Conservation Reserve Program

CP33 - Habitat Buffers for Upland Birds

Bird Monitoring and Evaluation Plan

2009 Annual Report

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Executive Summary

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The United States Department of Agriculture (USDA) offers a suite of Farm Bill conservation programs that provide incentives to enhance environmental quality on privately-owned agricultural lands. In 2004, the USDA Farm Service Agency initiated conservation practice Habitat Buffers for Upland Birds (CP33) under the continuous sign-up Conservation Reserve Program (CRP) to target recovery of northern bobwhite (*Colinus virgianianus*) and other upland bird species in row-crop agricultural landscapes. This was the first CRP practice designed specifically to help meet recovery objectives of a large-scale wildlife conservation initiative, and the first to require a wildlife monitoring component as part of its practice directive. In 2006, a coordinated CP33 monitoring effort was developed and implemented across 14 states containing 80% of enrolled CP33 acreage within the core bobwhite range. In 2009, the CP33 monitoring program was extended to include a Phase II component to evaluate breeding season bird response to upland habitat buffers after mid-contract management was scheduled to be initiated (2009-2011).

Bird densities in 2009 were variable across states/regions, and by species, but generally followed the same trends observed in 2006-2008. Bobwhite and other priority bird species exhibited a disproportionate response to upland habitat buffers, where a 5% change in primary land use increased densities by 60% or more compared to standard row-crop systems. Overall bobwhite densities varied little annually, ranging from 0.11-0.12 males/ha on non-buffered fields and 0.17-0.20 males/ha on buffered fields during 2006-2009. Breeding bobwhite densities were 0.07 males/ha (60%) greater on buffered than non-buffered fields over all survey points in 2009, representing a negligible (0.01 male/ha) decrease in effect size from 2008. Bobwhite densities were greatest, but effect size smallest in the Central Mixed-grass Prairie region (BCR 19) in 2009. Densities in the Eastern Tallgrass Prairie region (BCR 22) increased on both buffered and non-buffered fields, with a subsequent increase in effect size. Bobwhite densities and effect size in the Southeastern Coastal Plain region (BCR 27) exhibited a sharp decrease in 2009 compared to 2006-2008, whereas densities and effect size in the Central Hardwoods region (BCR 24) were consistent from 2008-2009.

Dickcissel (*Spiza americana*) density increased on buffered and non-buffered fields from 2006 to 2009 over all survey points, with effect sizes that increased from 0.18 males/ha in 2006 to 0.76 males/ha in 2009. Field sparrow (*Spizella pusilla*) sustained substantially greater densities on fields buffered with CP33 compared to non-buffered fields in 2009, though effect size decreased slightly in 2009. Indigo bunting (*Passerina cyanea*) densities were minimally twice that of other priority species across all survey points, with densities ranging from ~1-2 males/ha. However there were negligible differences in densities on buffered vs. non-buffered fields in 2009. Eastern meadowlark (*Sturnella magna*) generally exhibited minimal effect size in 2009, with a slight density decrease on buffered and non-buffered fields. Other species (grasshopper sparrow (*Ammodramus savannarum*), eastern kingbird (*Tyrranus tyrannus*), painted bunting, (*Passerina ciris*), scissor-tailed flycatcher (*Tyrannus forficatus*), upland sandpiper (*Bartramia longicauda*), and vesper sparrow (*Pooecetes gramineus*) were low in abundance and/or limited in range and exhibited variable response to CP33 buffers.

Evaluation of vegetation composition and mid-contract management activities suggests an equitable distribution of cover types (<40% cover per vegetation category) within upland habitat buffers. Succession in the buffers increased percent cover of litter and decreased percent bare ground. Landowner inquiries and in-field assessments suggest mid-contract management activities designed to set back succession and improve habitat quality for bobwhite were implemented on <50% of surveyed buffers from 2008-2009. Buffers that were managed utilized disking as a primary tool over alternative methods (e.g., fire, herbicide).

The CP33 monitoring program demonstrates that measurable and substantive conservation benefits can be achieved through targeted and strategically implemented conservation practices for wildlife. The CP33 monitoring program also demonstrates that coordinated monitoring across geopolitical boundaries is feasible and provides a critical mechanism whereby adaptive management can be applied to future practice development and refinement. However variable response to CP33 by species and across regions highlights the need for an understanding of ecological processes underlying observed differences in density.

Dickcissel
Photo courtesy of Jim Rathert, Missouri Department of Conservation.

Bobwhite Quail

Eastern Meadowlark

Indigo Bunting

Painted Bunting

Eastern Kingbird

Grasshopper Sparrow

Vesper Sparrow. Photo by George Jameson.

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Introduction

Since 2004 the USDA Farm Service Agency (FSA) has initiated several conservation practices under the continuous sign-up Conservation Reserve Program (CRP) targeted to enhance imperiled wildlife habitats in agricultural landscapes. The common thread among these practices is prioritization of conservation investments where the greatest wildlife benefits relative to costs will occur. Continuous CRP practice Habitat Buffers for Upland Birds (CP33) was the first of these practices, and aims to provide habitat for declining northern bobwhite and other upland bird species in row-crop agricultural landscapes (CRP notice 479; USDA 2004). Bobwhites are declining at alarming rates across most of their range, with 4% annual losses since 1980 (Sauer et al. 2008; Figure 1). Moreover, nearly 50% of grassland and 40% of scrub-successional bird species have experienced significant population declines during this time (Sauer et al. 2008). These declines are partly attributed to losses of habitat in agricultural landscapes, which could potentially be addressed by federally incentivized conservation provisions of the USDA Farm Bill.

The National Bobwhite Conservation Initiative (NBCI; Dimmick et al. 2002, Palmer and Terhune 2010) was developed to address the precipitous decline of bobwhite populations and outlines a strategy for the species' regional and range-wide recovery. The forthcoming NBCI revision states nearly 20% of the 195 million range-wide acres suggested by biologists to have high-medium potential for bobwhite restoration hold opportunities for field and field margin management (Palmer and Terhune 2010). Upland habitat buffers like those established through the CP33 practice may provide an opportunity to obtain habitat and population recovery goals outlined in the NBCI while providing economic incentives to producers for conservation.

FSA initiated CP33 Habitat Buffers for Upland Birds in 2004 and originally allocated 250,000 ac to 35 states within the bobwhite range (USDA 2004). Nearly 229,000 ac have been enrolled in 25 states, with the majority of acreage in Illinois, Kansas, and Missouri (USDA 2010a) (Figure 2). The success of the CP33 practice recently prompted FSA to increase CP33 acreage allocation to 350,000 ac in 2010 (CRP-654; USDA 2010b).

CP33 requires establishment of 30-120 ft native herbaceous buffers along row-crop field margins. Cropland eligible for CP33 enrollment must meet all standard CRP cropping history and eligibility criteria,

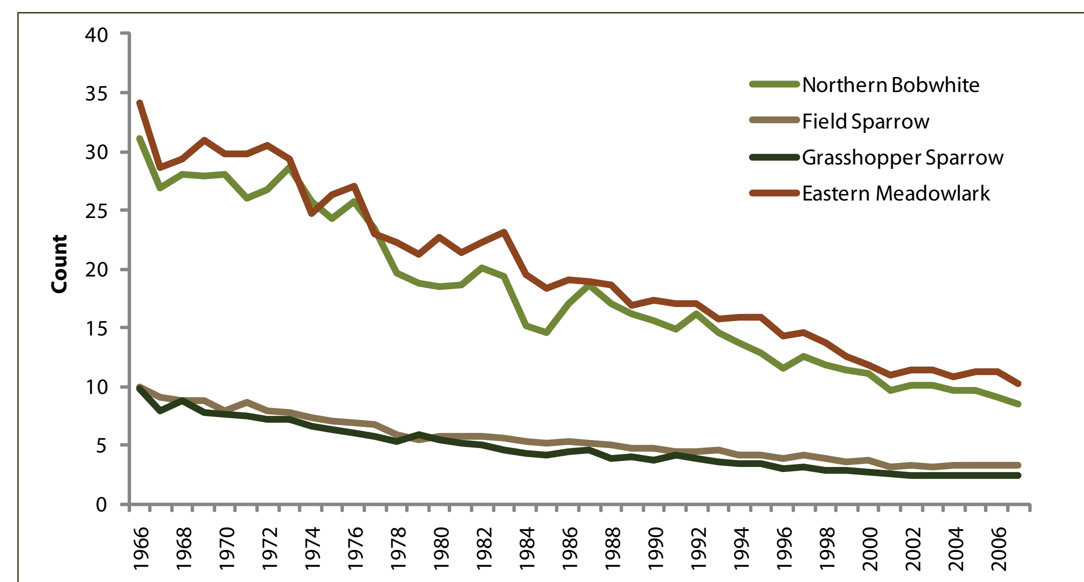

Figure 1. Population trends for northern bobwhite, grasshopper sparrow, eastern meadowlark, and field sparrow (1966-2008) according to the North American Breeding Bird Survey (Sauer et al. 2008).

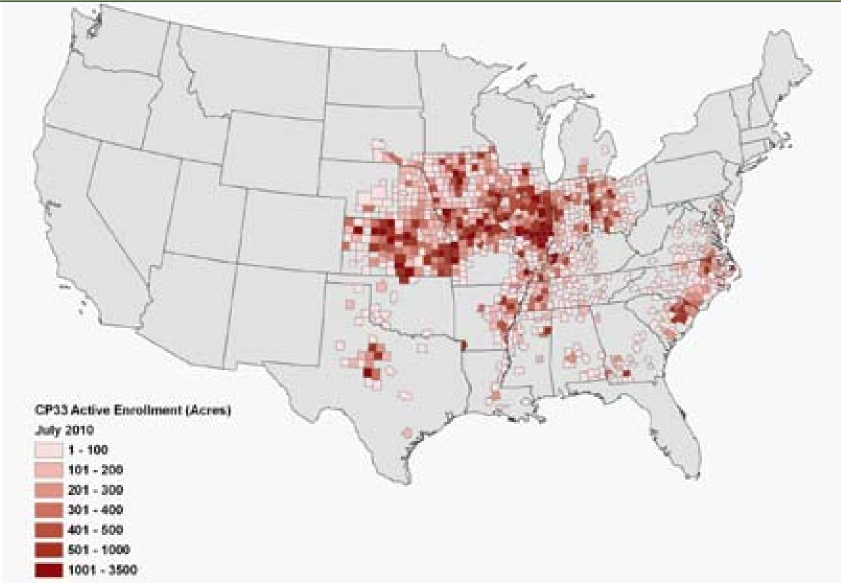

Figure 2. National distribution of CP33 active enrollment acreage by county as of July 2010 (USDA 2010a).

as well as hold potential for establishment of bobwhite populations (USDA 2004). CP33 buffers are enrolled in 10-year contracts and may be planted to native warm-season grass, forb, and legume mixes or established via natural regeneration following site preparation. A limited tree/shrub component (<10%) is also allowed. CP33 requires annual disturbance via light disking, burning, or herbicide application from contract years 4-10 on 1/3 of buffer acreage to maintain appropriate seral stage to meet bobwhite life history requirements. Incentives under the CP33 practice include a $100/ac Signup Incentive Payment (SIP), 40% Practice Incentive Payment (PIP), annual soil rental rate payment, 50% cost-share, and a Maintenance Incentive Payment (≤$5/ac) for mid-contract management and other maintenance activities.

When CP33 was initiated FSA mandated that states containing acreage implement monitoring for bobwhite and priority upland birds to evaluate population response to CP33 buffers (USDA 2004). Members of the Southeast Quail Study Group, now the National Bobwhite Technical Committee, saw the unprecedented opportunity to evaluate programmatic effects of a CRP practice across the bobwhite range and advocated for development of a coordinated monitoring plan across state boundaries to estimate regional and range-wide population response to CP33. From this the National CP33 Monitoring Program was developed and implemented using the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol" in 2006 (Burger et al. 2006). Since 2006 state fish and wildlife agencies, non-governmental organizations and universities in 14 states have collaborated with Mississippi State University to monitor differences in bobwhite and upland songbird densities and buffer vegetation characteristics on nearly 600 CP33 buffered fields paired with non-buffered control fields. States participating in coordinated monitoring represent 80% of enrolled CP33 acreage. Monitoring has been broken into 2 phases, with the initial phase (2006-2008) evaluating bird response in the 3 years following CP33 practice establishment and Phase II (2009-2011; contract years 4-6) evaluating bird response after mid-contract management activities were scheduled to commence.

Methods

Phase II Monitoring

Phase II monitoring (2009-2011) includes annual estimation of breeding season bobwhite and upland songbird densities on CP33 buffered and non-buffered fields via point-transect distance sampling methods outlined in the original CP33 monitoring protocol (Burger et al. 2006). Survey points are located in 10 Bird Conservation Regions (i.e., regions exhibiting similar habitat, land management, and bird communities (PIF 2007)). The majority of points are located in the Eastern Tallgrass Prairie (BCR 22), Southeastern Coastal Plain (BCR 27), Central Hardwoods (BCR 24), and Central Mixed-grass Prairie (BCR 19) regions (Figure 3). Bobwhite were a focal species in all BCR's, whereas priority songbird species were selected by Southeast Partners in Flight, based on specific conservation concern in each BCR (Table 1).

Breeding season point-transect bird surveys were conducted on 1146 fields (CP33=574; Control=572) in 14 states in 2009 (Figure 3). Non-buffered "control" fields were located during initial program set-up (2006) with criteria that they be similarly cropped and located 1-3 km from randomly selected CP33 buffered fields in each state. To allow changes in bird abundances to be accurately observed over the 6-year study, we encouraged that the same set of survey points be surveyed during Phase II monitoring as in Phase I monitoring. Only in extenuating and infrequent circumstances were points relocated during set-up of Phase II monitoring.

Generally 3 point transect bird surveys were conducted by state subcontractors at each point during May-July 2009 in accordance with the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol Phase II: Evaluating Mid-contract Management" (Burger et al. 2009). Paired buffered and non-buffered survey points were surveyed simultaneously by separate observers to ensure similar weather conditions, and observers were altered between visits within a single season if possible. Surveys were conducted between sunrise and three hours following sunrise during a 10-min count period (divided into 0-3, 4-5, and 6-10 min intervals). Uniquely identifiable singing or observed males were recorded once at their initial observed/perceived location and time interval into one of 6 pre-determined distance intervals (0-25, 26-50, 51-100, 100-250, 250-500, and >501 m). Surveys were not conducted during episodes of high wind (> 6.5 km/hr or sustained 4 or greater on Beaufort scale), >75% cloud cover, or precipitation.

Phase II monitoring also includes annual evaluation of buffer vegetation and evaluation of mid-contract management activities from years 4-6 of the CP33 contract (2009-2011). Phase II vegetation sampling extended protocols followed during Phase I to evaluate general vegetation composition and buffer characteristics during the 2009 growing season (May-August) on all monitored CP33 buffers. Vegetation sampling methods were variable by state; however

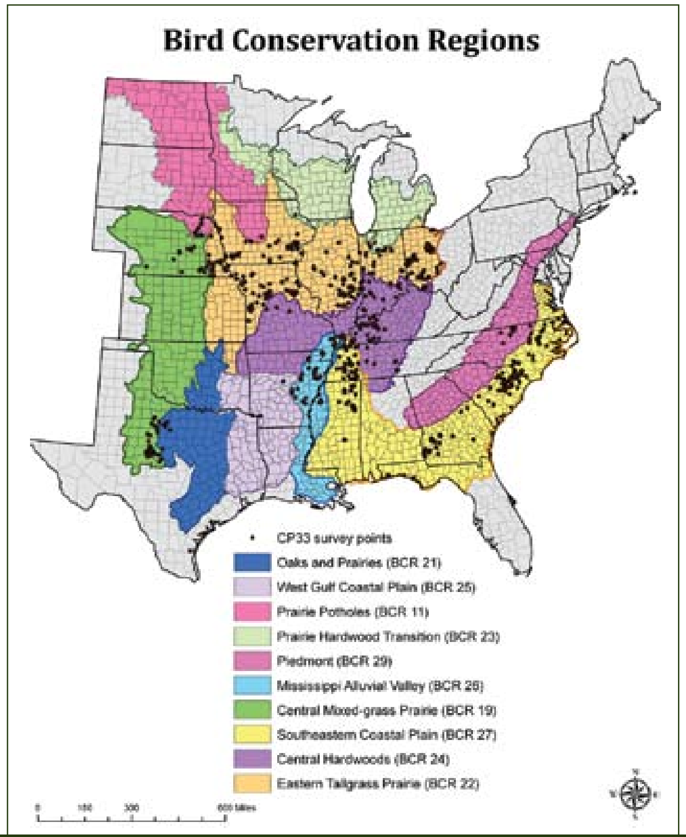

Figure 3. Distribution of survey points in 14 states as part of the national CP33 monitoring program 2006-2011 overlaid on Bird Conservation Region, state, and county boundaries.

the majority of states followed the standardized vegetation sampling protocol outlined in the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol Phase II: Evaluating Mid-contract Management" (Burger et al. 2009). Vegetation transects included 10 equally-spaced sampling points systematically distributed along midpoints of each buffer. Multiple layering of buffer vegetation required independent estimation of percent cover within each vegetation category (native warm season grass, exotic, forb, legume, woody, bare ground, litter) within a 1-m2 Daubenmire-type frame (Daubenmire 1959) for each vegetation transect point within the buffer. Buffer width was also recorded at each transect point. Other metrics included verification of buffer establishment, percent of entire buffer in native, exotic, and shrub/woody cover, and percent and description of non-compliant activities.

One of the primary objectives of the Phase II monitoring program was to evaluate bobwhite and upland bird response following the contract period when mid-contract management (MCM) was scheduled to be initiated (generally contract year 4). To successfully evaluate differences in bird densities following MCM, it was required that MCM activities be qualified and if possible quantified within CP33 buffers. We approached evaluation of MCM activities in 2 ways. First was to simply inquire to the landowner if MCM activities had been implemented on his/her CP33 buffers during the previous year, and if so, what type of activities took place (e.g., disking, burning, herbicide, etc.). However, in recognizing the potential limitations of this approach, we also included an in-field visual assessment of MCM activities conducted by experienced individuals during annual vegetation transect surveys. This included recording percent of the buffer that appeared to be managed and what type of management appeared to have taken place.

We also requested that if possible management be delineated (hand-drawn) on an aerial photograph of the buffered fields, with the objective of calculating area metrics by year and MCM type in a GIS. MCM surveys initiated in 2009 and will continue annually through 2011.

Data Analysis

Analysis of 2009 breeding season bird data was conducted using a 3-tiered approach, with results generated over all survey sites, regionally (i.e., within each BCR), and at the state level. Breeding season data were analyzed independently for each priority species using conventional distance sampling (CDS) or multiple-covariate distance sampling (MCDS) engines in program DISTANCE (Thomas et al. 2010). Distance sampling uses distances to detected individuals to calculate probabilities of detection, which are then incorporated into density estimates. Since habitat type and vegetation structure may influence the probability of detection of an individual, one of the primary objectives was to evaluate potential differences in detectability on CP33 buffered vs. non-buffered fields using stratification. Because the majority of states increased survey effort to 3 repetitions at each site in 2009 (and hence number of detections), we evaluated the need for stratification by habitat type (CP33 buffered vs. non-buffered) within year rather than pooling across years. In situations where limited number of observations (<50-75 observations/strata/year) prohibited year-specific detection function estimation at the desired level of inference, years were pooled to generate a detection function that was then applied to year-specific density estimates for each strata. In these cases we evaluated year as a covariate in MCDS as well. Right truncation was applied to all data sets when the detection probability $g(w) < 0.1$.

Model selection via Akaike's Information Criteria (AIC; Akaike 1973) was used to evaluate 3 key function models (uniform, half-normal, hazard rate) within each stratification type and was also used to select the best stratification scheme for modeling the detection function. When no models competed ($\Delta AIC>2.0$), model selection was based on the minimum AIC value, goodness of fit of the model, and probability density function plots generated for each model (Buckland et al. 2001). If stratified and global detection function models competed ($\Delta AIC<2.0$) and both schemes exhibit quality fit, the one with the lowest AIC was selected (Buckland et al. 2001). Once a model was selected addition of series adjustments to the key function model (half-normal – cosine or hermite polynomial, hazard rate – cosine, uniform – simple polynomial or cosine) was evaluated using AIC (Buckland 1992). In the rare case that key function models within the selected level of stratification competed ($\Delta AIC<2.0$) and models demonstrated variable density estimates, model uncertainty was accounted for using model averaging in a nonparametric bootstrap (B=1000). Point estimates of density were used for single model analyses, whereas averaged bootstrap estimates of density were used for analyses that incorporated model averaging. Species-specific density (D) estimates at each spatial scale were compared using simple effect sizes ($D_{buffered} – D_{non\text{-}buffered}$) and relative effect sizes (simple effect size/ $D_{non\text{-}buffered}$). Confidence intervals (95%) were calculated for effect sizes and significance of difference between $D_{buffered}$ and $D_{non\text{-}buffered}$ was determined by an effect size confidence interval crossing zero.

Results

2006-2009 Breeding Seasons

Results from 2009 breeding season analysis suggest densities were variable across states/regions, and by species, but generally followed the same trends observed in 2006-2008. Because of limitations with sample size and range for some species we generally could not report density estimates for all 10 BCRs. However, data from all survey points were included in overall density estimates. Histograms representing state, regional, and overall densities (± 95% confidence intervals) are presented below (Figures 4-18). For brevity in this report, tables containing densities (males/ha), effect sizes, and confidence intervals on effect size (as a measure of significance) can be found on the CP33 monitoring website at http://www.fwrc.msstate.edu/bobwhite/ on the "Results" page. Note that for species in states with too few observations (< 50-75 observations/strata/year) for annual detection function estimation, density estimates from previous years (2006-2008) may have changed slightly as the updated detection function informed the annual density estimates.

Bobwhite

We observed a slight decrease in effect size for bobwhite over all surveyed buffered vs. non-buffered fields from ~0.08 males/ha greater densities on buffered fields (70-74%) in 2006-2008 to 0.07 males/ha (60%). However, overall bobwhite densities varied little annually, ranging from 0.11-0.12 males/ha on non-buffered fields and 0.17-0.20 males/ha on buffered fields during 2006-2009 (Figure 4). Compared to other regions, the Central Mixed-grass Prairie (BCR 19, with survey sites in Texas and Nebraska) maintained 2-3 times greater bobwhite densities on buffered (0.46 males/ha) and non-buffered (0.44 males/ha) fields in 2009. However, this region also exhibited the least effect size, suggesting high quail abundance but limited response to CP33 in the landscape. Bobwhite in the Eastern Tallgrass Prairie (BCR 22) exhibited continued increasing densities on buffered (0.35 males/ha) and non-buffered (0.13 males/ha) fields through 2009, with a subsequent doubling in effect size over the 4-year study period (0.10 males/ha-0.22 males/ha greater densities on buffered fields in 2006 and 2009, respectively). Bobwhite densities in the Southeastern Coastal Plain (BCR 27) exhibited a sharp decline on both buffered and non-buffered fields in 2009. Densities peaked in 2008 (0.25 males/ha on buffered, 0.17 males/ha on non-buffered), and then dropped substantially in 2009 (0.07 males/ha on buffered, 0.02 males/ha on non-buffered), with effect size nearly halved (0.08 males/ha – 0.05 males/ha greater densities on buffered fields). This may have been due to actual decreases in populations, or in part due to changes in monitoring personnel/subcontractors 3 out of 5 states in the region. Bobwhite in the Central Hardwoods (BCR 24) exhibited similar densities in 2009 as in 2008 on buffered (0.19 males/ha) and non-buffered fields (0.15 males/ha), with only a slight change in effect size (to ~0.05 males/ha greater density on buffered fields). The smallest bobwhite densities were found in the Mississippi Alluvial Valley (BCR 26) from 2006-2008; however 2009 results were highly imprecise and are not reported here. Data from the Prairie Potholes (BCR 11), Oaks and Prairies (BCR 21), Prairie-hardwood Transition (BCR 23), West Gulf Coastal Plain (BCR 25), and Piedmont (BCR 29) are not presented here due to the limited number of survey sites and subsequently limited number of observations for these regions.

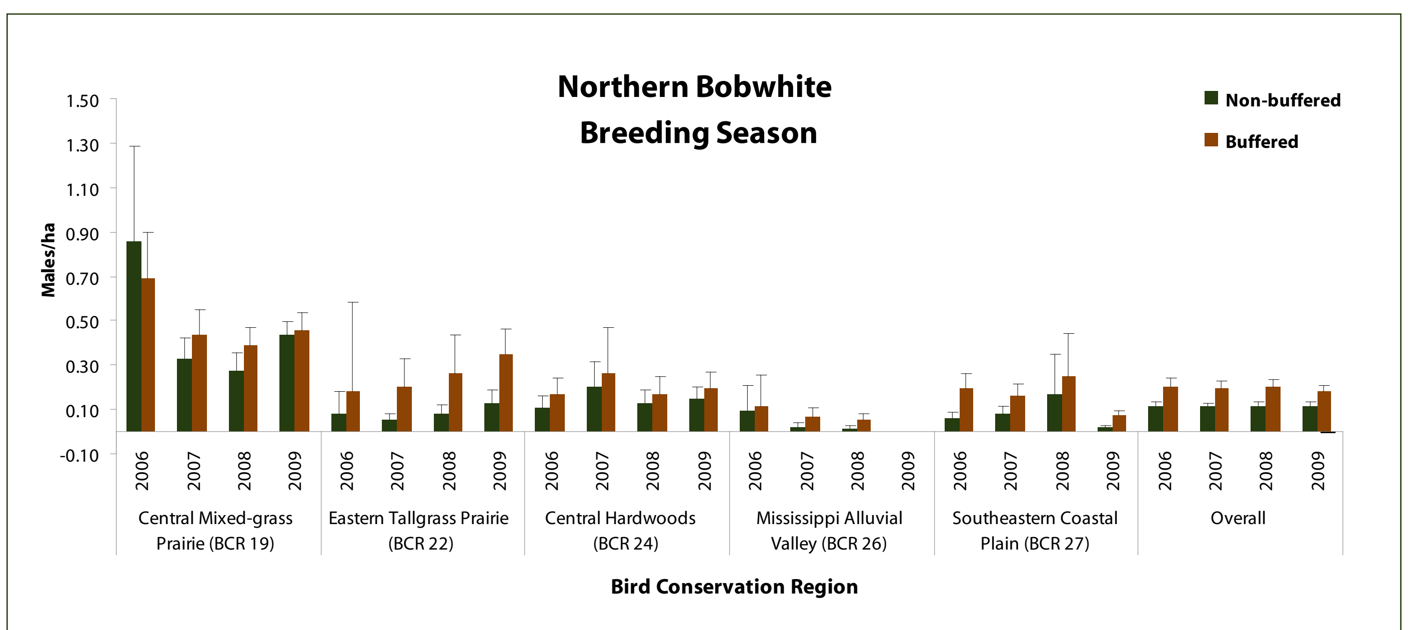

Figure 4. BCR-level and overall breeding season northern bobwhite density (males/ha) on surveyed CP33 buffered and non-buffered fields from 2006-2009. 2009 density estimates for the Mississippi Alluvial Valley were excluded due to highly erroneous results. Data from all survey sites in all regions are included in the overall density estimate. Error bars represent 95% confidence intervals.

Though highly variable, greatest bobwhite densities were observed in Nebraska and Illinois in all years, including 2009 (Figure 5). Effect sizes indicate that bobwhite densities were ~0.4-0.6 males/ha greater on buffered than non-buffered fields in these states in 2009, which represents a decrease in effect from 2008. Texas continued to demonstrate exceptional bobwhite densities on buffered and non-buffered fields, with a substantial increase in non-buffered density and reversal to a small, negative effect size in 2009. Bobwhite densities were consistently very low in Arkansas, Iowa, and Ohio in all years; however Arkansas and Ohio densities exhibited a slight increase on buffered fields in 2009. Kentucky, Mississippi, North Carolina and South Carolina all exhibited a substantial decrease in bobwhite densities on buffered and non-buffered fields in 2009 compared to previous years. However, Mississippi and North Carolina exhibited a strong positive effect size, whereas effect size in South Carolina diminished substantially in 2009, and did not vary from 2008-2009 in Kentucky. Intermediate densities, but large positive effects sizes continued to be observed in Georgia, Indiana, and Tennessee, though densities tended to decrease on buffered and non-buffered fields in these states in 2009.

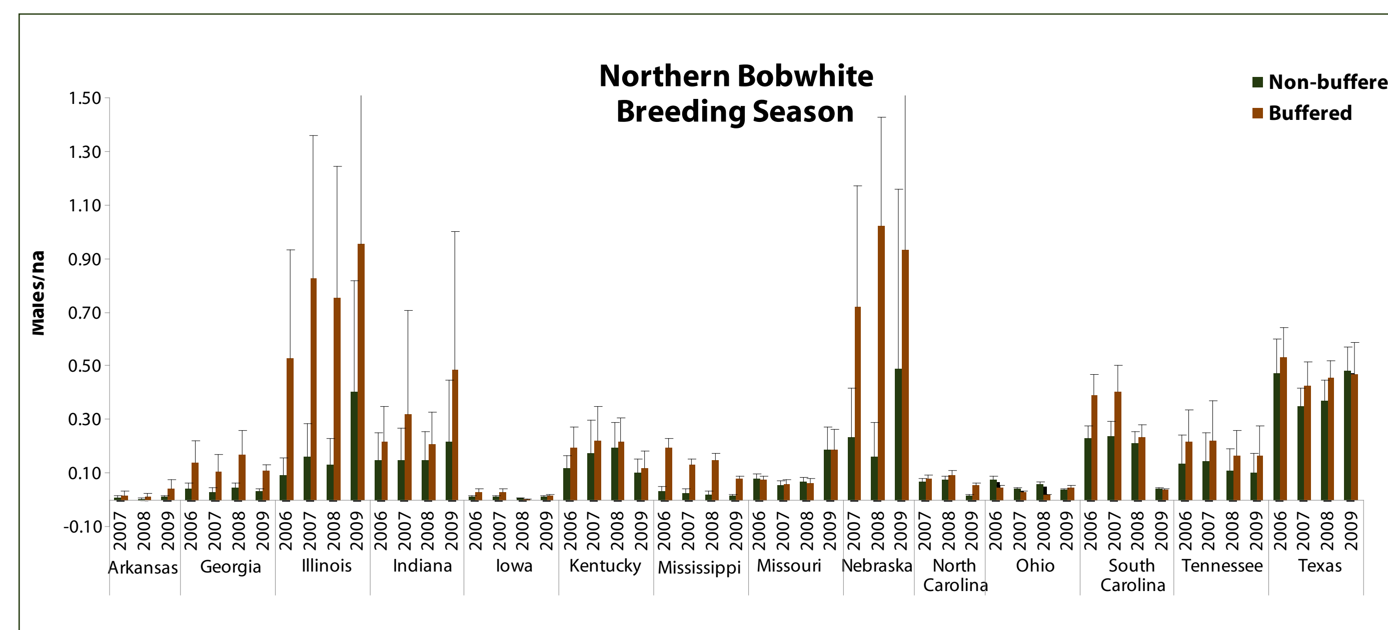

Figure 5. State-level breeding season northern bobwhite density (males/ha) on surveyed CP33 buffered and non-buffered fields from 2006-2009. Note: Arkansas, North Carolina, and Nebraska did not initiate breeding season surveys until 2007. Error bars represent 95% confidence intervals.

Dickcissel

Dickcissel exhibited a consistent increase in densities on buffered and non-buffered fields from 2006 to 2009 over all survey sites. Overall densities on buffered fields (1.36 males/ha) were substantially greater than those on non-buffered fields (0.60 males/ha) in 2009, with effect sizes that increased over the 4-year study period from 0.18 males/ha in 2006 to 0.76 males/ha in 2009 (Figure 6). Densities in the Mississippi Alluvial Valley (BCR 27) exhibited albeit large but variable increase in 2009 compared to previous years (e.g., density increased from 1.99 to 5.89 males/ha on buffered fields from 2008-2009), with an effect size of 3.91 males/ha greater density on buffered than non-buffered fields in 2009. Densities on buffered and non-buffered fields in the Eastern Tallgrass Prairie (BCR 22) exhibited linear increases from 2006 to 2009, with densities in both strata peaking in 2009 (0.60 and 1.08 males/ha on non-buffered and buffered fields, respectively), with an increase in effect size to 0.48 males/ha in 2009. Densities on buffered fields in the Central Mixed-grass Prairie (BCR 19), Central Hardwoods (BCR 24), and Southeastern Coastal Plain (BCR 27) decreased in 2009 compared to previous years. Dickcissel densities in the Central Mixed-grass Prairie peaked on buffered fields in 2007 and exhibited linear decreases each year since (0.48 males/ha in 2009); however densities on non-buffered fields remained similar (~0.20 males/ha) in 2008 and 2009. Measures of effect size suggest 0.28 males/ha greater density on buffered than non-buffered fields in this region in 2009. Dickcissel densities in the Central Hardwoods region decreased on buffered fields in 2009 to 0.70 males/ha, whereas densities increased on non-buffered fields to 0.44 males/ha. However, effect size remained 0.26 males/ha greater on buffered than non-buffered fields in 2009. Dickcissels exhibited a decrease in density on both buffered (0.21 males/ha) and non-buffered (0.13 males/ha) fields, and subsequent decrease in effect size to 0.07 males/ha in the Southeastern Coastal Plain region in 2009.

State-level dickcissel densities were variable in some states and consistent in other states in 2009 compared to estimates from previous years. Arkansas exhibited a sharp increase in density on buffered and non-buffered fields in 2009, likely strongly influencing the results observed in the Mississippi Alluvial Valley (Figure 7). Nebraska has consistently held high densities of dickcissels (~3-4 males/ha on buffered fields) throughout the study, but densities have decreased on buffered and non-buffered fields each year, with a subsequent decrease in effect size from 2008-2009. Dickcissel densities remained fairly high in Missouri, but decreased on buffered fields and increased on non-buffered fields from 2008-2009. Though slightly lower than 2008, densities in Mississippi continued to be much greater on buffered fields compared to non-buffered in 2009. Iowa exhibited moderate effect sizes (~0.50 males/ha) from 2006-2008, but densities decreased on buffered fields and increased on non-buffered fields in 2009, resulting in a decrease in effect size to 0.16 males/ha. Densities in Texas dropped dramatically on buffered fields from 2007 to 2009. Only 8 dickcissels were observed on buffered fields in 2009, compared to 79 in 2008, with a subsequent drop in density on buffered fields from 0.4 to 0.02 males/ha from 2008-2009. Georgia, North Carolina, Ohio, and South Carolina were excluded from analysis due to low sample size or limits of range extent.

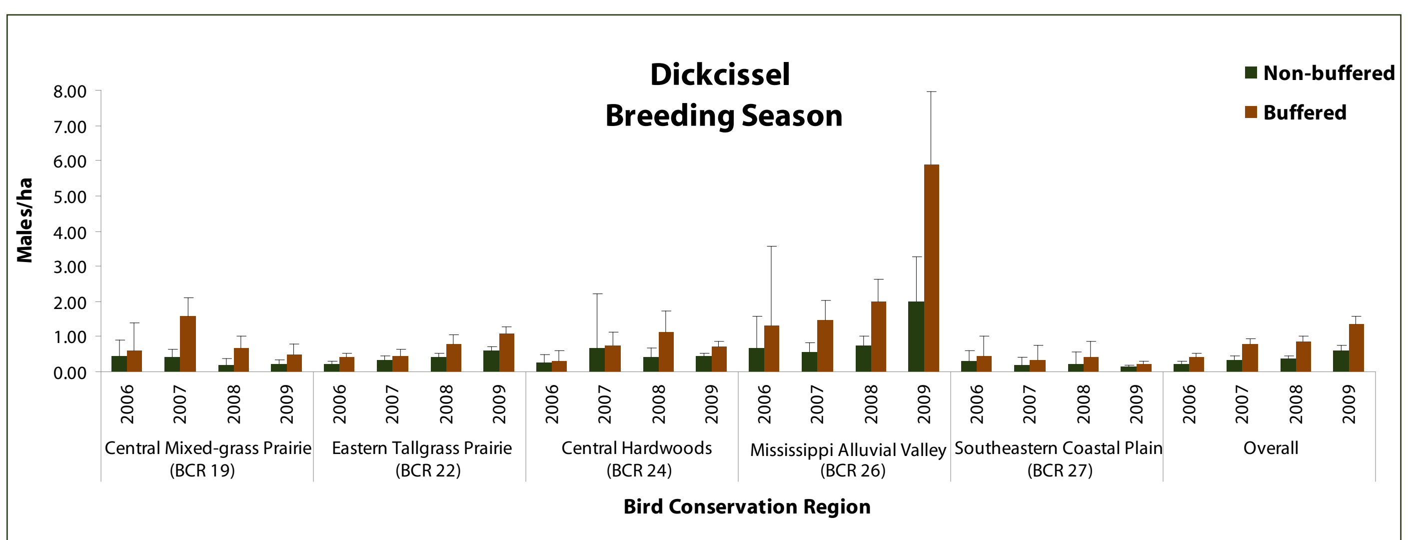

Figure 6. BCR-level and overall breeding season dickcissel density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Data from survey sites in all regions are included in the overall density estimate, except sites in Georgia, North Carolina, and South Carolina as these states are effectively out of the dickcissel range. Error bars represent 95% confidence intervals.

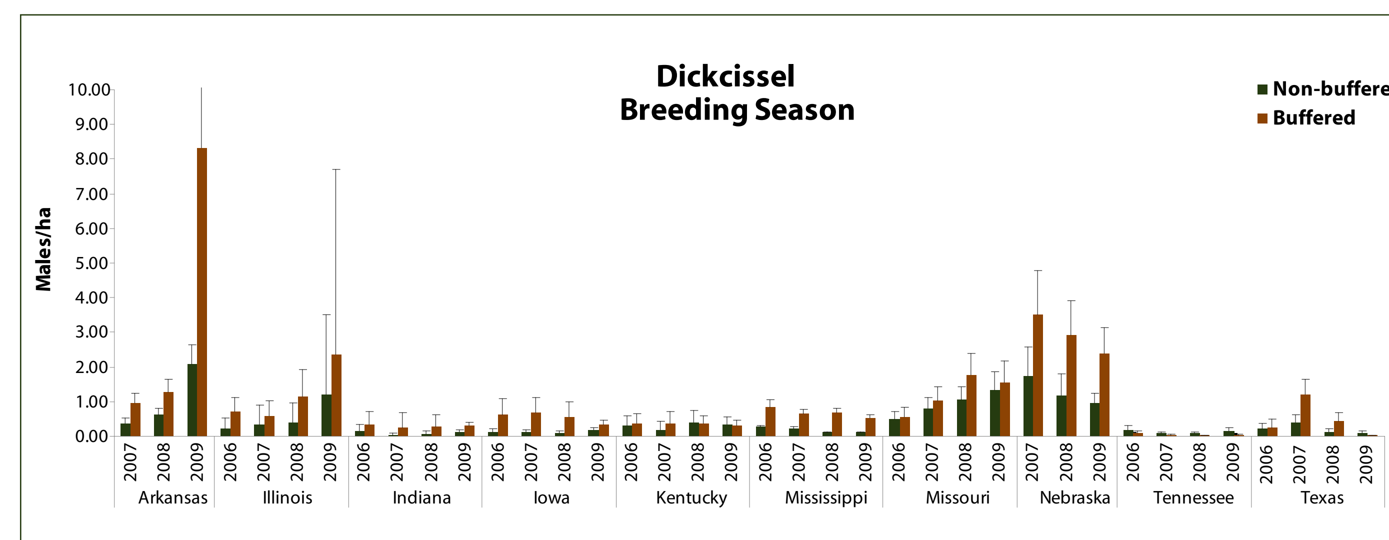

Figure 7. State-level breeding season dickcissel density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Survey sites in Georgia, North Carolina and South Carolina were excluded from analyses as sites in these states are effectively out of the dickcissel range, and densities for Ohio were not reported due to small sample size. Note also that Arkansas and Nebraska did not initiate breeding season surveys until 2007. All error bars represent 95% confidence intervals.

Field Sparrow

Field sparrow sustained substantially greater densities on fields buffered with CP33 compared to non-buffered fields in 2009. Overall field sparrow densities peaked in 2007 on buffered fields and have declined and appeared to stabilize through 2009 at 0.33 males/ha (Figure 8). Overall densities on non-buffered fields increased slightly to 0.15 males/ha from 2008-2009. Though effect size decreased in 2009, measures of effect size across the 4-year study period (0.18-0.34 males/ha) suggest field sparrows are at least twice as abundant on buffered than non-buffered fields. Low sample size or limited range extent precluded regional density estimation for all but 4 BCR's. However, for estimable regions, densities on buffered fields were consistently 1-2 times greater than those observed on non-buffered fields in 2009. Densities increased in the Eastern Tallgrass Prairie (BCR 22) in 2009 (0.24 and 0.65 males/ha on non-buffered and buffered fields, respectively) compared to previous years, and were the largest regional densities observed on buffered fields across the study. Effect size remained fairly constant (~0.4 males/ha greater on buffered fields) across the 4-year study period, though density increased on non-buffered fields in 2009. Densities in the Central Hardwoods (BCR 24) and Southeastern Coastal Plain (BCR 27) regions exhibited a linear decrease since 2007 on buffered and non-buffered fields. Effect sizes in both regions decreased slightly from 2008-2009, but continued to indicate >60% greater density on buffered than non-buffered fields. Though survey sites are limited to a subset of points in North Carolina, densities based off of pooled 2007-2009 data for the Piedmont region (BCR 29) suggested strong effect sizes in 2007-2008, with a sharp decrease on buffered and non-buffered fields in 2009. However we recommend cautious interpretation of Piedmont results due to a low number of survey points in that region, as well as a change in subcontractors from 2008-2009 monitoring.

Field sparrow densities at the state level reflected the general strong response to buffers for most states (Figure 9). However, densities dropped on both non-buffered and buffered fields in Indiana, Kentucky, and Nebraska in 2009 compared to previous years. Ohio, Illinois, and Indiana exhibited the greatest densities on buffered fields in 2009 (0.9-1.3 males/ha). Densities were 2 to 5 times greater on buffered compared to non-buffered fields in 8 out of the 12 states, with the largest effect sizes observed in Illinois, Indiana, and Ohio (0.56-0.64 males/ha) in 2009. Missouri and Ohio were the only states to exhibit substantial increases in density on both buffered and non-buffered fields in 2009 compared to previous years, however estimates from Ohio contained substantial variability (CV >40%). Similar to previous years, field sparrow densities in Iowa and Mississippi remained fairly low (<0.1 males/ha on both buffered and non-buffered fields) in 2009. Densities in North and South Carolina dropped substantially in 2009 compared to 2008, but have remained low (<0.27 males/ha on buffered and non-buffered fields) throughout the study. Texas and Arkansas were excluded from analysis due to low sample size or limited range extent.

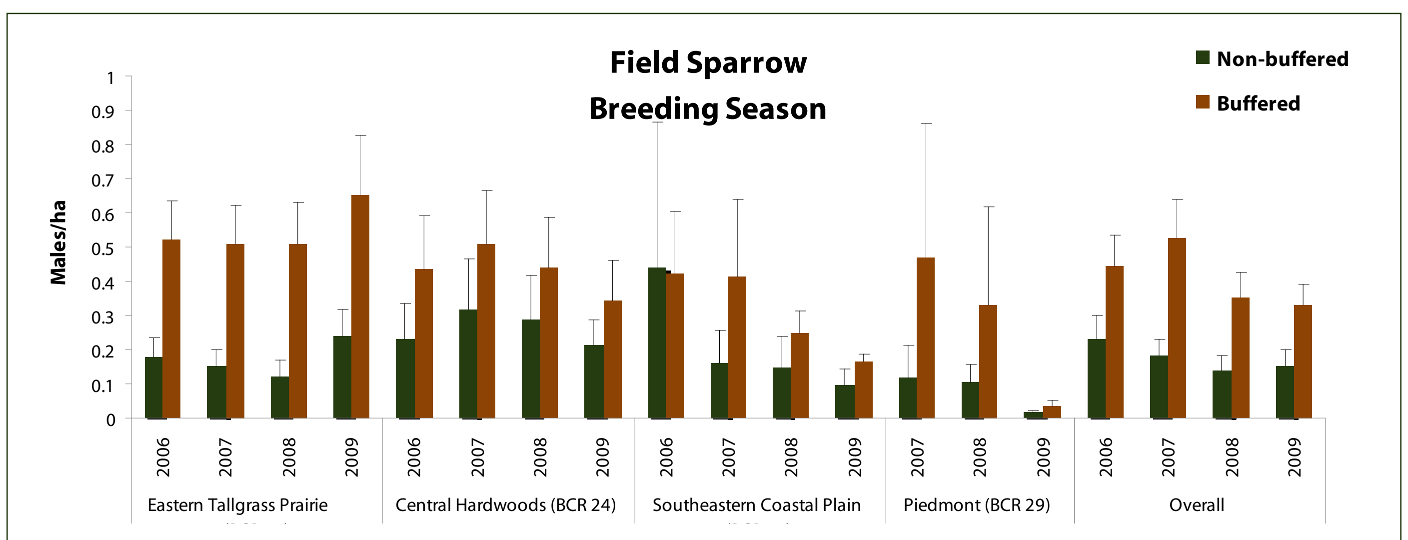

Figure 8. BCR-level and overall breeding season field sparrow density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Data from all survey sites except Texas are included in the overall density estimate. Error bars represent 95% confidence intervals.

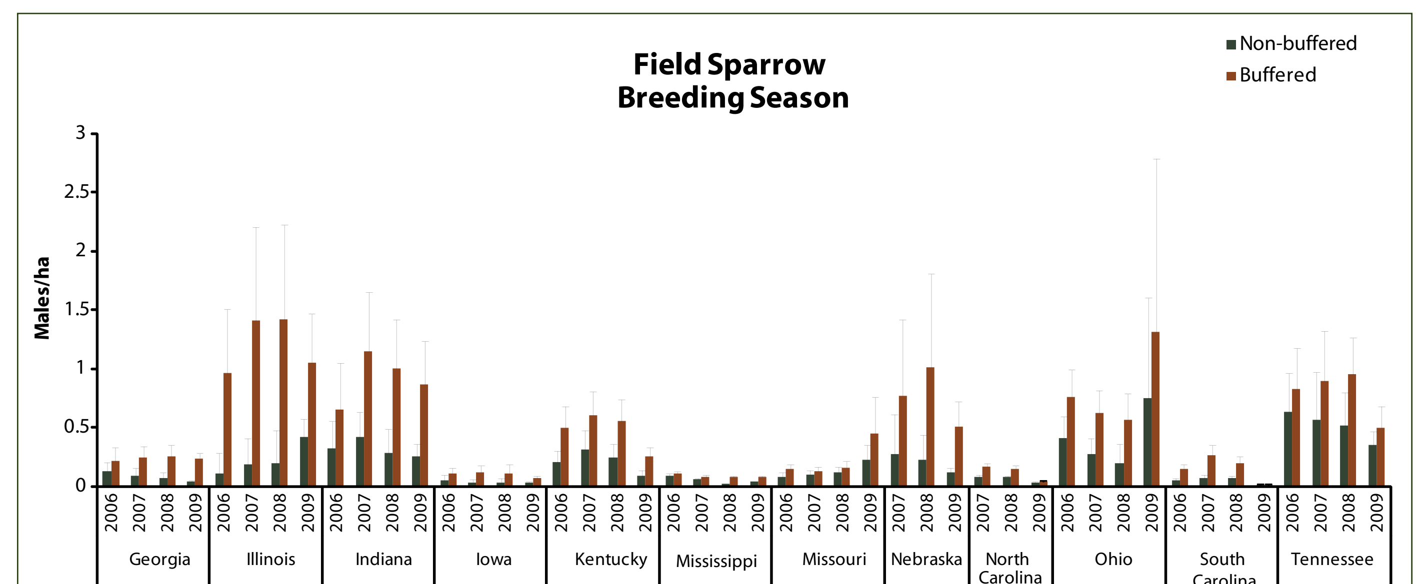

Figure 9. State-level breeding season field sparrow density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Survey sites in Texas were excluded from analyses as sites in this state are effectively out of the field sparrow range, and densities for Arkansas were not reported due to small sample size. Note also that North Carolina, and Nebraska did not initiate breeding season surveys until 2007. Error bars represent 95% confidence intervals.

Indigo Bunting

Indigo buntings are considerably more abundant than any other priority species in the monitoring program with densities minimally and often much greater than twice that of other priority species. Densities ranged from ~1-2 males/ha over all survey points, and increased slightly on buffered and non-buffered fields from 2008 to 2009 (Figure 10). However, increased densities on non-buffered fields elicited an annual decrease in effect size during the 4-year study period (e.g., 0.71 – 0.09 males/ha effect size in 2006 and 2009, respectively). Regional densities ranged up to 3 males/ha on buffered fields, with density increases on buffered and non-buffered fields from 2008 to 2009 in the Eastern Tallgrass Prairie (BCR 22), Central Hardwoods (BCR 24), and Southeastern Coastal Plain (BCR 27) regions. Densities in the Central Hardwoods were greater than all other BCR's in 2009 (2.7 males/ha buffered; 2.1 males/ha non-buffered), with an increase in effect size from 0.27-0.59 greater males/ha on buffered fields from 2008-2009. Densities peaked in the Eastern Tallgrass Prairie in 2007, declined sharply in 2008, and then increased slightly in 2009. Effect size in the Eastern Tallgrass Prairie dropped substantially (0.51-0.23 greater males/ha on buffered fields) from 2008-2009, respectively. Densities in the Southeastern Coastal Plain decreased on non-buffered fields in 2009 and exhibited the lowest observed effect size (0.22 greater males/ha on buffered fields) compared to previous years in that region. Though inference for the Piedmont region is limited to a subset of survey sites in North Carolina, results from pooled data in this region suggest indigo buntings exhibited up to 2 times greater densities on buffered compared to non-buffered fields, with greatest densities observed in 2008.

Similar to other species, indigo bunting densities were variable by state and year, but generally exhibited much greater densities compared to other species and a tendency toward greater densities on buffered than non-buffered fields. Greatest overall densities were observed in Tennessee, Kentucky, Indiana and Illinois, with densities in Tennessee approaching 5 males/ha on buffered fields (Figure 11). Several states exhibited indigo bunting densities <1 male/ha, including Iowa, Georgia, North Carolina, and Arkansas (except in 2009). Observed effect sizes in 2009 were greatest in Illinois with 1.65 greater males/ha on buffered compared to non-buffered fields. Arkansas, Missouri, and Ohio exhibited density increases on both buffered and non-buffered fields from 2008 to 2009, with Arkansas exhibiting a reversal to a negative effect size. Densities increased on buffered and non-buffered fields in Missouri and Ohio in 2009 compared to 2008. Survey sites in Texas were not analyzed due to limited range extent, whereas small sample size precluded analysis in Nebraska.

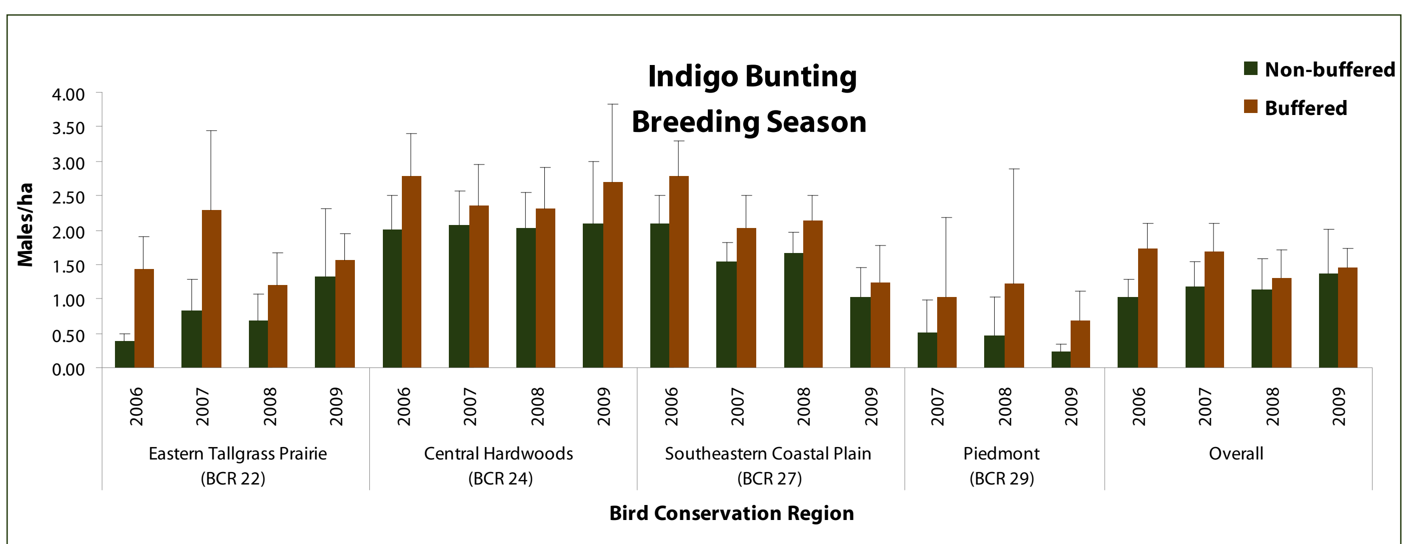

Figure 10. BCR-level and overall breeding season indigo bunting density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Data from all survey sites except those in Texas are included in the overall density estimate. Error bars represent 95% confidence intervals.

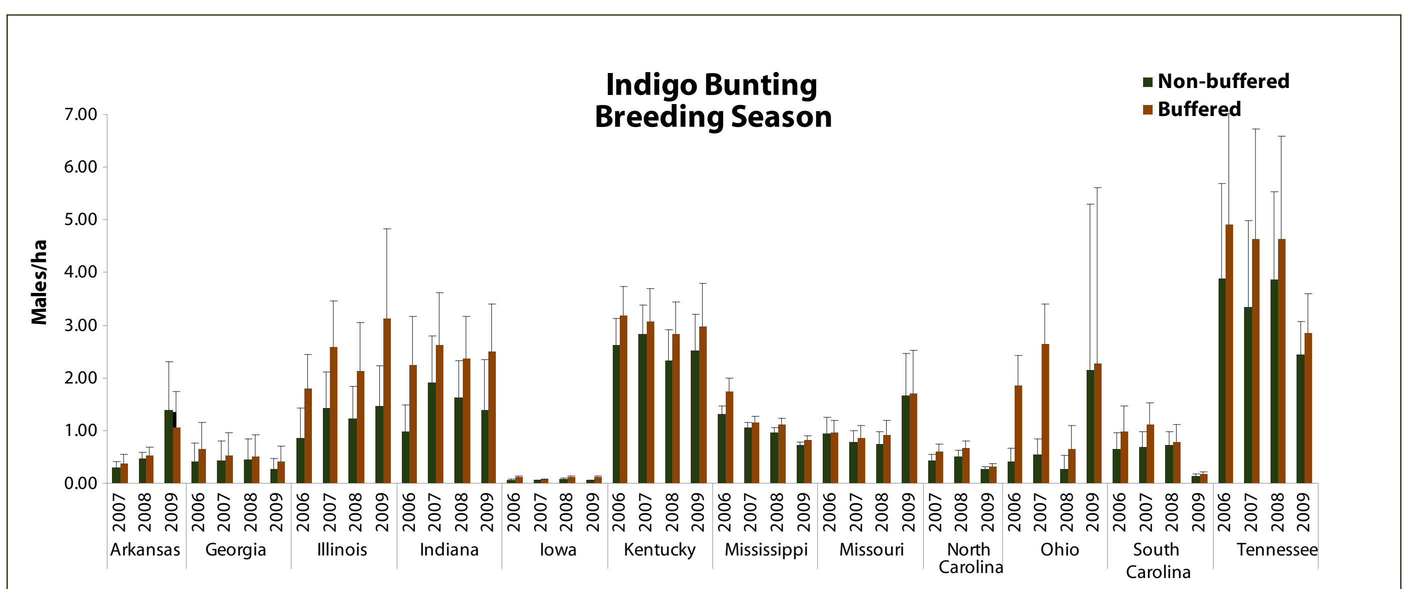

Figure 11. State-level breeding season indigo bunting density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Survey sites in Texas were excluded from analyses as sites in this state are effectively out of the indigo bunting range. Small sample size in Nebraska precluded density estimation. Arkansas and North Carolina did not initiate breeding season surveys until 2007. Error bars represent 95% confidence intervals.

Eastern Meadowlark

Eastern meadowlark densities and degree of effect size are annually and regionally variable, but generally exhibit little response to CP33 buffers in the landscape. Meadowlark densities decreased from 2008-2009 to 0.08 and 0.07 males/ha on non-buffered and buffered fields, respectively, over all survey points, exhibiting 0.01 greater males/ha on non-buffered than buffered fields in 2009 (Figure 12). From 2006-2008 meadowlark densities on buffered and non-buffered fields were greatest in the Central Mixed-grass Prairie (BCR 19) (0.25-0.35 males/ha) compared to other regions, but decreased substantially in 2009 (~0.1 males/ha on buffered and non-buffered fields) with negligible effect size. Densities in the Eastern Tallgrass Prairie (BCR 22) exhibited a positive effect size in 2007 and 2008. Densities on buffered fields declined each year from 0.22 males/ha (2007) to 0.09 males/ha (2009), while remaining constant on non-buffered fields (~0.13 males/ha), resulting in 0.03 greater males/ha on non-buffered fields. Densities on buffered fields in the Central Hardwoods (BCR 24) exhibited a nearly identical decline to that of the Eastern Tallgrass Prairie since 2007 (0.20 to 0.10 males/ha from 2007 to 2009), with densities on control fields remaining consistently between 0.08 – 0.10 males/ha each year. Although densities on buffered fields decreased, effect size remains positive at 0.02 greater males/ha on buffered fields. The Mississippi Alluvial Valley was the only region to exhibit annual increases in meadowlark densities on buffered and non-buffered fields, although densities in 2009 were very similar to those observed in 2008 (0.11-0.16 males/ha). Meadowlark densities were lower in the Southeastern Coastal Plain (BCR 27) in all years compared to other regions, but exhibited a substantial decrease on buffered and non-buffered fields in 2009 with negligible effect size.

Though variable by state, eastern meadowlark exhibited minimal response to buffered fields through 2009. Of the 12 states that were evaluated, 9 held meadowlark densities <0.25 males/ha throughout the duration of the 4-year study period (Figure 13). Greatest densities were observed in Nebraska during 2007-2008, but decreased sharply in 2009 (0.72 to 0.19 males/ha on non-buffered fields and 0.64 to 0.15 males/ha on buffered fields from 2008-2009). Greatest densities observed in 2009 were in Illinois (~0.30 males/ha on buffered and non-buffered fields), with a reversal in effect size to 0.04 greater males/ha on non-buffered fields. Indiana also exhibited a reversal in effect from 0.18 greater males/ha on buffered than non-buffered fields in 2008 to negligibly greater density on non-buffered fields in 2009. In fact, most states (67%) exhibited declines on both buffered and non-buffered fields in 2009 compared to 2008. Arkansas was one of the few states that exhibited a density increase on both buffered and non-buffered fields, with a reversal of effect to 0.06 greater males/ha on buffered than non-buffered fields in 2009. Low sample size precluded density estimation for Georgia and South Carolina in each year of the study.

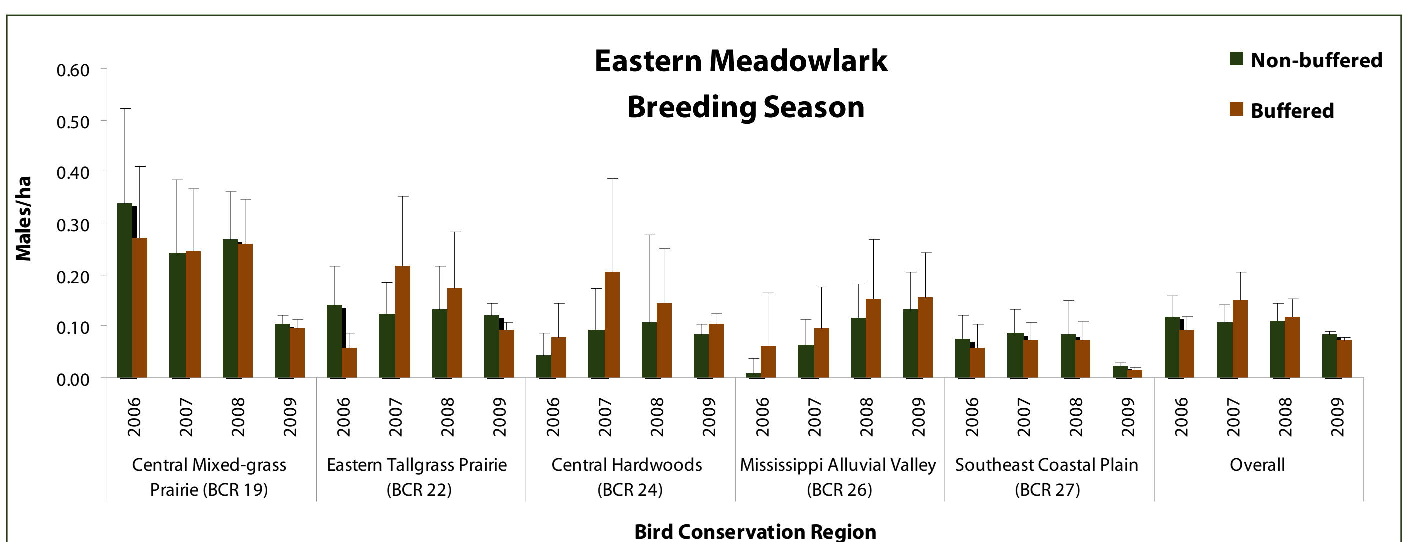

Figure 12. BCR-level and overall breeding season eastern meadowlark density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Small sample size precluded density estimation for BCR's 11, 23, 25, and 29; however data from all BCR's are included in the overall density estimate. Error bars represent 95% confidence intervals.

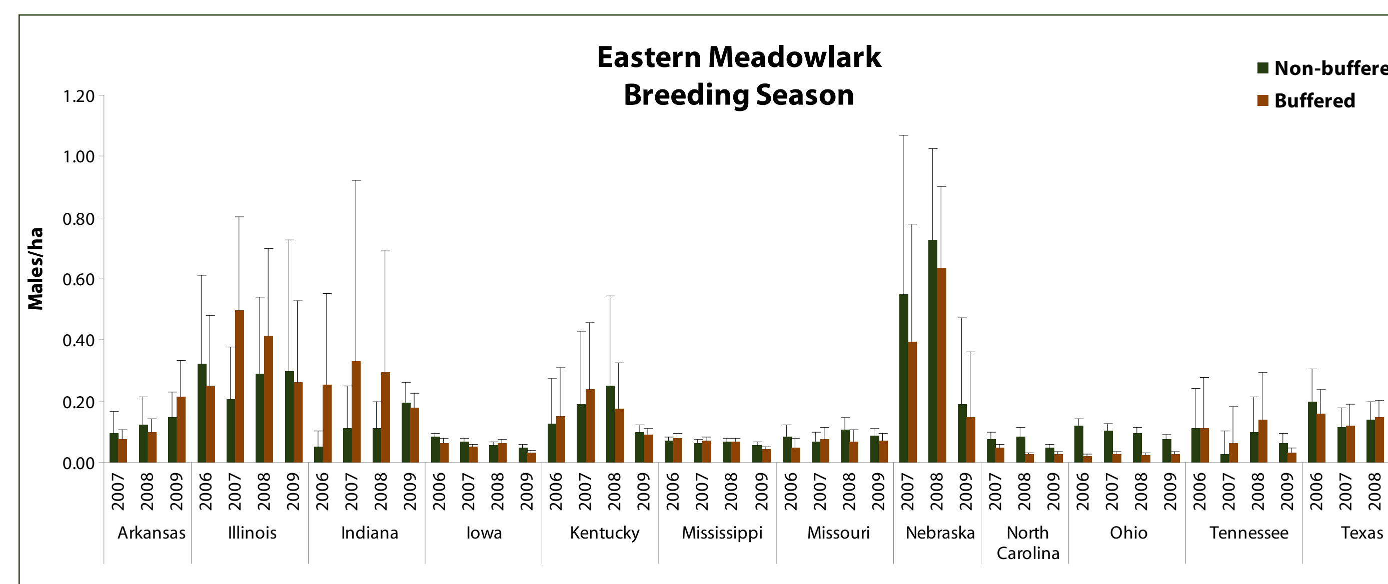

Figure 13. State-level breeding season eastern meadowlark density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Small sample size precluded density estimation in Georgia and South Carolina. Note: Arkansas, North Carolina and Nebraska did not initiate breeding season surveys until 2007. Error bars represent 95% confidence intervals.

Other Species

Several priority species occur in low abundances, such that annual or regional density estimates could not previously be calculated. As the CP33 monitoring program progresses we are increasingly capable of using multi-year data to calculate species-specific detection functions, which are then used to inform year-specific density estimates. Annual data based off of a pooled 4-year detection function for grasshopper sparrow suggest low densities (<0.20 males/ha over all survey points) with slightly greater densities (0.03 males/ha) on buffered fields compared to non-buffered fields in 2009 (Figure 14). Greatest grasshopper sparrow densities and greatest effect sizes were observed in the Central Mixed-grass Prairie (BCR 19) with densities on buffered fields approaching 0.35 males/ha in 2009 (0.24 male/ha greater density on buffered than non-buffered fields. Grasshopper sparrow densities also increased in the Eastern Tallgrass Prairie (BCR 22) to nearly 0.20 males/ha on buffered fields, and effect size also increased to 0.06 males/ha greater densities on buffered fields. Grasshopper sparrows in the Central Hardwoods (BCR 24) exhibited a sharp density decrease on non-buffered fields, with 0.05 greater males/ha on buffered than non-buffered fields in 2009. Grasshopper sparrow density has typically been very low in the Southeastern Coastal Plain (BCR 27) (~<0.02 males/ha), with 0.02 greater males/ha on non-buffered fields in 2009. Georgia and South Carolina (except in 2009) were excluded from regional and overall analysis due to limited sample size.

Eastern kingbirds respond variably to buffers and demonstrate greater densities on buffered fields in most regions and years. Kingbird densities were fairly low (<0.2 males/ha) across regions and overall during the 4-year study period. However, kingbirds exhibited an overall density increase on buffered and non-buffered fields in 2009 compared to 2008 (0.18 and 0.14 males/ha on buffered and non-buffered fields, respectively), with 0.04 greater males/ha on buffered than non-buffered fields (Figure 15). Kingbird densities in the Eastern Tallgrass Prairie (BCR 22) exhibited a slight increase on buffered fields in 2009 compared to 2008, and a subsequent reversal in effect to 0.03 greater males/ha on buffered fields in 2009. Densities in the Central Hardwoods (BCR 24) declined linearly since 2007 on both buffered and non-buffered fields and have diminished to a near-zero effect size. Densities in the Southeastern Coastal Plain (BCR 27) have also declined since 2007 on buffered and non-buffered fields with virtually identical densities across strata (0.08 males/ha) in 2009.

Four other priority species (painted bunting, scissor-tailed flycatcher, upland sandpiper, vesper sparrow) were present in limited abundance or in a subset of sample states but had enough observations for analysis based off of a pooled 4-year detection function. However, we suggest cautious interpretation of these results due to the limited range of states where these species were located and/or low number of detections. Painted bunting, upland sandpiper, and vesper sparrow densities were generally very low (<0.08 males/ha) (Figure 16). Painted bunting, present in Arkansas, Mississippi, South Carolina, and Texas, exhibited the greatest densities and greatest effect size (0.06 males/ha) on buffered fields in 2006 (note Arkansas was not included in the 2006 estimate), followed by a decline on buffered fields in 2007 and 2008 and an increase on both buffered and non-buffered fields in 2009. However there was virtually no effect in 2009 in contrast to previous years. Upland sandpiper, found only in Missouri and Nebraska, were the least abundant species (<0.02 males/ha) and only exhibited positive response to buffers in 2008 (note 2006 estimates could not be calculated because data from Nebraska was not available until 2007) (Figure 16). Vesper sparrows were present in Iowa, Illinois, Indiana, Missouri, and Ohio and were also low in abundance (<0.05 males/ha), but exhibited increasing effect from 2008 to 2009 (Figure 16). Scissor-tailed flycatchers were present in Arkansas and Texas, and exhibited higher densities in 2006 compared to 2007-2009, with 0.51 greater males/ha on buffered than non-buffered fields (Figure 17). However, densities diminished to ~0.5 males/ha from 2007 to 2009 with effect size in 2009 exhibiting 0.31 greater males/ha on non-buffered than buffered fields.

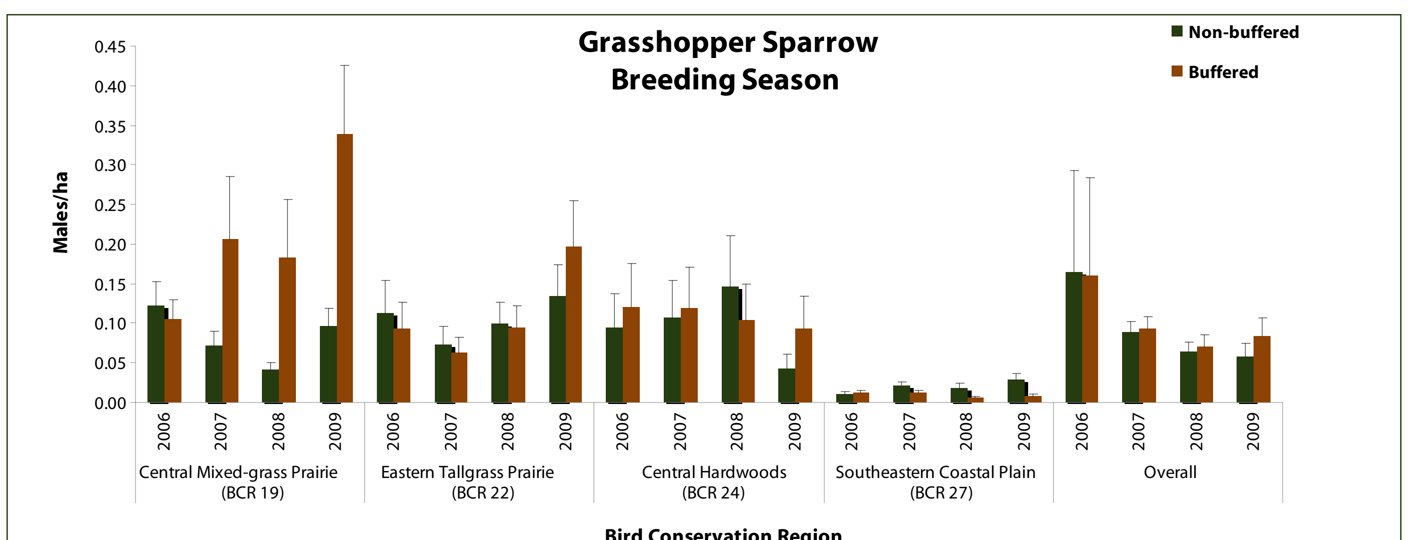

Figure 14. BCR-level and overall breeding season grasshopper sparrow density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Data from all survey sites except Georgia are included in the overall density estimate. Error bars represent 95% confidence intervals.

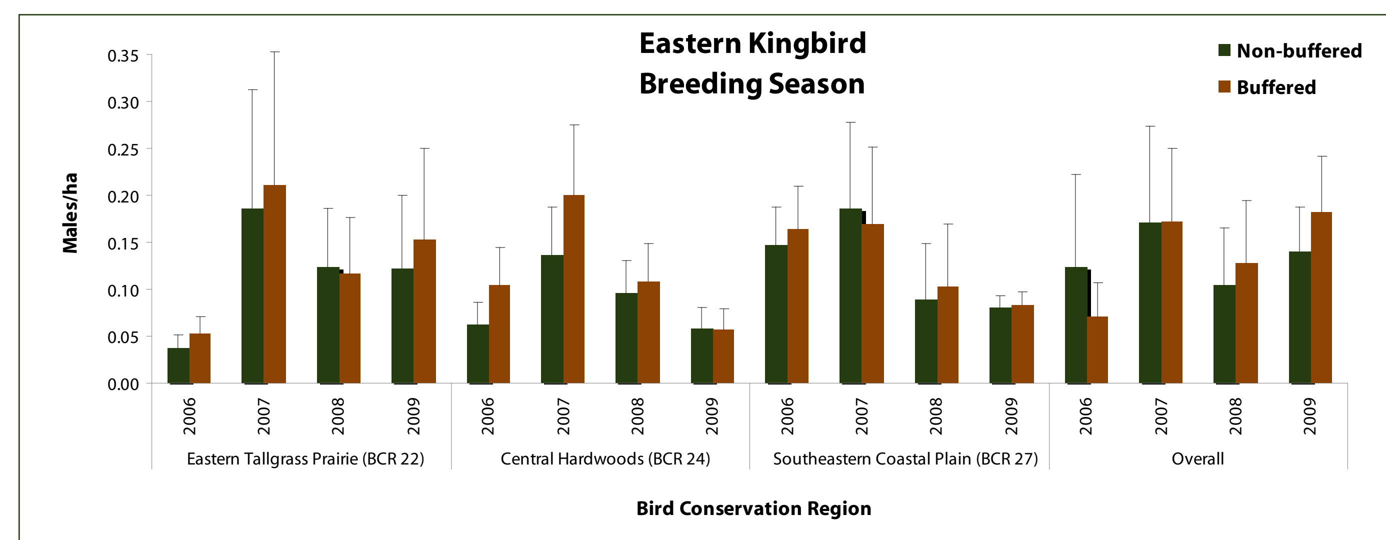

Figure 15. BCR-level and overall breeding season eastern kingbird density (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Data from all survey points are included in the overall density estimate. Error bars represent 95% confidence intervals.

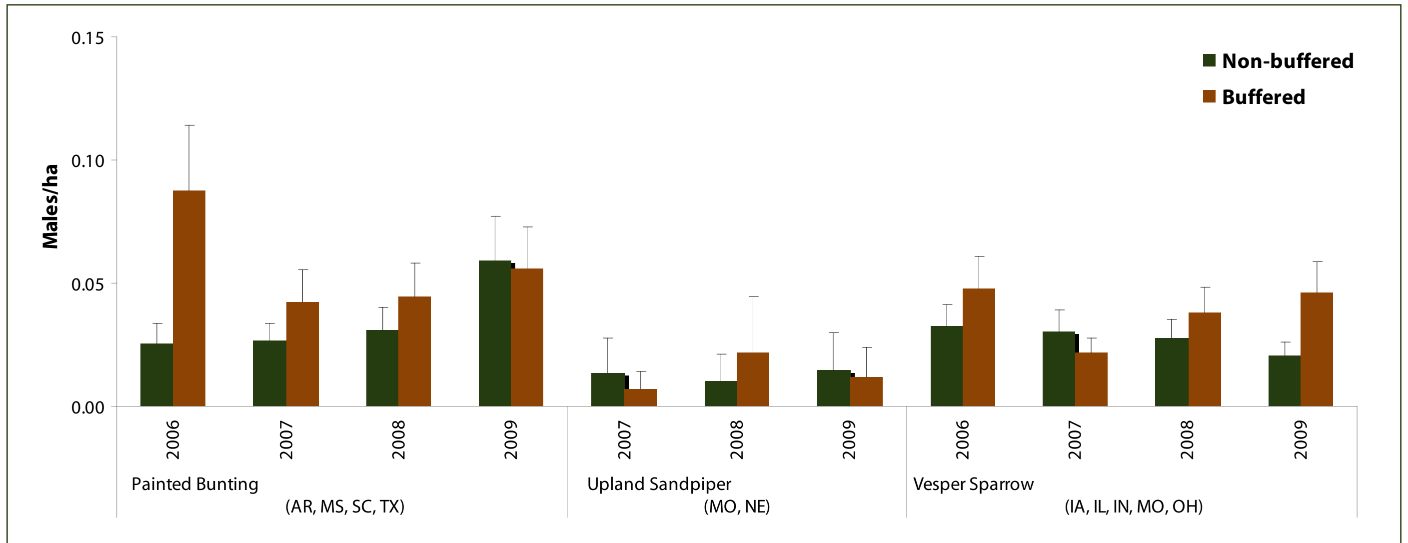

Figure 16. Breeding season painted bunting, upland sandpiper, and vesper sparrow densities (males/ha) on surveyed buffered and non-buffered fields from 2006-2009. Error bars represent 95% confidence intervals.

Figure 17. Breeding season scissor-tailed flycatcher density (males/ha) on surveyed buffered and non-buffered fields in Arkansas and Texas from 2006-2009. Error bars represent 95% confidence intervals.

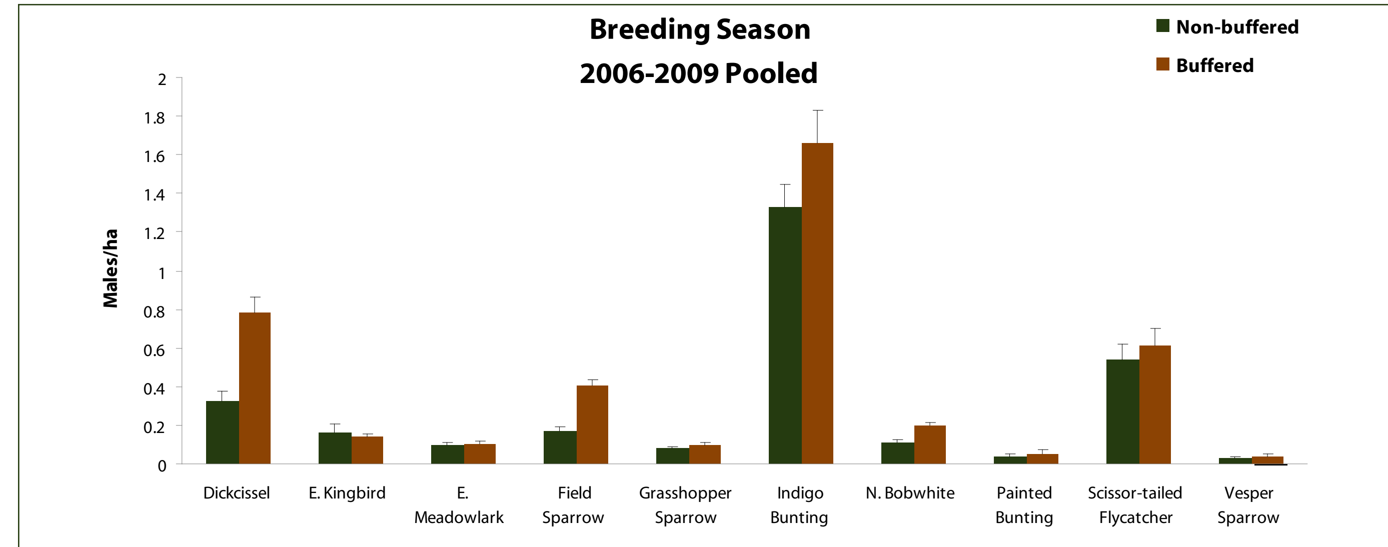

Figure 18. Density estimates (males/ha) pooled over all sample sites and years of species of interest on buffered and non-buffered fields during the 2006-2009 breeding season. Error bars represent 95% confidence intervals.

CP33 buffer planted to native warm-season grasses during the first growing season after planting.

Vegetation/Mid-contract Management Evaluation

Vegetation surveys were conducted following variable protocols in 15 states in 2007 and 10 states in 2008, and 14 states in 2009. Mean contract width established by the conservation plan in the CRP contract over all surveyed CP33 contracts in 2009 was 87 ft (Table 2). Cover was established on 94% of buffers by 2009 (Table 2). Of the states collecting information on perceived dominant taxa within buffers, 44% were dominated by native grasses, 28% were dominated by forbs, 15% were dominated by a mixture of native grasses and forbs, and 13% were dominated by exotic species (Table 2). As succession has progressed in buffers, average cover of trees and shrubs has increased despite commencement of management activities in 2009 (4.47% shrubs, 4.68% trees) (Table 3). For states that quantified noncompliant activities, percent noncompliance decreased to 7.81% in 2009 (Table 3). Predominant noncompliance activities in 2009 included mowing, road/turnrow/driven, equipment disturbance/parking, planted to crops and herbicide drift (Table 3). Mean buffer width at 10 systematically placed points along each CP33 field was 85.74 ft in 2009, nearly identical to mean contracted buffer width (Table 4). Vegetation transect surveys at 10 systematically placed points along each CP33 buffer demonstrated that mean percentage cover was less than 40% in each vegetation category in 2009 (NWSG, forb, legume, woody, exotic, litter, bare) (Figure 19, Table 4). Percent cover of NWSG, forb and legume cover decreased, whereas percent cover of exotics increased to 18% in 2009. Common exotics present in CP33 buffers in both years included bahiagrass (*Paspalum notatum*), Bermudagrass (*Cynodon dactylon*), tall fescue (*Schedonorus phoenix*), Johnsongrass (*Sorghum halepense*), and brome (*Bromus* spp.) (Table 2). Percent cover of litter increased from 34% in 2008 to 37% in 2009, whereas percent cover of bare ground decreased from 20% to 17% from 2008-2009 (18%). Percent coverage of woody species remained <2% in 2009.

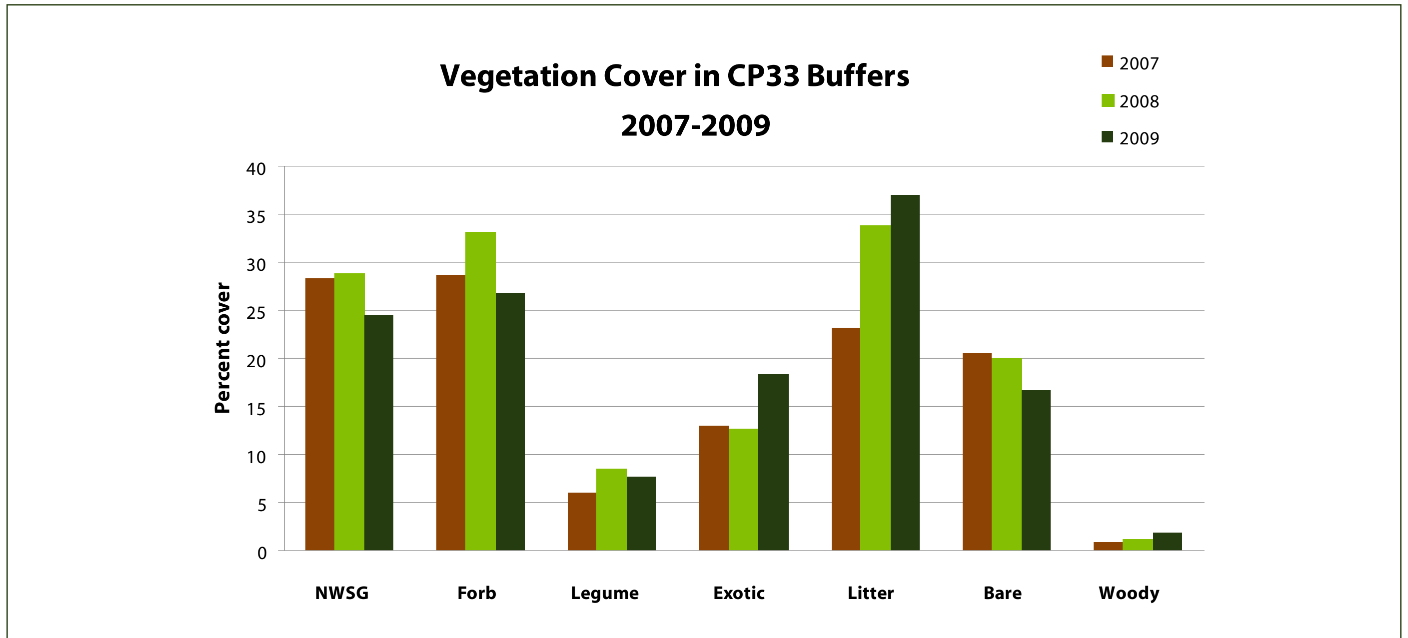

Figure 19. Percent cover of native warm-season grasses (NWSG), forbs, legumes, woody plants, exotics, litter, and bare ground within CP33 upland habitat buffers averaged over 15 states in 2007, 10 states in 2008, and 14 states in 2009.

However, we suggest using caution when comparing estimates across years due to the difference in number of states conducting vegetation surveys in each year.

Of the 13 states that participated in the mid-contract management (MCM) survey, 12 took part in the initial landowner inquiry. Over 60% of landowners with fields containing CP33 survey points within those 12 states were contacted regarding MCM activities (Table 5). Nearly 45% of those landowners indicated that some type of MCM activity took place on their CP33 buffers from 2008-2009 (55% indicated no MCM activities had been implemented) (Figure 20). North and South Carolina exhibited the greatest amount of MCM participation (≥80% of landowners indicating MCM took place) (Table 5). For landowners across all states that indicated MCM activities took place, 49% had disked, 17% had burned, and 20% had mowed their buffers (mowing is not an accepted MCM practice under CRP-479 except to facilitate subsequent burning, disking, or herbicide) (Figure 20). Herbicide, and combinations of disking, mowing, burning, and herbicide were also suggested by landowners (Table 5, Figure 20). On average, landowners estimated that they had managed over 20% of their buffer area through one of the aforementioned methods (Table 5).

In-field assessment of MCM activities conducted during vegetation surveys indicated discrepancies from landowner inquiries, likely due to difficulties experienced by the surveyor in determining presence and/or extent of MCM activities. Within 13 states conducting in-field MCM assessments, MCM activities appeared to take place on 25% of buffered fields (75% of buffers appeared unmanaged, or the surveyor was uncertain if management had occurred) (Figure 21). For fields with apparent MCM activities, the majority (63%) appeared disked, whereas burning, herbicide, mowing, and combination methods accounted for 28% of MCM activities (Figure 21). For buffers where MCM was apparent, 38% of buffer area appeared to be managed within fields (Table 6).

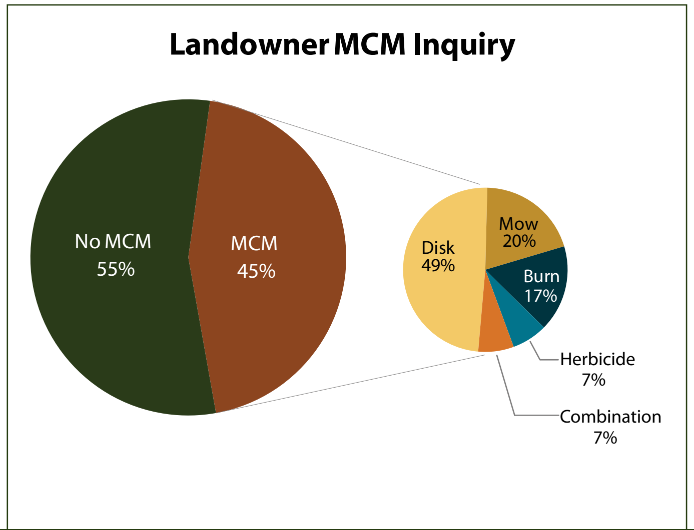

Figure 20. Percent of landowners indicating that mid-contract management (MCM) was/was not implemented on CP33 buffers in 12 states from 2008-2009 (left). For landowners indicating MCM was implemented, type of management activity landowners indicated (right).

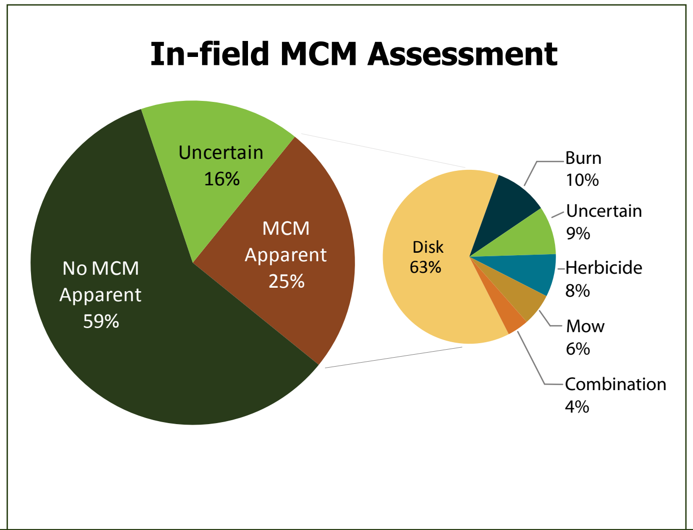

Figure 21. Percent of mid-contract management (MCM) that was, was not, or could not be determined apparent during in-field MCM assessment (left). For fields where MCM was apparent, type of management activities that appeared to have occurred (right).

Interpretation

The CP33 practice and national monitoring program exemplify the iterative nature of strategic habitat conservation, whereby careful biological planning led to the design, delivery, and subsequent evaluation and refinement of a targeted conservation practice. The success of this process from inception to refinement is proof that strategic habitat conservation is viable in practice, and that conservation investments produce worthwhile dividends when strategically implemented. The national CP33 monitoring program affords the opportunity to fully implement the strategic habitat conservation/adaptive management approach through evaluation of multi-scale multi-year bird response to the CP33 upland habitat buffer practice. The continuation of monitoring through Phase II (2009-2011) extends this evaluation through 6 years of the 10-year CP33 contract, allowing for evaluation of bird response following buffer succession and management over time, not simply immediately following establishment.

Differences in densities on buffered and non-buffered fields from 2006- 2009 illustrate that positive effects of buffers are sustained for bobwhite and some priority bird species 4 years following buffer establishment. Over all survey points, male bobwhite density increased from 1 bird/~21 ac on non-buffered row-crop fields to 1 bird/~13 ac on fields buffered by CP33 in 2009. This increase in density demonstrates that bobwhite exhibit a disproportionate response to CP33 upland habitat buffers which compose only 5% of the landscape at 500 m and 1.4% of the landscape at 1500 m around a survey point.

However regional and annual differences in response to buffers were apparent for all species, highlighting the likely variability in baseline populations, and variable response to CP33 buffers among regions and years. For example, throughout the study bobwhite densities have consistently been greatest but with the least effect size in the Central Mixed-grass Prairie region (BCR 19), exemplifying likely differences in baseline bobwhite abundances compared to other regions. Ample baseline bobwhite abundance paired with little effect of CP33 may reflect quality bobwhite habitat in landscapes around both buffered and non-buffered fields in that region. In contrast, densities and effect sizes have increased in the Eastern Tallgrass Prairie each year, suggesting strong breeding season response to the habitat provided by CP33 buffers in that region. These differences highlight the need to evaluate bird response to conservation practices at a regional scale, and will provide feedback regarding where practice establishment will be of greatest benefit.

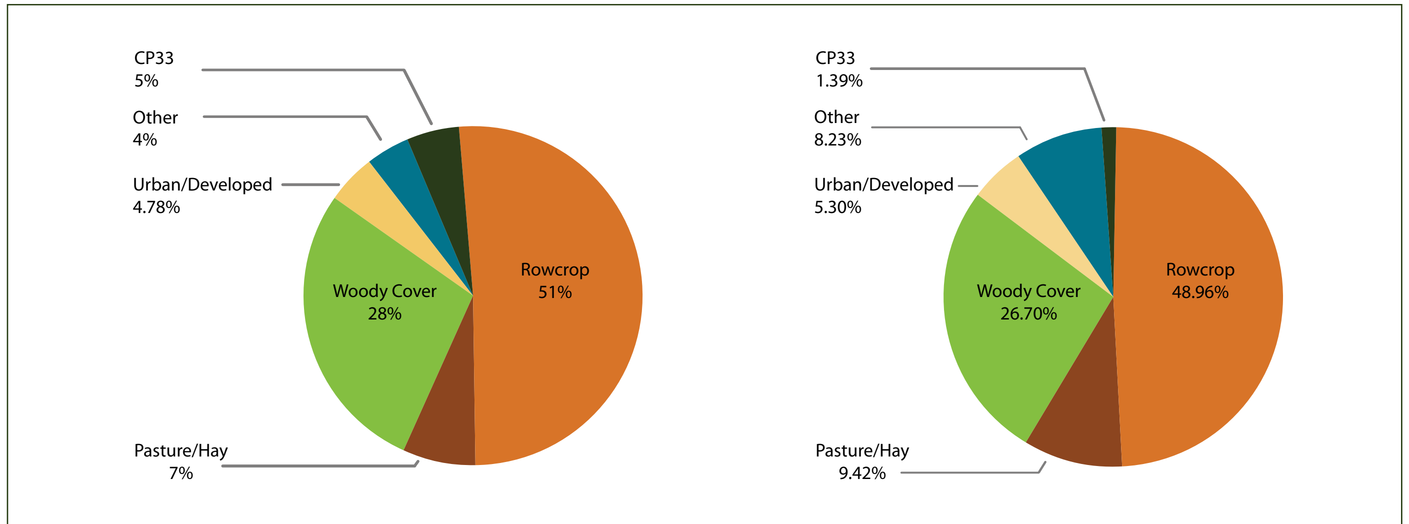

Figure 22. Percent composition of land cover/land use at a 500 m (left) and 1500 m (right) radii around fields containing CP33 upland habitat buffers in 14 states.

For regions where bobwhite response to CP33 buffers is greatest, the question remains whether observed effect sizes have the capacity to contribute toward meeting the population recovery goals of the National Bobwhite Conservation Initiative. Clearly densities observed on CP33 buffers are insufficient to restore "huntable" bobwhite populations (assuming 1 bird/ac is huntable) in each region. However, when implemented strategically in the landscape and in conjunction with other conservation management practices, upland habitat buffers have the potential to increase bobwhite abundances in a tangible manner. Diffuse application of CP33 buffers on the landscape may not produce increases in bobwhite densities comparable to buffers applied in a strategic and targeted manner in areas where potential bobwhite response will be greatest. Judicious CP33 buffer implementation coupled with a conservation management strategy may provide a means of producing densities that contribute toward bobwhite population recovery.

Many other grassland and scrub-successional birds suffer similar population trajectories as bobwhite and may realize benefits from upland habitat buffer establishment. Our results suggest that over the past 4 years some upland bird species exhibit very strong response to CP33, regionally and overall (e.g., dickcissel, field sparrow), whereas some species exhibit variable or negligible response (e.g., eastern meadowlark, grasshopper sparrow). Results from analysis of priority bird species suggests there are clear differences in habitat needs across the grassland and scrub-successional bird "guilds", whereby targeting a single management strategy toward an entire guild may fail for some species. Variable needs for vegetation composition and structure and habitat patch size for priority species warrants caution when designing and implementing a single conservation practice to benefit all species of a particular guild. The solution is to be realistic that not all management strategies will provide equal benefits across species with differing habitat and patch size requirements. To truly effect population increases in all severely declining grassland/scrub-successional bird species, a strategic habitat conservation approach using a suite of available conservation practices and programs should be applied.

Evaluation of vegetation composition, buffer characteristics, and mid-contract management activities has revealed interesting trends regarding sustainability of buffer quality over time. Percent litter has increased and percent bare ground has decreased annually since 2007, suggesting breeding season habitat quality for bobwhite within buffers may be diminishing. Mandatory mid-contract management, intended to maintain habitat quality by setting back succession and reducing litter accumulation had been applied to <50% of surveyed buffers in 2009. This lack of implementation of MCM across CP33 buffers may explain why percent litter continues to increase and percent bare ground continues to decrease though the opposite should be expected.

The CP33 monitoring program also exemplifies the feasibility of coordinated monitoring across geopolitical boundaries. When the practice was initiated bobwhite managers strove for standardization of data collection via a coordinated monitoring effort to provide inference regarding bobwhite response to upland habitat buffers, beyond the scale at which the data were collected (i.e., at the state level). Moreover, coordination of CP33 monitoring via a single entity provided states with additional resources for implementation of required monitoring, which facilitated multi-scale synthesis of analysis and results. CP33 monitoring exemplifies that coordinated monitoring across multiple agencies/organizations is entirely possible and can be very successful given the appropriate funding mechanism and monitoring infrastructure.

Acknowledgements

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Table 1. Species (by alpha-code) of interest selected for each Bird Conservation Region (BCR) for CP33 contract monitoring in 2006-2008.

Bird Conservation Region	Species
11- Prairie Potholes	
19-Central Mixed-grass Prairie	BEVI, DICK, EAKI, EAME, FISP, GRSP, INBU, NOBO, PABU, STFL, UPSA
22-Eastern Tallgrass Prairie	DICK, EAKI, EAME, FISP, GRSP, INBU, NOBO, VESP, UPSA
23-Prairie Hardwood Transition	DICK, EAKI, EAME, FISP, INBU, NOBO, VESP
24-Central Hardwoods	DICK, EAKI, EAME, FISP, INBU, NOBO
25-Western Gulf Coast Plain	DICK, EAKI, EAME, INBU, NOBO, PABU
26-Mississippi Alluvial Valley	DICK, EAKI, EAME, FISP, GRSP, INBU, NOBO, PABU
27-Southeast Coastal Plain	DICK, EAKI, EAME, FISP, GRSP, INBU, NOBO, PABU
29-Piedmont	EAKI, EAME, FISP, INBU, NOBO

Table 2. Average designated contract width, method and percentage of cover establishment, and types of exotic species present on surveyed CP33 upland habitat buffers in 14 states in 2009. Mean contracted buffer width and percent of contracts planting native grasses (NG) or allowing buffers to naturally regenerate (NR) based off of contract information from buffers sampled during 2009 vegetation surveys. Note that not all CP33 contracts specified buffer width or contract cover.

		Contract Cover1				
State	Mean Contract Width (ft)	NR	NG	Establish (2009)	Dominant Cover	Exotics Present
Arkansas	103	5%	95%	85%	NWSG (60%), Forb (0%), Grass/Forb (24%), Exotic (16%)	Bermudagrass, Brome, Echinocloa, Johnsongrass, Sericea lespedeza
Georgia	87	67%	33%	97%	NWSG (0%), Forb (84%), Grass/Forb (3%), Exotic (13%)	Bahiagrass, Bermudagrass, Johnsongrass
Illinois	81	0%	100%	89%	NWSG (74%), Forb (15%), Grass/Forb (7%), Exotic (4%)	Smooth Brome, Fescue, Reed Canary
Indiana	87	12%	88%	100%	NWSG (58%), Forb (21%), Grass/Forb (17%), Exotic (4%)	Brome, C. Goldenrod, C. Thistle, Clover, Fescue, Johnson, Orchard, Reed Canary, Timothy
Iowa	84	3%	97%	100%	NWSG (88%), Forb (0%), Grass/Forb (0%), Exotic (12%)	
Kentucky	84	3%	97%	100%	NWSG (2%), Forb (0%), Grass/ Forb (88%), Exotic (10%)	Bahiagrass, Bermudagrass, Brome, Fescue, J. Stiltgrass, Johnsongrass, Mare's tail, Orchardgrass, Reed Canary, Ryegrass, Timothy
Mississippi	89	31%	63%	73% (2008)		Bermudagrass, Fescue, Johnsongrass
Missouri	N/A	N/A	N/A	N/A		N/A
Nebraska	80	0%	100%	88%	NWSG (37%), Forb (15%), Grass/Forb (17%), Exotic (32%)	Brome, Cheatgrass, K. Bluegrass, Orchardgrass
North Carolina	85	95%	5%	100%	NWSG (29%), Forb (69%), Grass/Forb (0%), Exotic (0%)	Fescue
Ohio	65	0%	100%	95%	NWSG (49%), Forb (42%), Grass/Forb (0%), Exotic (10%)	Brome, Cogongrass, Fescue, Johnson, K. Bluegrass, Orchardgrass, Red Top, Reed Canary, Timothy
South Carolina	92	100%	0%	100%	NWSG (42%), Forb (58%), Grass/Forb (0%), Exotic (0%)	Fescue
Tennessee	75	93%	0%	100%		Bermudagrass, Clover, Fescue, Orchardgrass
Texas	119	43%	57%	100%	NWSG (48%), Forb (7%), Grass/Forb (3%), Exotic (41%)	Bermudagrass, Johnsongrass, Sorghum
Overall	87	35%	64%	94%	NWSG (44%), Forb (28%), Grass/Forb (15%), Exotic (13%)	

Table 3. Average percent shrubs, trees, and non-compliance (NC), type of non-compliance activities (in order of prevalence), percent mid-contract management (MCM) and type of mid-contract management activities on surveyed CP33 upland habitat buffers in 14 states in 2007, 10 states in 2008, and 14 states in 2009.

State		% Shrub	% Tree	% Exotic	% NC	Noncompliance Type	% MCM	MCM Type
Arkansas	2007	1.03	0.26		2.56	Mow	10.9	Disk
	2009	0.96	0.6	22.09	21.5	Uncertain, herbicide drift		
Georgia	2007	1	1.08		7.5	Road/turnrow/driven , planted to crops, mow, equipment disturbance, planted to pine, food plot, equipment/parking/debris/hay	11.1	Disk, herbicide, disk and burn
	2008	3.58	1.63		14.2	Mow, planted to crops, road/turnrow/driven, equipment parking	20.2	Disk, burn, herbicide
	2009	2.53	2.9	14.88	15.3	Road/turnrow/driven, mow, planted to crops, herbicide drift		
Illinois	2007	0.73	8.71		10.1	Mow, road/turnrow/driven, planted to crops, not contract width	0	N/A
	2009	2.19	0.63	17.96	6.96	Mow, road/turnrow/driven, herbicide drift, equipment parking	0	N/A
Indiana	2007	0.77	2.03		10.9	Herbicide drift, mow, road/driven/turnrow , equipment disturbance	0	N/A
	2008	0.27	0		12.3	Mow, herbicide drift, planted to crops, road/turnrow/driven, equipment parking	5.65	Disk
	2009	0	2.48	12.12	9.64	Mow, road/turnrow/driven, planted to crops, equipment parking, herbicide drif		
Iowa	2007	0.13	0		N/A	Mow, road/turnrow/driven	12.4	N/A
	2008	0.26	0.13		N/A	N/A	8.38	N/A
	2009	1.43	0.71	16.43	N/A	N/A		
Kansas	2007	0.53	0.25		2.76	Road/turnrow/driven, mow, equipment parking/debris/hay, underwater	0.22	N/A

Table 3. Average percent shrubs, trees, and non-compliance (NC), type of non-compliance activities (in order of prevalence), percent mid-contract management (MCM) and type of mid-contract management activities on surveyed CP33 upland habitat buffers in 14 states in 2007, 10 states in 2008, and 14 states in 2009 (continued).

State		% Shrub	% Tree	% Exotic	% NC	Noncompliance Type	% MCM	MCM Type
Kentucky	2007	1	6		15.3	Mow, road/turnrow/driven, equipment parking/debris/hay, planted to crops	0.5	N/A
	2008	1.07	6.56		21.1	Mow, road/turnrow/driven, equipment storage, barn built	2.26	Mow
	2009	4.41	6.75	20.75	7.71	Herbicide drift, road/turnrow/driven, mow, planted to crops		
Mississippi	2007	0	1.38		7	Road/turnrow/driven, planted to crops, mow, equipment disturbance, herbicide drift	0	N/A
	2008	0.28	1.03	0.56		Road/turnrow/driven	3.42	
	2009	4.11	8.31	49.75	5.66	Mow, road/turnrow/driven		
Missouri	2007	N/A	N/A		N/A	N/A	N/A	N/A
	2008	N/A	N/A		N/A	N/A	N/A	N/A
	2009	N/A	N/A		N/A	N/A	N/A	N/A
Nebraska	2007	0.46	0.78		7.39	Road/turnrow/driven, herbicide drift, mow, equipment parking, planted to crops	0	N/A
	2008	0.28	0.92		16.3	Road/turnrow/driven, herbicide drift, mow, planted to crops	N/A	N/A
	2009	1.96	5.35	19.24	7.97	Herbicide drift, planted to crops, mow, road/turnrow/driven		
North Carolina	2007	2.39	3.34		8.73	Road/turnrow/driven, mowed, planted to crops, plowed, herbicide drift, food plot	13.2	Disk
	2008	2.44	6.58		4.39	Herbicide drift, planted to crops, road/turnrow/driven	21.2	Disk, burn, herbicide
	2009	16.5	11.92	17.44	2.56	Mow		

Table 3. Average percent shrubs, trees, and non-compliance (NC), type of non-compliance activities (in order of prevalence), percent mid-contract management (MCM) and type of mid-contract management activities on surveyed CP33 upland habitat buffers in 14 states in 2007, 10 states in 2008, and 14 states in 2009 (continued).

State		% Shrub	% Tree	% Exotic	% NC	Noncompliance Type	% MCM	MCM Type
Ohio	2007	0.1	0.6		N/A		N/A	
	2009	4.28	2.88	17.05	9.23	Mow, driven/equipment parking, herbicide drift		
South Carolina	2007	2.89	0.97		4.86	Road/turnrow/driven, planted to crops, food plot, mow, equipment parking, herbicide drift	30.5	Disk
	2008	3.99	1.18		3.22	Road/turnrow/driven, planted to crops, herbicide drift, mow, equipment parking	31.6	Disk
	2009	8.99	4.87	22.26	N/A	N/A		
Tennessee	2007	0	0		6.28	Mow, equipment parking/ debris/hay, road/turnrow/ driven, planted to crops, herbicide drift	N/A	N/A
	2008	0.24	0.12		8.78	Mow	N/A	N/A
	2009	N/A	N/A	7.85	5.26	Mow, herbicide drift, road/equipment parking/ equipment damage, planted to crops		
Texas	2007	2.44	4.69		7.46	Mowed, road/turnrow/ driven	0	N/A
	2009	6.21	8.76	35.52	1.9	Road/turnrow/driven, plowed		
Overall	2007	0.96	2.15		7.57		6.56	
	2008	1.38	2.02		10.1		13.3	
	2009	4.47	4.68	21.03	7.81		N/A	

Table 4. Average buffer width, percent native warm-season grass (NWSG), forb, legume, exotic vegetation, litter, bare ground, and woody across 10 transect points systematically distributed on each surveyed CP33 upland habitat buffers in 15 states in 2007, 10 states in 2008, and 14 states in 2009.

State		Mean Buffer Width (ft)	% NWSG	% Forb	% Legume	% Exotic	% Litter	% Bare	% Woody
Arkansas	2007	98.82	34.40	24.34	3.18	9.28	11.02	16.15	1.03
	2009	98.72	41.46	13.34	18.38	22.65	46.51	12.98	N/A
Georgia	2007	87.98	8.21	35.34	2.44	15.04	23.58	13.28	0.39
	2008	81.10	5.45	31.37	3.27	6.13	35.45	19.76	1.19
	2009	82.64	4.91	41.10	5.86	11.64	26.75	16.72	N/A
Illinois	2007	82.33	36.82	15.49	5.06	13.44	13.89	15.66	0.16
	2009	84.76	38.54	15.09	4.56	19.85	11.87	9.82	0.26
Indiana	2007	67.44	21.38	30.15	8.58	12.33	18.63	11.83	1.01
	2008	76.51	35.43	26.31	8.73	12.78	0.00	11.82	0.00
	2009	87.35	29.99	26.97	8.31	11.90	18.97	5.83	2.09
Iowa	2007	111.01	36.68	20.61	3.89	15.91	47.97	N/A	.32
	2008	76.41	61.19	26.25	6.22	2.88	78.12	N/A	.32
	2009	133.46	50.77	33.34	8.97	20.46	46.37	N/A	.14
Kansas	2007	106.80	32.50	20.23	3.47	10.28	20.55	19.21	0.17
Kentucky	2007	80.16	29.88	21.36	14.43	17.08	27.32	6.42	1.44
	2008	77.37	35.21	21.74	20.60	15.86	35.29	8.99	1.93
	2009	78.63	30.89	27.40	9.24	18.28	45.85	26.76	0.00
Mississippi	2007	79.09	62.89	42.36	14.68	11.99	22.20	49.86	0.14
	2008	N/A	38.00	43.72	13.12	7.71	22.80	21.76	0.40
	2009	100.49	5.89	26.46	16.64	51.71	67.90	32.15	N/A
Missouri	2007	N/A	N/A	24.05	N/A	20.18	37.15	31.21	0.87
	2008	N/A	N/A	39.93	N/A	22.22	61.14	38.26	2.08
	2009	13.18	12.01	18.16	3.59	17.13	57.63	38.65	0.48
Nebraska	**2007**	77.42	24.67	34.26	11.91	16.00	29.41	21.21	1.20
	2008	76.62	28.31	20.79	6.53	16.72	43.36	22.19	1.23
	2009	76.69	35.97	20.71	9.03	19.24	32.91	10.01	1.53

Table 4. Average buffer width, percent native warm-season grass (NWSG), forb, legume, exotic vegetation, litter, bare ground, and woody across 10 transect points systematically distributed on each surveyed CP33 upland habitat buffers in 15 states in 2007, 10 states in 2008, and 14 states in 2009 (continued).

State		Mean Buffer Width (ft)	% NWSG	% Forb	% Legume	% Exotic	% Litter	% Bare	% Woody
North Carolina	2007	74.95	8.28	41.02	3.33	15.37	12.42	14.82	2.87
	2008	88.75	8.06	51.22	6.15	20.01	16.15	18.35	1.50
	2009	80.86	1.57	42.31	0.00	0.00	16.01	13.42	8.17
Ohio	2007	62.34	29.10	28.30	0.85	8.40	26.20	13.70	0.60
	2009	64.08	35.25	33.10	11.33	12.25	85.77	13.84	0.49
South Carolina	2007	92.40	21.63	33.39	2.96	7.03	15.09	18.34	1.36
	2008	90.59	19.51	37.11	2.85	7.99	11.60	19.18	1.37
	2009	69.60	0.09	38.07	0.14	0.00	12.68	10.87	5.44
Tennessee	2007	74.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2008	74.58	N/A	N/A	N/A	14.73	N/A	N/A	N/A
	2009	70.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Texas	2007	116.12	21.15	30.39	3.72	9.85	18.39	35.61	0.48
	2009	159.59	30.29	12.17	3.34	33.38	11.52	8.90	0.09
Overall	2007	86.55	28.28	28.66	6.05	13.01	23.13	20.56	0.86
	2008	80.24	28.89	33.23	8.43	12.70	33.77	20.04	1.11
	2009	85.74	24.43	26.79	7.64	18.34	36.98	16.66	1.87

Table 5. Percent of landowners contacted regarding mid-contract management (MCM) activities, management activities indicated by landowners, percent of buffers that were estimated managed, and percent of buffer area within managed buffers estimated by the landowner for each state participating in the MCM survey.

State	% Landowners Initial MCM Inquiry	Management Activities Indicated	% Buffers Managed	If Managed, % Borders Estimated Managed
Arkansas				
Georgia	97%	None (15), Disk (13), Mow (2), Herbicide (2), Burn (1)	59%	34%
Illinois	11%	None (1), Burn (1), Disk/Mow (1)	67%	30%
Indiana	81%	None (12), Burn (7), Disk (6), Herbicide (1), Mow (1)	52%	22%
Iowa				
Kentucky	100%	Mow (3), Herbicide (1), Herbicide/ Mow (1), None (1)	13%	3%
Mississippi	90%	None (17), Disk (9), Burn (5), Mow (4)	60%	22%
Missouri	95%	None (40), Burn (5), Mow (5), Disk (4), Disk/Burn/Mow (1)	26%	10%
Nebraska	12%	None (5)	0%	
North Carolina	75%	Disk (17), None (5), Mow (4), Disc/ Mow (2), Burn (1), Herbicide (1)	83%	25%
Ohio	67%	None (28), Burn (1)	3%	20%
South Carolina	27%	Disk (7), None (2), Disk/Mow (1)	80%	26%
Tennessee	85%	None (19), Mow (5), Herbicide (4), Disk (3), Burn/Disk (3)	44%	9%
Texas	25%	Shred (4), Disk (1)	50%	36%
Overall	64%		45%	22%

Table 6. Apparent buffer management, percent of buffer area managed, and type of mid-contract management (MCM) activities from in-field MCM assessment of surveyed CP33 buffers.

State	Buffer appeared managed	Buffer did not appear managed	Uncertain	Of those managed, average % of buffer managed	Apparent Management Activities
Arkansas	6%	94%	0%	30%	Disk (2)
Georgia	56%	38%	5%	55%	Disk (17), Herbicide (1), Combination (1)
Illinois	11%	85%	4%	47%	Burn (2), Disk (1), Uncertain (1)
Indiana	33%	67%	0%	54%	Fire (5), Disk (5), Mow (2), Combination (1)
Iowa	34%	66%	0%		
Kentucky	3%	93%	5%	15%	Herbicide (1)
Mississippi	10%	8%	83%	44%	Disk (1)
Missouri	32%	37%	32%	45%	Burn (2), Disk (2)
Nebraska	0%	90%	10%		
North Carolina	40%	33%	28%	31%	Disk (11), Mow (2)
Ohio	2%	86%	12%	5%	Herbicide (1)
South Carolina	59%	8%	32%	33%	Disk (14), Uncertain (7)
Tennessee	41%	54%	5%	53%	Disk (6), Herbicide (4), Mow (2), Burn/Disk (1), Disk/Herbicide (1)
Texas					
Overall	25%	58%	16%	38%	