaceous and low-growing woody plant species than untreated forest stands. Prescribed burning in fully stocked saw timber and midrotation pine stands had more than twice the herbaceous and low-growing woody plant species than untreated forest stands. Precommercially thinned pine stands that were prescribe burned (PBT) had fewer herbaceous and low-growing woody species (n=18) than PB and PBTO stands, but had a greater diversity of plant species than untreated forest stands. The majority of herbaceous plants in burned stands were legumes and forbs, which are important sources of food and cover for bobwhite and other wildlife species. Vertical structure of forest stands was also enhanced in stands that were prescribed burned, or burned in combination with thinning or creation of forest openings. Forest stands that were prescribed burned and thinned (PBTO) and simply prescribed burned (PB) also had greater diversity and number of shrubs than untreated forest stands. Many of the observed shrub layer plants were soft mast producers that are extremely important food sources for wildlife. Additionally, these shrubs provide nesting and protective cover important to many forest wildlife species. Prescribed fire is an essential conservation practice that restores ecological function and integrity to fire-dependent systems and enhances wildlife habitat in southern pine systems.

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Prescribed burning is the intentional use of controlled fire to accomplish land and wildlife management objectives. Prescribed burning mimics the natural process of wildland fire and is an essential management practice in fire-dependent systems (i.e., pine/grasslands, prairie, savanna, glades, etc.). Fire alters the competitive balance among plant species and improves wildlife habitat by setting back plant succession, controlling undesirable vegetation, stimulating germination of desirable plants, and reducing wildfire hazards (NRCS eFOTG 2006) (http://www.nrcs.usda.gov/technical/efotg/). Many studies have documented the value of prescribed burning for wildlife (Greenfield 1997; Brose et al. 1999; Lindenmayer 1999; Sparks et al. 1999; Brawn et al. 2001; Cram et al. 2002; Artman et al. 2005; and Backs and Bledsoe 2006).

Prescribed burning to enhance wildlife habitat value is cost-shared under a myriad of U.S. Department of Agriculture (USDA) conservation programs, including the Wildlife Habitat Incentives Program (WHIP), Environmental Quality Incentives Program (EQIP), and Conservation Reserve Program (CRP). Prescribed burning under USDA conservation programs is conducted under the Natural Resource Conservation Service (NRCS) Conservation Practice Standard (CPS) Code 338, Prescribed Burning. This project created public demonstration areas to illustrate the benefits of prescribed burning and evaluated current NRCS guidelines for prescribed burning and burning conducted in combination with forest thinnings and openings (CPS Code 666, Forest Stand Improvement; CPS Code 384, Forest Slash Treatment) for providing wildlife habitat.

Prescribed Burning and Burning in Combination with Thinnings and Forest Openings

Effects of prescribed burning were evaluated at the 2,300-acre Clemson Pee Dee Research and Education Center in the Coastal Plain region of South Carolina. Prescribed burning was conducted in three treatment combinations during February 2004 and 2005 following NRCS guidelines. Treatment combinations included prescribed burning (PB) in 4 distinct forest stands, prescribed burning in a precommercially thinned (chipped) forest stand (PBT), and prescribed burning in two separate forest stands that were subject to clearing of forest openings and commercially thinned (BPTO) (fig. 1). Two of the four PB treatments were conducted in 50-year-old mixed pine-hardwood forests (*Pinus tadea*, *P. palustris*, *Quercus* spp., *Carya* spp.) (19–31 acres, BA 100 ft^2). The remaining two PB treatments were conducted in a 17-year-old loblolly pine (*P. tadea*) stand (36 acres, BA 110 ft^2), and a 20-year-old loblolly pine stand (22 acres, BA 110 ft^2). The PBT treatment was conducted in a 17-year-old loblolly pine stand (36 acres, BA 120 ft^2) that had been precommercially thinned in rows by chipping in 15-foot-wide strips alternating between 30-foot-wide uncut areas. The BPTO treatments were conducted in two 50-year-old mixed pine-hardwood (*P. tadea*, *P. palustris*, *Quercus* spp., *Carya* spp.) forest stands (20 and 25 acres, BA 100 ft^2) that were commercially thinned to a basal area of 80 square feet and also contained scattered forest openings (1–2 acres in size). Two 50-year-old

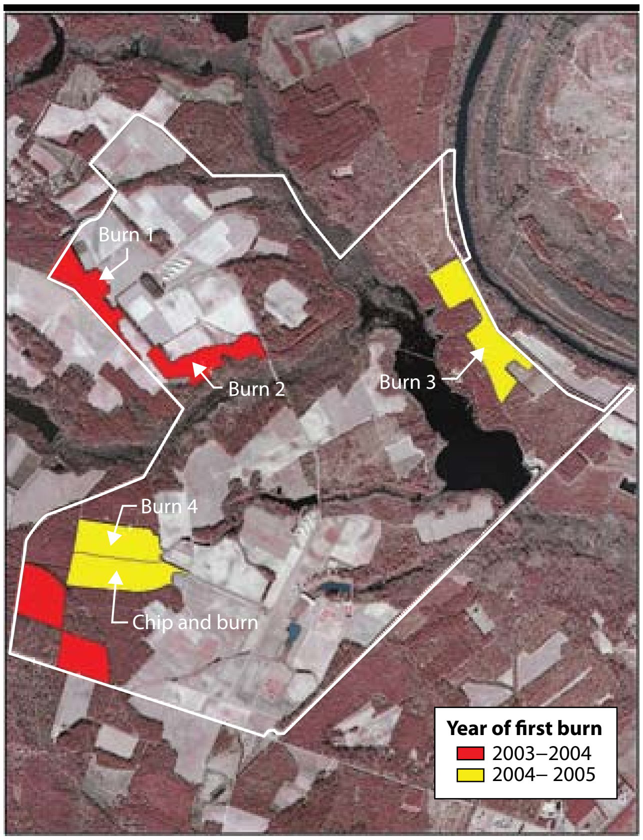

Figure 1. Prescribed burn (PB=burn 1-4), prescribed burn/ thinned (PBT= chip and burn), prescribed burn/thinned/ forest openings (PBTO=thin/open/burn) forest stands.

mixed pine-hardwood (*P. tadea*, *P. palustris*, *Quercus* spp., *Carya* spp.) forest stands (11 and 31 acres, BA 100 ft^2) were used as untreated controls.

Plant Responses to Practices

Prescribed burning and burning in combination with thinnings and creation of forest openings dramatically improved forest habitat for early successional wildlife species such as the northern bobwhite (figs. 2 and 3). Stands subjected to prescribed burning in combination with forest openings and commercial thinning (PBTO) had nearly three times more herbaceous and low-growing woody plant species (n=34) than untreated forest stands (n=11) (fig. 4). These results concur with past studies that demonstrated the importance of prescribed burning and forest openings to stimulate herbaceous plant growth. Prescribed burning in fully stocked sawtimber and midrotation pine stands had more than twice the herbaceous and low-growing woody plant species (n=23) than untreated forest stands (n = 11). Precommercially thinned pine stands that were prescribe burned (PBT) had fewer herbaceous and low-growing woody species (n=18) than PB and PBTO stands, but had a greater diversity of plant species than untreated forest stands. The decreased diversity of herbaceous and low-growing woody

Figure 2. Forest stand before thinning, openings, and prescribed burning.

Figure 3. Forest stand after thinning, openings, and prescribed burning.

LANDSCAPE-LEVEL MANAGEMENT

plants in PBT stands may be attributed to row thinning and the relatively dense stand of loblolly pine that remained in alternating rows. The majority of herbaceous plants in burned stands were legumes and forbs, which are important sources of food and cover for bobwhite and other wildlife species. Vertical structure of forest stands was also enhanced in stands that were prescribed burned or burned in combination with thinning or creation of forest openings.

Forest stands that were prescribed burned and thinned (PBTO) and simply prescribed burned (PB) had greater diversity and number of shrubs than untreated forest stands (PBTO=16, PB=17, control=10) (fig. 5). Many of the observed shrub layer plants were soft mast producers that are extremely important food sources for wildlife. Additionally, these shrubs provide nesting and protective cover important to many forest wildlife species (table 1). The variety of shrubs found in PBTO and PB forest

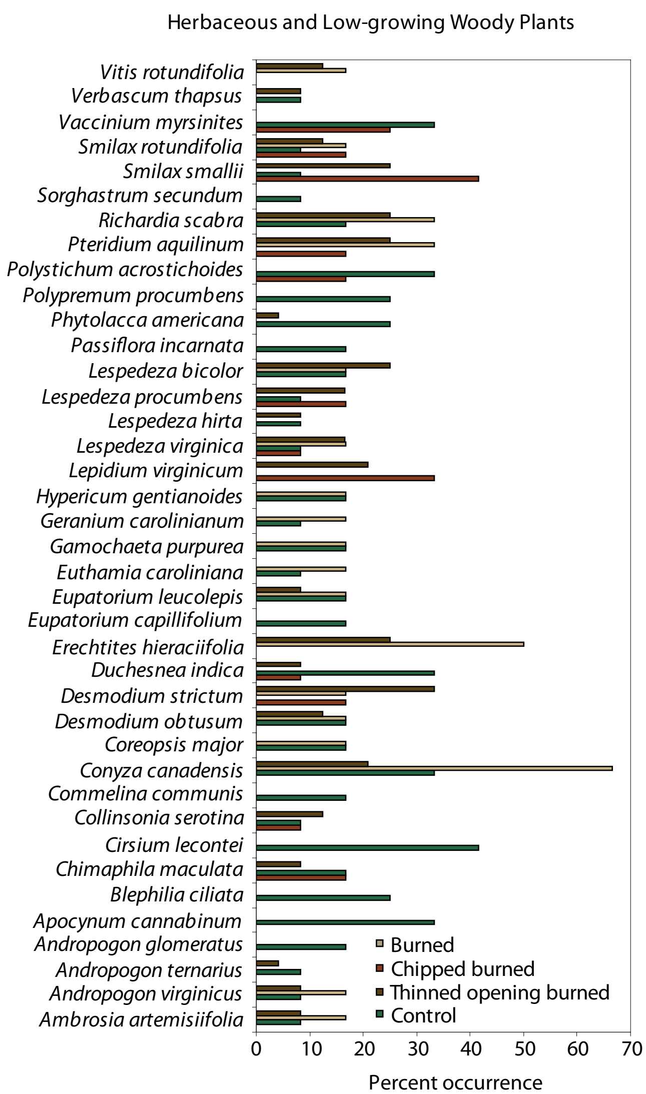

Figure 4. Herbaceous and low-growing woody plants in burned (PB), burned/chipped (PBT), burned/thinned/opening (PBTO), and untreated (control) forest stands.

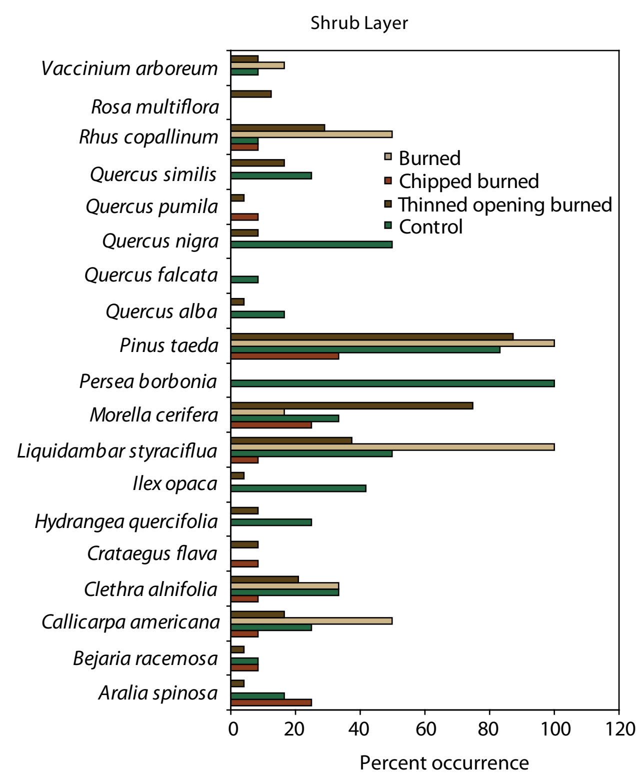

Figure 5. Shrub layer in burned (PB), burned/chipped (PBT), burned/thinned/opening (PBTO), and untreated (control) forest stands.

LANDSCAPE-LEVEL MANAGEMENT

ensures the availability of mast throughout most of the year. PBT forest stands had fewer shrub species (n=7), which may be attributed to row thinning and the relatively dense stand of loblolly pine remaining in alternate rows. PB, PBTO, and untreated forest stands had a similar number of tree species (PB=10, PBTO=8, control=10); however, tree composition of each area differed (fig. 6). This likely resulted from the removal of some tree species during thinning and/or forest opening operations. Care should be taken to inventory and mark trees prior to thinning or harvest operations so that trees that are important to wildlife may be retained within the forest stands.

Table 1. Presence of birds in burned (PB), burned/chipped (PBT), burned/thinned/opening (PBTO), and untreated (control) forest stands.

Bird Species	Burn	Chipped/Burn	Thinned/ Opening/Burn	Control
Wild Turkey	•	•	•	
Northern Bobwhite	•	•	•	
Barred Owl			•	
Screech Owl	•		•	
Great Horned Owl	•		•	•
Sharp-shinned hawk	•		•	•
Broad-winged Hawk			•	•
Red-shouldered hawk	•			
American Goldfinch	•			•
American Redstart			•	•
Black-throated Blue Warbler	•		•	•
Blue-gray Gnatcatcher	•		•	•
Blue Grosbeak	•			•
Blue Jay	•	•		•
Boat-tailed Grackle	•			
Brown Thrasher	•			•
Brown-headed Cowbird	•		•	
Northern Cardinal	•		•	•
Carolina Chickadee	•		•	•
Carolina Wren	•		•	•
Chipping Sparrow	•	•		•
Common Crow	•			•
Common Grackle	•			•
Eastern Bluebird	•			
Eastern Kingbird	•		•	•
Eastern Phoebe	•		•	
Eastern Towhee	•		•	
Eastern Wood Pewee	•		•	•
European Starling	•			•
Gray Catbird	•		•	•

Bird Species	Burn	Chipped/Burn	Thinned/ Opening/Burn	Control
Indigo Bunting	•		•	•
Magnolia Warbler	•	•		•
Northern Mockingbird	•			•
Red-winged Blackbird	•		•	•
Prothonotary Warbler	•		•	•
Rose-breasted Grosbeak			•	•
Ruby-throated Humming-bird	•		•	•
Song Sparrow		•		
Summer Tanager	•			
Tufted Titmouse	•		•	•
Yellow-rumped Warbler			•	•
Yellow-billed Cuckoo	•			•
Chuck-will's-widow	•		•	
Red-headed Woodpecker	•		•	•
Red-bellied Woodpecker			•	•
Downy Woodpecker	•		•	•
Hairy Woodpecker	•		•	•
Red-cockaded Woodpecker			•	
Wood Duck	•			•
Bachman's Sparrow		•		
Louisiana Waterthrush	•			•
Brown Creeper	•		•	
Orchard Oriole	•		•	•
Red-eyed Vireo	•		•	•
Yellow-breasted Chat	•	•	•	•
American Woodcock			•	•
Hooded Warbler			•	•
Kentucky Warbler	•		•	•
Painted Bunting	•		•	•

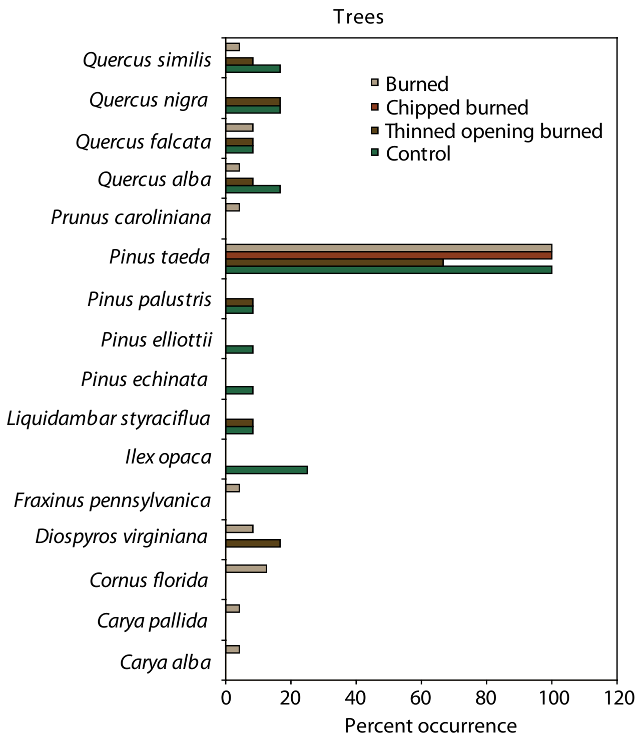

Figure 6. Trees in burned (PB), burned/chipped (PBT), burned/thinned/opening (PBTO), and untreated (control) forest stands.

Recommendations

The following recommendations should be considered when planning and implementing prescribed burning in forest stands:

- Design and layout areas to be burned in advance as part of an overall land use and management program to provide maximum benefit for wildlife.
- Prioritize burning needs, and develop a burning schedule to maximize efforts within limited burning opportunities. This should be part of an overall prescribed burning plan.
- Identify and mark proposed and burned stands in the field and on aerial photographs, and where practical, archive within a GIS database.
- To maintain early successional plants important to wildlife, prescribe burn entire forest stands every 3 years by burning only a third of the stand annually to retain wildlife cover.
- Protect mast-producing trees and wildlife cover prior to prescribed burns.
- Since local conditions dictate the response of vegetation to burning, experiment with timing of prescribed burns. Burning in late February or early March may encourage forbs and legumes; whereas, burning during the growing season in late May or June may result in a greater variety of grasses.
- Develop a network of firebreaks between forest stands to provide access and serve as openings that can be managed for native herbaceous plants important to wildlife.
- Where possible, use prescribed burning with forest thinning and openings to maximize response of vegetation.
- Integrate prescribed burning for wildlife, where possible, with burning for timber management.
- Develop a program to document and monitor the success of prescribed burning and modify burning schedules when appropriate.

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Clemson University
Department of Aquaculture, Fisheries, and Wildlife
Natural Resources Enterprises Workshop
February 15, 2007

Greg Yarrow (associate professor at Clemson University) hosted a USDA NRCS Bobwhite Restoration Project Field Day on February 15, 2007. The Natural Resources Enterprises Workshop and field tour was held at the Pee Dee Research and Education Center in Florence, South Carolina (fig. 1), and featured morning presentations on the revenue potential from natural resource enterprises, development, marketing and operation of a natural resource enterprise, fee hunting and fishing opportunities, liability and legal considerations, and landowner cost-share programs. The afternoon session included a Wildlife Habitat Conservation and Management field tour that included several stops at research sites that were part of the USDA NRCS Bobwhite Restoration Project, as well as demonstrations of Farm Bill conservation practices for wildlife, farm and forest management for wildlife, wetland wildlife management, and outdoor education trail systems. Sites involved in the USDA NRCS Bobwhite Restoration Project research study included riparian forest buffers, hedgerows, field borders, native warm-season grass plantings, and variable sized forest thinnings and openings (fig. 2). There was an excellent turnout for the event with 102 landowners in attendance.

Figure 1. It was an excellent turnout for the Natural Resources Enterprises Workshop held at the Pee Dee Research and Education Center in Florence, SC.

Figure 2. Forest openings provide quality habitat for quail and other early successional bird species. Thinning of forests stimulates the herbaceous plant community, attracting quail and other birds to ample food and ground cover.

United States Department of Agriculture

Natural Resources Conservation Service

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Use of Human Dimensions Information as a Tool for Selecting Large-scale Bobwhite Restoration Areas

LANDOWNER PERSPECTIVE

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Acknowledgments and disclaimer

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Use of Human Dimensions Information as a Tool for Selecting Large-scale Bobwhite Restoration Areas

Much of the potential success of northern bobwhite (*Colinus virginianus*) restoration is dependent on the skill at engaging private landowners in habitat restoration on multiple, contiguous farms. Large-scale restoration is needed to ensure bobwhite population viability and hunting sustainability. This magnitude of restoration will be best accomplished if landowners work together—cooperatively—in implementing habitat management. As part of a study to develop a systematic approach for using landowner attitude data to identify restoration areas, the study presents highlights from a landowner questionnaire. Study participants represented a diverse mix of landowner types with 20 percent classified as owner of rural land not used for farming (i.e., recreational landowner), 20 percent as full-time farmer, 24 percent as part-time farmer, and 36 percent as landlord of a farm. When deciding how to manage their land, the most popular considerations were "quietly enjoying my land," "being a good steward," "leaving my land for my children," "conserving the land for future income," and "providing good hunting opportunities." Many of the landowners had participated in conservation programs. The two most used programs were the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) and programs of Missouri Soil and Water Conservation Districts. Across all programs, 76 percent rated their experiences as good. Experiences rated as good were highest (90%) for other Federal conservation programs and lowest (46%) for the USDA Grassland Reserve Program. A large majority of landowners wanted bobwhite on their property, and they recognized that habitat management is the solution to quail restoration. A much smaller percentage of landowners, however, were actually willing to use prescribed quail-friendly practices, and an even smaller fraction liked the concept of a quail habitat restoration cooperative. There were many reasons why landowners showed little interest in quail conservation including "do not like the habitats (e.g., weeds, unmowed grass, native grass) or the practices (e.g., prescribed fire);" "do not have the expertise or equipment to implement the practice;" "do not have the labor or money;" "do not want strangers knocking on their door asking to hunt the restored habitat;" "do not like contracts or the detailed requirements of wildlife habitat practices." On the other hand, many landowners showed interest in quail habitat restoration, and several such multilandowner initiatives are thriving in Missouri. The top priority for landowners interested in joining a cooperative was knowing that management is, in fact, increasing quail abundance. Many of the barriers to participation in quail restoration identified by landowners not interested in joining a cooperative were also important to landowners interested in cooperatives, but they were not an obstacle to taking action. Landowners interested in joining a cooperative fit the following profile: row crop income was not important; had positive experience with government conservation programs; were willing to use quail-friendly management (fire, disking, native plants, etc.); money and time were less of a constraint; had attended habitat workshops; allowed quail hunting; were male; had some college education; and owned their land for just a few years. Overall responses from this study confirm the need for aggressive restoration programs involving collaboration between conservation agencies and organizations. Landowner needs are complex; therefore, multiple strategies must be used to craft programs that are effective, socially acceptable, and economically attractive.

Use of Human Dimensions Information as a Tool for Selecting Large-scale Bobwhite Restoration Areas

Much of the potential success of northern bobwhite (*Colinus virginianus*) restoration is dependent on management of habitat on private land. Efficacious selection of restoration areas requires a foundation of ecological and sociological information. Although much is known about bobwhite habitat management, skill at engaging landowners in habitat restoration at a large scale is meager. Habitat restoration programs are increasingly focusing on multiple, contiguous farms to ensure viable bobwhite population and sustainable hunting opportunities. Such large-scale restoration will be best accomplished if landowners work together—cooperatively—in implementing habitat management.

To accomplish bobwhite habitat restoration on private lands, it is critical to improve understanding of how landowners make management decisions. Decision support tools are needed to help resource managers identify and predict landowner suitability for participating in cooperative habitat restoration ventures. As part of a study to develop a systematic approach for using landowner sociological data to identify restoration areas, landowner attitudes were evaluated using a mail-in survey.

A 31-question, self-administered, mail-back questionnaire, entitled "Songbirds and Small Game on Private Lands" was used to assess landowner characteristics and estimate landowner suitability (defined as their knowledge, willingness, and ability) for carrying out habitat restoration in a cooperative setting. *As required, the survey protocol and questionnaire were approved for use by the University of Missouri Institutional Review Board for Use on Human Subjects in Research, as outlined in the Code of Federal Regulations (Exemption 46.101.b.2).*

The questionnaire was mailed in August 2005 to 1,659 rural landowners who owned at least 20 acres in five 70,000-acre study areas in Adair, Caldwell, Clark, Gentry, Knox, Lewis, Macon, and Scotland Counties in north Missouri. A total of 735 completed questionnaires were received, and responses to select questions are described in this note. The first section provides basic information about landowners in the survey area (e.g., kind of farming they do, what is important to them, satisfaction with conservation programs). The second section features responses to those questions that relate to the landowners' perception of managing their property for bobwhite and their interest in working cooperatively for bobwhite restoration.

Section I. Background information on landowners

Question: As a landowner, are you a full-time farmer, part-time farmer, nonfarming farmland landowner (landlord), or owner of rural land not used for farming?

The respondents represent a diverse mix of landowner types with 20 percent classified as owner of rural land not used for farming (i.e., recreational landowner), 20 percent as full-time farmer, 24 percent as part-time farmer, and 36 percent as landlord of a farm (fig. 1).

Question: How important or unimportant is each of these factors to you when deciding how to manage your land?

The top responses included "quietly enjoying my land," "being a good steward," "leaving my land for my children," "conserving the land for future income," and "providing good hunting opportunities" (fig. 2). Respondents ranked "receiving income from row crops," "government programs" and "livestock" lower in importance.

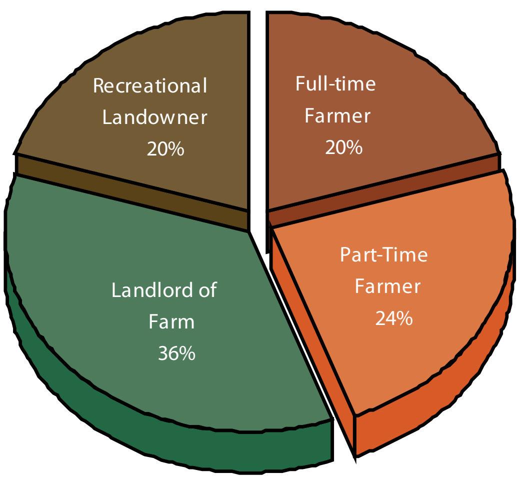

Figure 1. Classification of landowners responding to the mail survey.

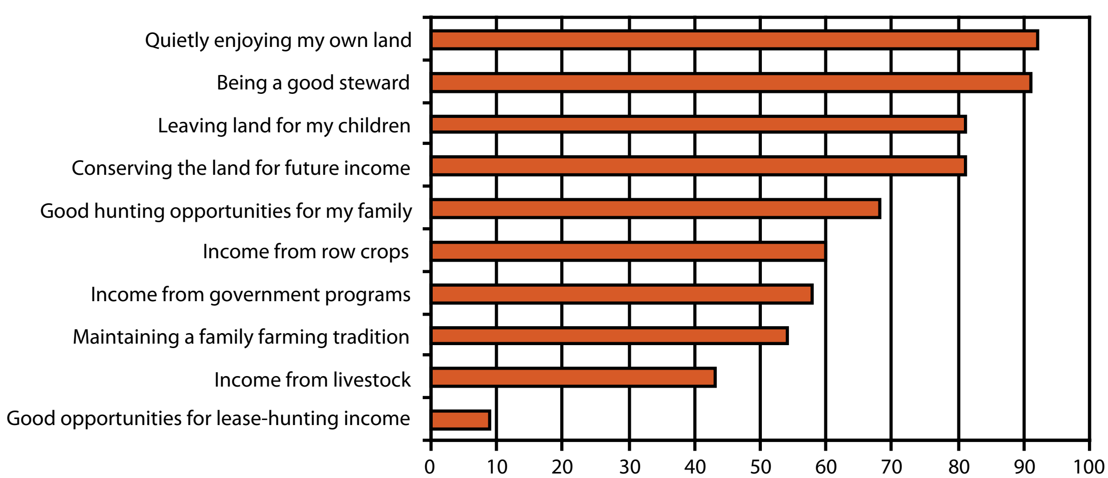

Figure 2. Percent of landowners choosing different reasons for owning land.

LANDOWNER PERSPECTIVE

Question: Have you participated in any of the following conservation programs? For each program please rate your overall experience (good, neutral, bad).

Many of the landowners had participated in a government or nongovernment conservation program. The two most used programs were the USDA CRP and programs of Missouri Soil and Water Conservation Districts. Of these respondents, more than 80 percent rated their experience with these programs as positive across all programs, 76 percent rated their experiences as good (fig. 3). Experiences rated as good were highest (90%) for other Federal conservation programs and lowest (46%) for the USDA Grassland Reserve Program.

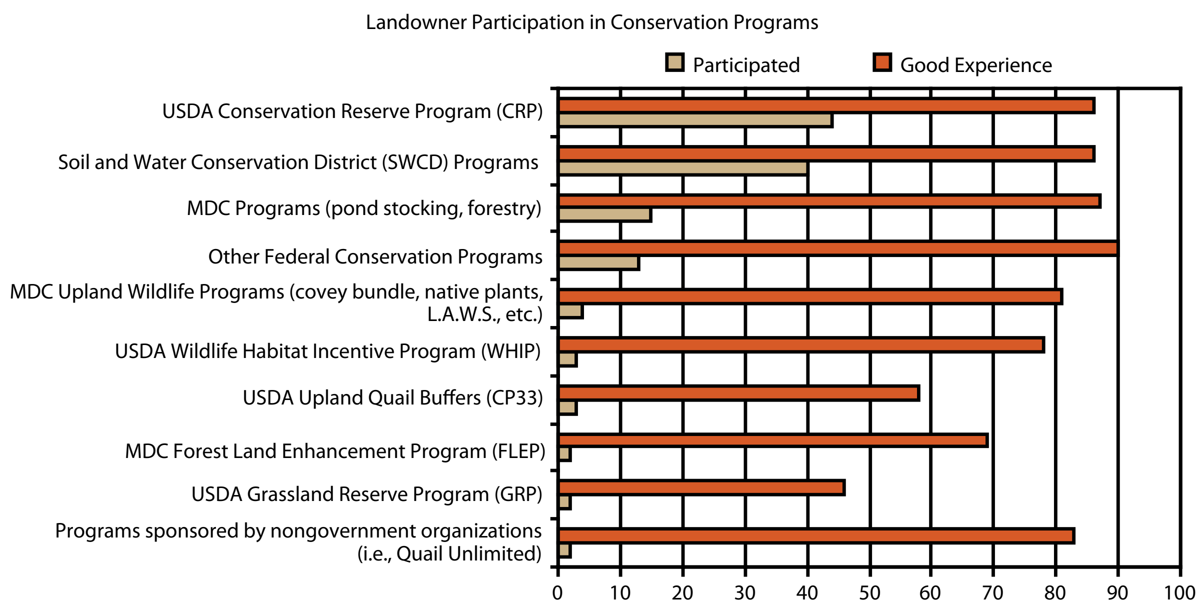

Figure 3. Percent of landowners that have participated in a conservation program, and if so, a rating of their experience.

LANDOWNER PERSPECTIVE

Section II. Landowner attitudes toward wildlife

Question: How important or unimportant is it to you to have the following on your property?

Quail and other small game are very popular with landowners. About 80 percent of the landowners said it was very important or somewhat important to have quail on their property (fig. 4). The least wanted natural resources were hawks/owls, native plants, and birds at my feeder. There were several differences among landowner types. Many recreational landowners (55–80%) liked deer, native plants, and hawks/owls, whereas fewer full-time farmers (36–58%) liked these species.

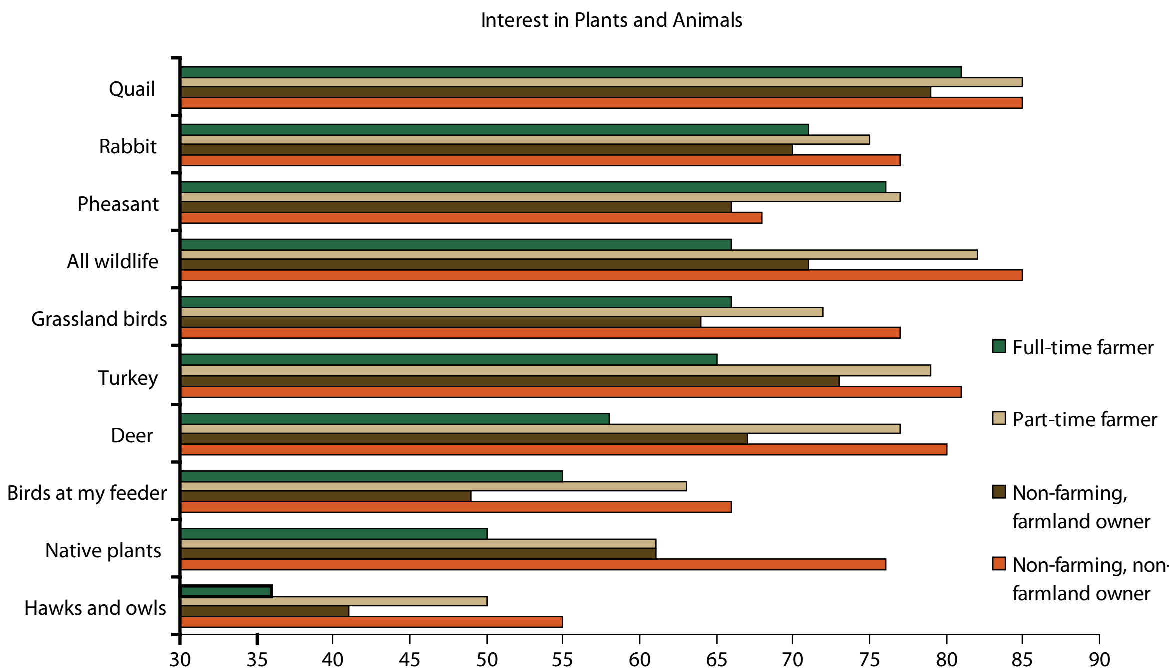

Figure 4. Percent of landowners choosing somewhat important or very important to having various types of plants and animals on their property.

Question: The practices listed below are known to benefit quail. Quail do best when there is a mix of plants, the stand is thin, and woody plants are nearby. How likely or unlikely is it that you would use each of these practices on your land to benefit quail?

Although there is great interest in having bobwhite quail on their property, less than 52 percent of landowners said they might integrate quail-friendly management practices into their operation (fig. 5). A question about quail-friendly practices is very important for two reasons. First, it describes the kind of management activity that needs to be done to benefit quail. Second, it allows biologists to identify landowners who might be willing to do the work, but who are not necessarily interested in a cooperative venture.

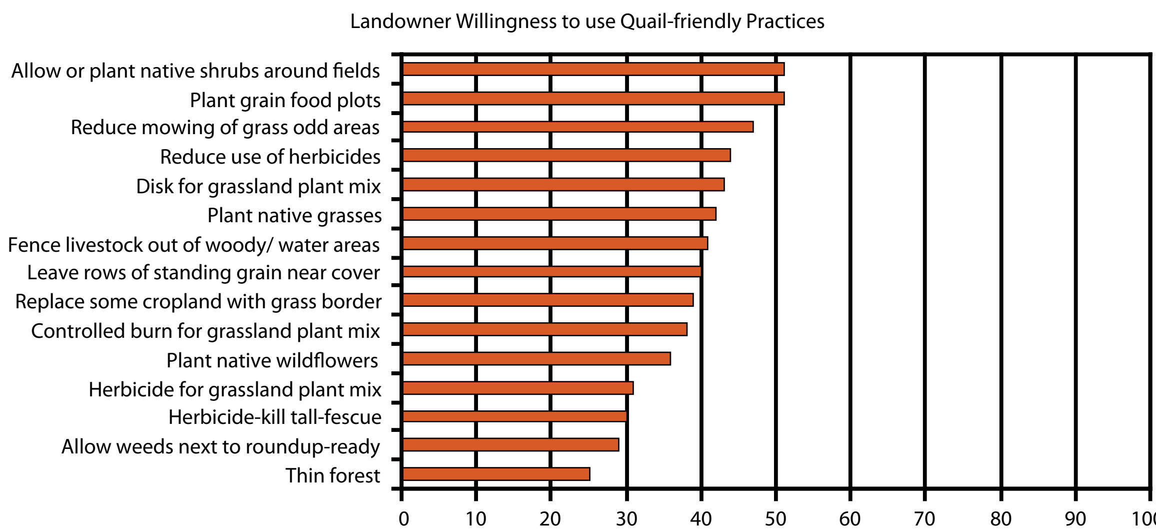

Figure 5. Percent of landowners indicating they were somewhat likely or very likely to use quail-friendly practices on their land. Note: some of the habitat management choices (e.g., fence rows) were deleted because their meaning is ambiguous.

LANDOWNER PERSPECTIVE

Question: Would you be interested in joining a quail cooperative?

This question was introduced with a description of what a cooperative might be (neighbors working together, sharing equipment, getting special technical assistance, etc.). It was indicated that landowners would not be obliged to allow hunting or public access. Compared to the popularity of quail-friendly practices, even fewer said they would be interested in joining a quail management cooperative if it was offered (fig. 6). Among landowner types, full-time farmers were most negative (66%) and part-time farmers were the least negative (52%). Within each landowner category, there was a significant percentage (ranging from 22–31%) of respondents that answered maybe. This response suggested that many landowners might have an interest if certain criteria were met. The next two questions addressed this issue.

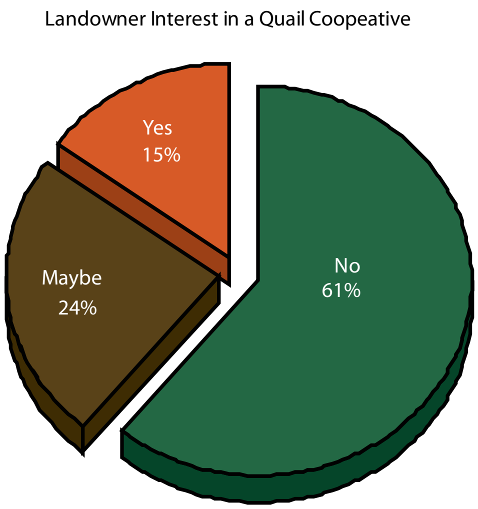

Figure 6. Percent of landowners interested in participating in a quail cooperative.

Question: How important or unimportant would these parts of a quail cooperative be to you?

If landowners answered with a positive response (yes or maybe) to joining a quail cooperative, they had the opportunity to rate the importance of a list of features. The most important features, as identified by at least 60 percent of the respondents, are cost-share incentives, knowing that they are impacting quail numbers, labor and technical assistance, no government red tape, written plans, information and equipment sharing, education, and labor assistance (fig. 7).

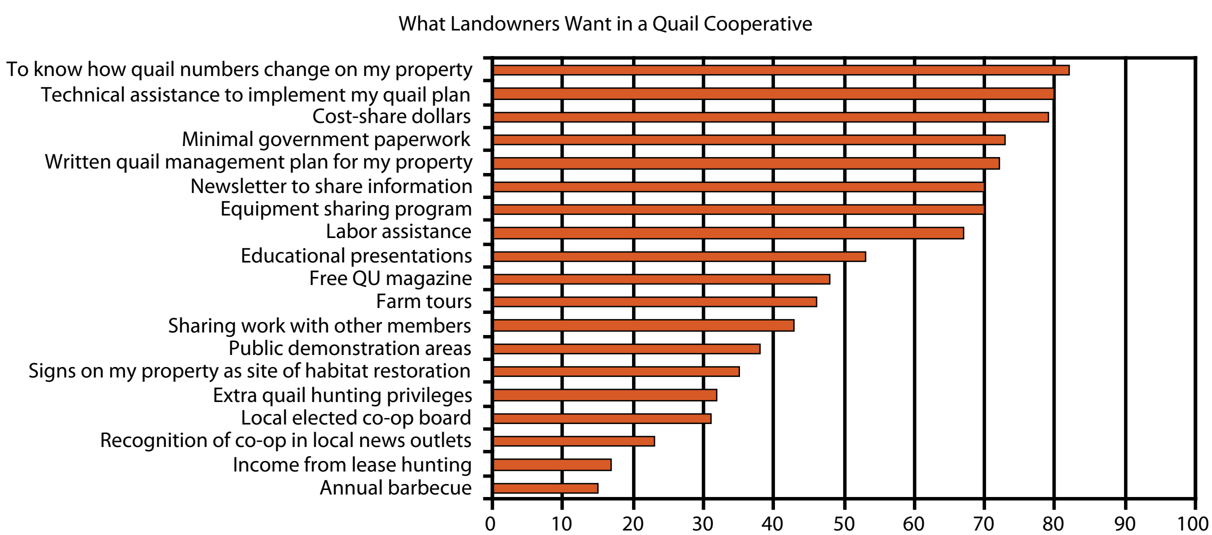

Figure 7. Percent of landowners indicating that select features of a hypothetical quail habitat restoration cooperative would be very important or somewhat important to their willingness to participate.

Question: What are your reasons for not joining a quail cooperative?

If landowners answered no or maybe to participation in a cooperative, they were asked to rate the importance of a list of reasons why. About 65 percent said that they did not want to attract unwanted hunters (fig. 8). Those that said maybe were more concerned about hunters than those that said no (72% vs. 63%, respectively). However, the reason is not that they dislike hunters, because in an earlier question 66 percent of these landowners did allow neighbors and family to access their property to hunt and fish. This suggests that the unwanted hunters are strangers that a habitat restoration program might attract.

Other important reasons for not wanting to join a quail co-op were not wanting to be involved in long-term contracts and not willing to dedicate the time or deal with the requirements of government programs. In addition, the lack of labor, equipment, and money were cited as other important reasons. A lack of interest in quail or the belief that habitat does not help quail were not often cited by the respondents, which suggests that landowners had an interest in quail and believed that habitat is important.

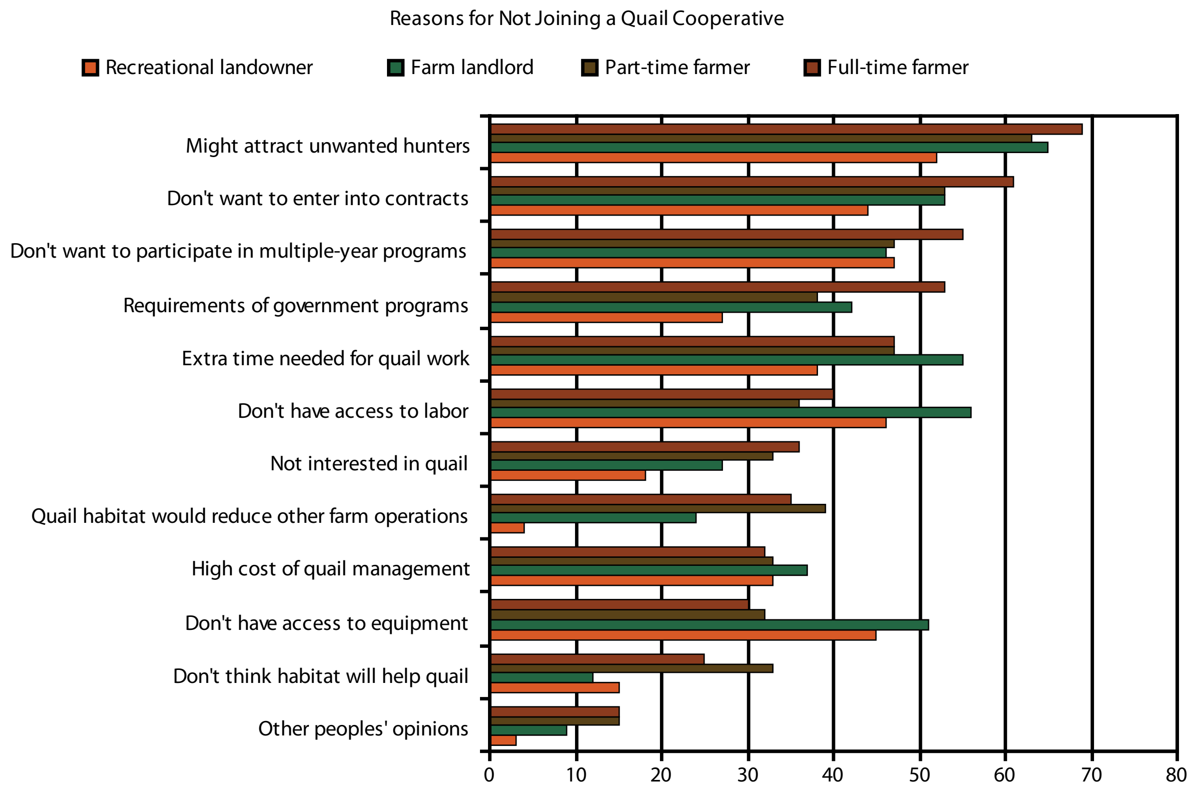

Figure 8. Percent of landowners indicating that select reasons for not joining a hypothetical quail habitat restoration cooperative are very important or somewhat important.

LANDOWNER PERSPECTIVE

Summary

This study provided insights into landowner willingness and ability to carry out quail habitat restoration on their property. A large majority of landowners wanted quail on their property, and they realized that habitat management is the solution to quail restoration. A much smaller percentage of landowners, however, were actually willing to use prescribed quail-friendly practices, and an even smaller fraction was willing to participate in a hypothetical cooperative quail habitat restoration venture.

Obstacles to landowner action included dislike of strangers knocking on their door requesting permission to hunt, contracts and program requirements, time, labor, equipment, and money. Agricultural producers were less interested in quail restoration than were recreational landowners. Focus group discussions with farmers revealed that some expect quail to exist with very little habitat. These farmers wanted quail habitat programs to be more farmer-friendly, cost-effective, and practical.

Many landowners in this study showed tremendous potential for large-scale quail habitat restoration, and several such initiatives are thriving in Missouri. The top priority for landowners interested in joining a cooperatives was knowing that management is, in fact, increasing quail abundance. Many of the barriers to participation in quail restoration identified by landowners not interested in joining a cooperative were also important to landowners interested in cooperatives, but they were not an obstacle to taking action. Landowners interested in joining a cooperative fit the following profile: row crop income was not important, had positive experience with government conservation programs, were willing to use quail-friendly management (fire, disking, native plants, etc.), money and time were less of a constraint, had attended habitat workshops, allowed quail hunting, were male, had some college education, and owned their land for just a few years. Cost-share incentives, equipment, education, technical assistance, and knowing that management is in fact increasing quail abundance were all cited as important parts of a quail habitat restoration program.

Overall responses from this study confirm the need for aggressive restoration programs involving collaboration between resource agencies and conservation organizations. Landowner needs are complex, so multiple strategies must be used to craft programs that are effective, socially acceptable and economically attractive.

NRCS Conservation Practice Standards

National Handbook of Conservation Practices

http://www.nrcs.usda.gov/technical/Standards/nhcp.html

Code	Practice Name	Practice Standards Link
314	Brush Management	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/314.pdf
327	Conservation Cover	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/327.pdf
338	Prescribed Burning	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/338.pdf
382	Fence	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/382.pdf
384	Forest Slash Treatment	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/384.pdf
386	Field Border	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/386.pdf
391	Riparian Forest Buffer	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/391.pdf
393	Filter Strip	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/393.pdf
394	Firebreak	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/394.pdf
422	Hedgerow Planting	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/422.pdf
511	Forage Harvest Management	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/511.pdf
528	Prescribed Grazing	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/528.pdf
550	Range Planting	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/550.pdf
595	Pest Management	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/595.pdf
612	Tree/Shrub Establishment	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/612.pdf
643	Restoration and Management of Rare or Declining Habitats	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/643.pdf
645	Upland Wildlife Habitat Management	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/645.pdf
647	Early Successional Habitat Development Management	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/647.pdf
666	Forest Stand Improvement	ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/666.pdf

APPENDIX B

Products and Presentations

Theses/Dissertations

Butler, A.B. 2007. Habitat characteristics influencing resident and over-wintering grassland birds on the dry prairie of south-central Florida. M.S. Thesis. University of Georgia, Athens, GA.

Conover, R.R. In prep. Grassland bird associations in managed agricultural matrix. Ph.D. Dissertation. Iowa State University, Ames, IA.

Gruchy, J.P. 2007. An evaluation of field management practices to improve bobwhite habitat. M.S. Thesis. University of Tennessee, Knoxville, TN.

Heaton, W.C. 2007. Evaluation of conservation management practices for Northern bobwhites and shrub-scrub songbirds. M.S. Thesis. Clemson University, Clemson, SC.

Labrum, K. 2008. Bobwhite production, brood ecology, and brood movements in response to habitat restoration in Northern Arkansas. M.S. Thesis. Arkansas Tech University, Russellville., AR.

Riddle, J.D. 2007. Maximizing impacts of field borders for quail and early-succession songbirds: What's the best design for implementation? Ph.D. Dissertation. North Carolina State University, Raleigh, NC.

Peer-reviewed Publications

Butler, A.B., J.A. Martin, W.E. Palmer, and J.P. Carroll. In prep. Effects of patch size and habitat characteristics on breeding birds in south Florida's dry prairie. Journal of Wildlife Management.

Butler, A.B., J.A. Martin, W.E. Palmer, and J.P Carroll. In prep. Habitat use by two migrant grassland passerines over-wintering on south Florida's dry prairie. The Wilson Journal of Ornithology.

Conover, R.R., S.J. Dinsmore, and L.W. Burger, Jr. In prep. Avian assemblages in reconstructed linear and block early-succession habitats amongst row-crop agriculture. American Midland Naturalist.

Gruchy, J.P., and C.A. Harper. 2006. When is the best time to disk native warm-season grasses for wildlife? Pages 296–303 *in* M.A. Sanderson et al. (eds.). Proceedings of the 5th Eastern Native Grass Symposium. Harrisburg, PA, October 10–13, 2006.

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Martin, J.A., W.E. Palmer, and J.P. Carroll. In prep. Response of northern bobwhite populations to NBCI and Farm Bill practices. American Midland Naturalist.

Martin, J.A., A.B. Butler, W.E. Palmer, and J.P. Carroll. In prep. The forgotten grassland: Management needs for south Florida grasslands. Conservation Biology.

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Riddle, J.D., C.E. Moorman, and K.H. Pollock. 2008. A comparison of methods for estimating northern bobwhite covey detection probabilities. Journal of Wildlife Management 72:1437–1442.

Riddle, J.D., C.E. Moorman, and K.H. Pollock. 2008. The importance of habitat shape and landscape context to northern bobwhite populations. Journal of Wildlife Management 72:1376–1382.

Books/Book Chapters/Manuals

Harper, C.A., G.E. Bates, M.P. Hansbrough, M.J. Gudlin, J.P. Gruchy, and P.D. Keyser. 2007. Native warm-season grasses: Identification, establishment, and management for wildlife and forage production in the Midsouth a manual for natural resource professionals and other land managers. PB 1752. UT Extension, Knoxville, TN. 204 pages.

Semi-technical/Popular Articles

Abercrombie, E., and C.B. Dabbert. This issue. Habitat availability for northern bobwhite can be increased using EQIP in the Texas high plains. USDA NRCS Technical Note.

Baxter, R.J., and J.C. Bednarz. This issue. Response of Northern Bobwhite Populations and the Associated Avian Communities to Landscape Level Management in Arkansas. USDA NRCS Technical Note.

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Guliano, W., J. Selph., A. Wilcox., E. Wilcox, and J.A. Martin. 2005. Guide to important plants for bobwhites and cattle in south Florida.

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Abercrombie, E.D., and C.B. Dabbert. Northern bobwhite and scaled quail response to Environmental Quality Incentives Program (EQIP) practices in the Shortgrass Prairie Conservation Region (TBCR 18). 13th Annual Wildlife Society Conference. Anchorage, AK, September 23–27, 2006.

Abercrombie, E.D., and C.B. Dabbert. 2007. Northern bobwhite and scaled quail response to Environmental Quality Incentives Program (EQIP) practices in the Shortgrass Prairie Conservation Region (TBCR 18). Texas Chapter of the Wildlife Society. Beaumont, TX.

Baxter, R.J., and J.C. Bednarz. 2007. Songbird and northern bobwhite responses to management practices in Fulton County Arkansas. Partners in Flight Annual Meeting. Memphis, TN, February 2007.

Conover, R.R., S.J. Dinsmore, and L.W. Burger, Jr. 2007. Avian nesting ecology in linear vs. block early succession habitat. Society of Conservation Biology, Iowa State University Chapter Symposium. Ames, IA, February 2007.

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Gruchy, J.P., and C.A. Harper. Managing quality early successional habitat on native warm-season grass fields in Tennessee. Annual meeting of the Tennessee Chapter—The Wildlife Society. Fall Creek Falls, TN.

Gruchy, J.P., and C.A. Harper. Effects of seasonal herbicide applications with and without disking on tall fescue renovation in Tennessee. Annual meeting of the Tennessee Chapter - The Wildlife Society. Paris Landing State Park, TN, 2006.

Heaton, W.C. 2005. Evaluation of four conservation management practices for northern bobwhites and grassland songbirds. South Carolina USDA Wildlife Services Conference. Hickory Knob State Park Resort, McCormick, SC, August 8–10, 2005.

Knipp, L.A. 2004. USDA's Farm Bill wildlife habitat practices. RC & D Meeting. Greenville, SC, October 13, 2004.

Knipp, L.A. 2005. Sustainable land management demonstration and research for wildlife. South Carolina State Meeting for USDA Wildlife Services. Hickory Knob State Park, McCormick, SC, August 8, 2005.

Knipp, L.A., and A.J. Savereno. 2005. Integrating wildlife habitat enhancement with agricultural practices. 27th Annual Southern Conservation Tillage Systems Conference. Pee Dee Research and Education Center, Florence, SC, June 29, 2005.

Labrum, K., and C. Kellner. 2007. Bobwhite reproductive ecology in Northern Bobwhite Conservation Initiative (NBCI) management areas. Arkansas Quail Committee Meeting. February 27, 2007.

Labrum, K., and C. Kellner. 2007. Bobwhite nesting and brood-rearing habitat use in response to habitat restoration efforts in Arkansas. Arkansas Academy of Science Meeting. Arkansas Tech University, April 13–14, 2007.

Martin, J.A. 2006. Thinking and looking large: what you should think about (and why) when managing for bobwhites. NRCS Soil Conservation Society Meeting. Quincy, FL.

Martin, J.A. 2006. Implementing the NBCI on Florida rangelands using Farm Bill programs. Southeastern Partners in Flight Annual Meeting. Tallahassee, FL.

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Osborne, D.C., D. Sparling, J. Cole, and D. Howell. 2006. Response of northern bobwhite, vegetation and arthropods to mid-contract management in aging CRP grasslands of south-central Illinois. Gamebird 2006. Athens, GA, May 31–June 4, 2006.

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Riddle, J., C.E. Moorman, and F. Perkins. 2005. Maximizing the impact of field borders for quail and early-succession songbirds: what's the best design for implementation? 11th Annual Southeast Quail Study Group Meeting. Gilbertsville, KY, August 14–17, 2005.

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Savereno, A.J. Wildlife research initiatives at the Pee Dee Research and Education Center. Florence Chapter of Society of American Foresters. Florence, SC, April 25, 2005.

Scroggins, H.J., T.V. Dailey, R.A. Reitz, T B. Treiman, C.D. Scroggins, R.A. Pierce, II, and W.B. Kurtz. 2006. Focusing on bobwhite quail: Results of four northern Missouri focus groups. 12th International Symposium on Society and Resource Management. Vancouver, BC, June 7, 2006.

Sparling, D., D. Osborne, J. Cole, and D. Howell. 2005. Response of northern bobwhite, vegetation and invertebrates to three methods of renovating monotypic CRP grasslands in south-central Illinois. 11th Annual Southeast Quail Study Group meeting. Gilbertsville, KY, August 14–17, 2005.

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Workshops/Field Days/Seminars

Abercrombie, E.D., and C.B. Dabbert. 2007. Wildlife habitat and native grasses benefiting quail. NRCS, Ladies Farm Tour Public Field Day. Plains, TX, September 11, 2007.

Baxter, R.J., and J.C. Bednarz. 2006. Response of northern bobwhite populations and the associated avian communities to landscape level management: Progress report. Great Arkansas Quail Outing. Arkansas Game and Fish Commission Media Day. Mammoth Springs, AR, May 23–24, 2006.

Baxter, R.J., and J.C. Bednarz. 2006. Response of northern bobwhite populations and the associated avian communities to landscape level management: Progress report. Fulton County Quail Focal Area Appreciation Day. Landowner Appreciation Banquet. Cherokee Village, AR, August 26, 2006.

Baxter, R.J., and J.C. Bednarz. Response of northern bobwhite populations and the associated avian communities to landscape level management. Fulton County, AR Field Day. Saddle, AR, September 5, 2007.

Conover, R.R., S.J. Dinsmore, and L.W. Burger, Jr. 2007. Wildlife Habitat on Agricultural Farms Field Day. Clarksdale, MS, July 18, 2007.

Dabbert, C.B., and E.D. Abercrombie. 2007. EQIP/quail in the High Plains of Texas. USDA NRCS/MSU Northern Bobwhite Habitat Restoration Project Field Day. Morton, TX, May 24, 2007.

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Gruchy, J.P., and C.A. Harper. 2006. Managing native warm-season grasses for wildlife. UT/NRCS Early Successional Wildlife Habitat Field Day. McMinn County, TN, June 22, 2006.

Gruchy, J.P., and C.A. Harper. 2006. Renovating tall fescue and other non-native grasses. UT/NRCS Early Successional Habitat Field Day. McMinn County, TN, June 22, 2006.

Gruchy, J.P., and C.A. Harper. 2006. Using herbicides to manage early successional habitat for wildlife. Wildlife and Water Quality on North Carolina Farms Field Day. Ammon, NC, August 16, 2006.

Harper, C.A., and J.P. Gruchy. 2005. Managing early successional habitat for wildlife. Steak and Potatoes Field Day. Plateau Research and Education Center. Crossville, TN, August 26, 2005.

Harper, C.A., and J.P. Gruchy. 2005. Managing native warm-season grasses for wildlife. USDA NRCS training. Roane County, TN, September, 16, 2005.

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Heaton, W.C. 2005. Evaluation of four conservation management practices for northern bobwhites and grassland songbirds. South Carolina Public High School Teachers Continuing Education Program. Nemours Wildlife Foundation, Beaufort, SC, July 2005.

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Knipp, L.A. 2005. Sustainable land management demonstration and research for wildlife. Class presentation for Dr. Dave Guynn. Clemson University, Clemson, SC, March 21, 2005.

Knipp, L.A. 2005. Evaluation of USDA Farm Bill wildlife habitat conservation practices. Native Grasses Conference for Small Farmers. Americus, GA. September 7, 2005.

Knipp, L.A., and A.J. Savereno. 2004. USDA NRCS in-house training: Field tour of WHIP project for NRCS employees in the Pee Dee region. Florence, SC, September 2, 2004.

Knipp, L.A., and A.J. Savereno. 2004. Landscapes for learning, 6th Annual Betsy M. Campbell Gardening with Children and Youth Symposium. Field tour of WHIP project. Florence, SC, October 21–22, 2004.

Knipp, L.A., and A.J. Savereno. 2005. Wildlife Habitat Incentive (WHIP) Program and CP33 Field Day. Pee Dee Research and Education Center. Florence, SC, October 2005.

Knipp, L.A., and A.J. Savereno. 2005. Field tour for selected guests. South Carolina Wildlife Federation visit project site. Pee Dee Research and Education Center. Florence, SC, November 12, 2005.

Knipp, L.A., and A.J. Savereno. 2006. South Carolina Prescribed Fire Council meeting. Pee Dee Research and Education Center. Florence, SC, October 31, 2006.

Knipp, L.A., G. Yarrow, and A.J. Savereno. 2005. Field tour for selected guests. South Carolina Forestry Commission and NRCS personnel visit research site. Pee Dee Research and Education Center. Florence, SC, July 19, 2005.

Knipp, L.A., G. Yarrow, and A.J. Savereno. 2007. Alternative Enterprises Workshop at Pee Dee Research and Education Center. Florence, SC, February 15, 2007.

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Riddle, J.D. 2007. The importance of landscape context and field border shape for northern bobwhite and early-succession songbirds. Fisheries and Wildlife Sciences Program Seminar. North Carolina State University, Raleigh, NC, August 23, 2007.

Riddle, J.D. 2008. Maximizing the benefit of agricultural soil and water conservation practices for northern bobwhite and songbirds. Hampden-Sydney College, Hampden-Sydney, VA, February 17, 2008.

Riddle, J., and C.E. Moorman. 2005. Quail management: Field borders and surrounding landscapes. Quail Management Workshop. Edgecombe County Extension Center, Tarboro, NC, February 2, 2005.

Riddle, J., and C.E. Moorman. 2006. How to establish field borders with landscape context in mind. Wildlife and Water Quality on North Carolina Farms Workshop. Jones Lake State Park, NC, August 16, 2006.

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Wiggers, E.P. 2006. Management techniques for old fields. University of Georgia Techniques in Wildlife Management Class Field Trip. Nemours Wildlife Foundation, Beaufort County, SC, April 2006.

Wiggers, E.P. ,and C.A. Harper. 2007. Grassland Management for Wildlife Workshop. Nemours Wildlife Foundation, SCDNR, NRCS, Clemson University Extension, USDA NRCS Bobwhite Restoration Project Field Day. Nemours Plantation, Beaufort County, SC, October 11, 2007.

Posters

Abercrombie, E.D., and C.B. Dabbert. 2007. Northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*) response to Environmental Quality Incentives Program (EQIP) practices in the Shortgrass Prairie Conservation Region (TBCR 18). 13th Annual Southeast Quail Study Group Meeting. Lone Wolf, OK, August 6–9, 2007.

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