Conservation Reserve Program

CP33 - Habitat Buffers for Upland Birds

Bird Monitoring and Evaluation Plan

2006 Annual Report

USDA Farm Service Agency

Mississippi Wildlife, Fisheries, & Parks

Mississippi State University

FWRC

NRCS

Conservation Reserve Program

Bird Monitoring and Evaluation Plan
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Executive Summary

In 2005, the USDA-Farm Service Agency (FSA) implemented the Habitat Buffers for Upland Birds (CP33) practice as part of the Continuous Conservation Reserve Program (CRP). The FSA allocated 250,000 CP33 acres to 35 states to be actively managed over a period of 10 years and charged the Southeast Quail Study Group with the development of a CP33 monitoring protocol with the goal of generating measures of population response for northern bobwhite (*Colinus virginianus*) and other priority songbird species.

The FSA adopted the monitoring protocol developed by the SEQSG and encouraged states with CP33 allocation to participate in coordinated monitoring. The CP33 national monitoring protocol suggested monitoring of the 20 states that encompass 95% of the allocated CP33 acreage over a 3 year period. State-level point-transect monitoring began in the 2006 breeding season on at least 40 CP33 contract fields paired with similarly cropped control fields in 11 states. Monitoring continued in the fall of 2006 with bobwhite covey call surveys in 14 states. Comparative abundance of bobwhite and other priority species on CP33 and control fields were estimated for the 2006 breeding season and fall using a 3-tiered approach (across bobwhite range (national), within each Bird Conservation Region (BCR), and within each state).

There was a positive overall response by bobwhite and variable response by priority songbird species to establishment of CP33 habitat buffers around cropped fields compared to control fields. The greatest magnitude of effect of bobwhite to CP33 habitat buffers occurred in the Southeastern Coastal Plain (SCP) in the 2006 breeding season and in the SCP and Eastern Tallgrass Prairie (ETP) the following fall. Dickcissel (*Spiza americana*), field sparrow (*Spizella pusilla*), vesper sparrow (*Pooecetes gramineus*), indigo bunting (*Passerina cyanea*) and painted bunting (*Passerina ciris*) all showed strong positive response to CP33 with regional relative effect sizes reaching up to a 162% increase in density relative to control fields. However, not all species benefited from CP33. Eastern meadowlark (*Sturnella magna*) and grasshopper sparrow (*Ammodramus savannarum*) densities were consistently greater in control rather than CP33 sites, most likely due to their affinity for larger patches and habitat preferences for shorter cover.

If differences in local abundance of bobwhite and select grassland bird represent actual increases in recruitment/population levels attributable to CP33, instead of merely redistribution of extant populations, CP33 has achieved remarkable success in just its first 2 years of implementation. A population response of this magnitude is substantive, given that at the field and farm scale CP33 typically represents only a 2 – 10% change in land use.

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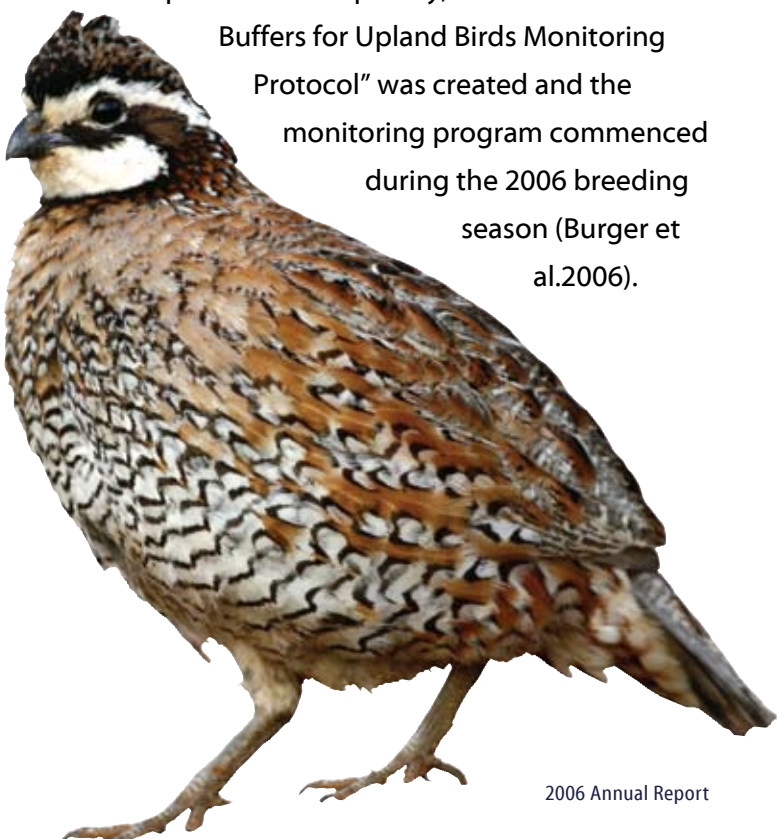
Introduction

The North American Breeding Bird Survey (BBS), currently the only large-scale and long-term measurement tool used to estimate population trends of bird species in North America, provided the first indication that grassland obligate and successional-shrub dependent species in the United States were experiencing a severe decline. BBS results suggest that 43% of grassland species and 34% of successional-scrub species have exhibited significant population declines since 1980 (Sauer et al. 2006). Among these, some of the most severe annual declines are found in populations of Henslow's sparrow (*Ammodramus henslowii*) (5.7%), northern bobwhite (3.8%), grasshopper sparrow (3.4%), eastern meadowlark (3.1%), and field sparrow (2.4%) (Sauer et al. 2006). Contributing to the cause of these declines is no doubt the historical conversion of many native grasslands to agricultural production, which is exacerbated today by factors such as clean-farming techniques that reduce the amount of fallow area around field edges, urbanization, reforestation, and fire-exclusion. The inevitable habitat changes that coincide with these factors have resulted in the dependence of many early-successional species on suboptimal habitat for various parts of their life cycle.

In response to population recovery goals set by the Northern Bobwhite Conservation Initiative (NBCI; Dimmick et al. 2002), the Southeast Quail Study Group has emphasized the development of methods to increase bobwhite populations in agricultural landscapes. To realistically attain the population recovery goals, it is essential that management practices coexist with agricultural production, and hence avoid requiring producers to remove whole fields from crop production. The implementation of subsidized mixed native warm-season grass, forb, and legume buffers around cropped fields may be one method to increase bobwhite and other early-successional songbird habitats with minimal or positive economic impact on landowners (Barbour et al 2007). In 2004, following recommendation by the SEQSG, the USDA-Farm Service Agency (FSA) implemented the Habitat Buffers for Upland Birds (CP33) practice as part of the Continuous Conservation Reserve Program (CRP). The FSA allocated 250,000 CP33 acres to 35 states to be actively managed over a period of 10 years.

As the majority of CRP practices were initially established to decrease soil erosion and increase water quality, the FSA raised concern about the paucity of information regarding effects of CRP practices on wildlife populations. To address these concerns, the FSA charged the SEQSG with the development of a CP33 monitoring program to estimate bobwhite and priority songbird population response to implementation of CP33 at a state, regional and national level over a 3 year sampling period. Subsequently, the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol" was created and the monitoring program commenced during the 2006 breeding season (Burger et al.2006).

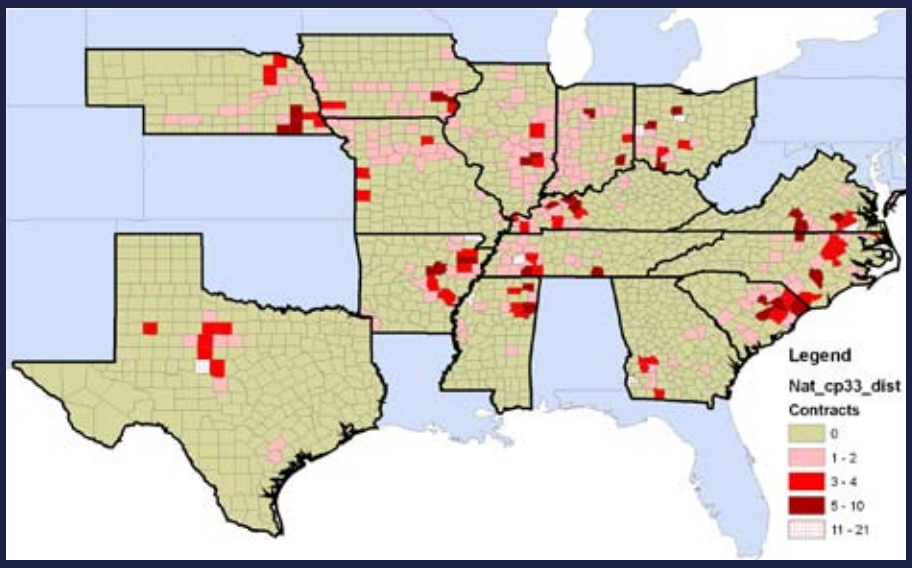


Methods

Survey Methods

Of the 35 states that were allocated CP33 acreage, 20 of those states encompass 95% of the CP33 acreage and are located within the core range of northern bobwhite. The FSA required monitoring within each of the designated 20 states for a 3-year period to evaluate effects of field borders on populations of bobwhite and other species of interest. State-level monitoring of CP33 contract fields (Figure 1) includes annual surveys of at least 40 CP33 fields with one survey point per field. To evaluate effects of CP33 habitat buffers, control fields located >1 km and <3 km from a surveyed CP33 field and exhibiting the same agricultural use were selected for comparison. Each of the 40 selected CP33 fields and each matching control field were surveyed at least once during the breeding season (May – July) and once during the fall (September – November).

Figure 1. National distribution of monitored CP33 contracts in 2006.



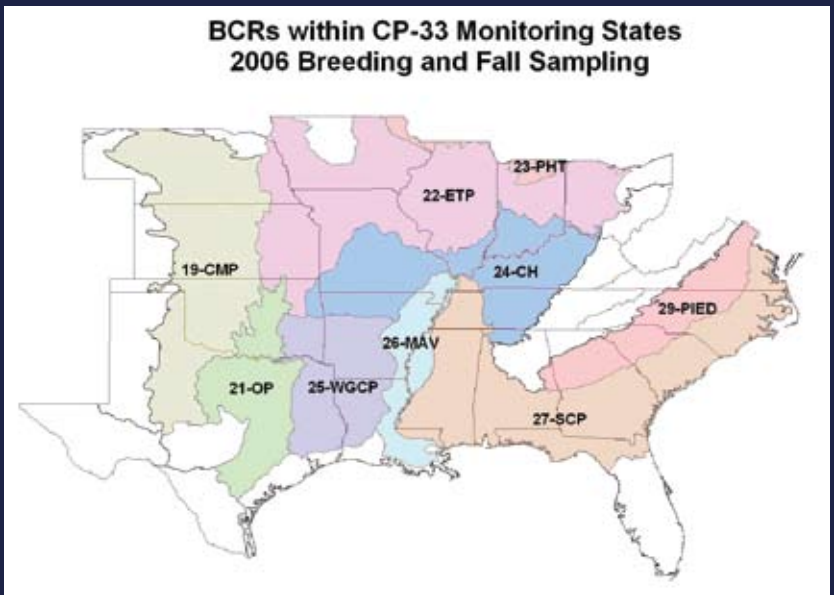
2006 Breeding Season

Point-transect surveys of calling male bobwhites and other priority species, selected for each BCR (Figure 2, Table 1), were conducted during May through July 2006 on paired CP33 and control fields. Point-transect surveys were conducted between sunrise and two hours following sunrise. All calling male bobwhite and singing males of the selected priority species were counted during a 10-min survey at each point, and each bird was recorded within a pre-determined distance band with a maximum distance of 500 m. During the 2006 breeding season, 11 states conducted CP33 monitoring following the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol" (Burger et al. 2006) (Table 2). Nine states had insufficient numbers of CP33 contracts (<40) to conduct monitoring or were incapable of implementing the monitoring program due to logistical issues (Table 2). Although not required, several states conducted up to four survey replications at each point. Paired CP33 and control fields were surveyed simultaneously to ensure similar weather conditions.

2006 Fall Covey Counts

Fall counts of calling bobwhite coveys were conducted using point-transect sampling between September and November 2006 (based on geographic location) on paired CP33 and control fields. Fourteen states conducted covey count surveys during the fall of 2006, with 13 of those states following the "CP33-Habitat Buffers for Upland Birds Monitoring Protocol" (Burger et al. 2006). Covey call surveys were conducted simultaneously on paired CP33 and control fields from 45 min before sunrise to 5 min before sunrise or until covey calls had ceased. Covey locations and time of calling were recorded on datasheets containing aerial photos of the survey location. Distance was later measured from georeferenced NAIP imagery in ARCGIS to generate an exact radial distance from the point to the estimated location of the calling covey. In an effort to derive measures of density that incorporated variable calling rates, number of adjacent calling coveys and weather characteristics (6-hr change in barometric pressure (1 am – 7 am; in/Hg), percent cloud cover, and wind speed (km/hr)) were recorded during each survey (Wellendorf et al. 2004).

Figure 2. Geographic location of Bird Conservation Regions included in the 2006 breeding and fall CP33 monitoring program. BCR's include Central Mixed Grass Prairie (19-CMP), Oaks and Prairies (21-OP). Eastern Tallgrass Prairie (22-ETP), Prairie-Hardwood Transition (23-PHT), Central Hardwoods (24-CH), Western Gulf Coast Plain (25-WGCP), Mississippi Alluvial Valley (26-MAV), Southeastern Coastal Plain (27-SCP), and Piedmont (29-PIED).



Data Analysis

Analysis of 2006 breeding season and fall covey count data was conducted using a 3-tiered approach, with results generated nationally (across bobwhite range), regionally (within each BCR), and within each state. Density estimates were obtained for fall covey data, and for species with adequate numbers of detections in the breeding season using program Distance 5.0 (Thomas et al. 2006). Relative abundances were estimated for species in the breeding season with too few detections to accurately estimate density.

2006 Breeding Season-BCR-level

We used conventional distance sampling (CDS) in program Distance 5.0 (Thomas et al. 2006) to estimate a detection function for each species of interest based on the probability of detecting a singing male at a given radial distance (m) from the survey point (Buckland et al. 2001). Species of interest varied based on location (Table 1). Species of interest for all BCR's included northern bobwhite, eastern meadowlark, and eastern kingbird (*Tyrannus tyrannus*). In accordance with species' range some BCR's also included dickcissel, field sparrow, grasshopper sparrow, vesper sparrow, indigo bunting, painted bunting and scissor-tailed flycatcher (*Tyrannus forficatus*) when appropriate. Data were recorded in the field within one of 5 distance intervals (25, 50, 100, 250, 500 m). Intervals were accounted for in program Distance by generating a mid-distance value for each observation (e.g., observation in 100-250 m distance band recorded as mid-distance of 175 m), and then conducting analysis based on the 5 distance intervals. We accounted for outliers in the data (which cause difficulties in model-fitting) by right-truncating observations beyond 499 m prior to analysis (Buckland et al. 2001).

Sample sizes within most BCR's were adequate to generate a BCR-level detection function and subsequent BCR-level density estimates within program Distance. The Mississippi Alluvial Valley (MAV; $k_{(CP33)}$=12, $k_{(control)}$=13), and Prairie Hardwood Transition (PHT; $k_{(CP33)}$=3, $k_{(control)}$=3) did not have adequate sample sizes to generate BCR-specific detection functions or density estimates for species of interest; however samples from MAV and PHT were included in state-level analyses.

In program Distance we first evaluated the fit of global (pooled CP33 and control) or stratified (separate CP33 and control) detection functions within each BCR for each species of interest using Akaike Information Criteria (AIC; Akaike 1974). We evaluated the fit of four key-function models with appropriate series expansion term (uniform +cosine, uniform+simple polynomial, half-normal+hermite polynomial, hazard rate+cosine) (Buckland et al. 2001). We based model selection on minimum AIC value, evaluation of the fit of the detection probability, and probability density plots generated for each model. We then used either the global or stratified detection functions to generate stratified density estimates for CP33 and control groups.

We used a nonparametric bootstrap (B=1000) to generate variance and 95% confidence intervals around density estimates. We calculated an estimate of simple effect size by subtracting the control group density estimate from the CP33 density estimate within each BCR.

For species of interest that did not have adequate sample sizes to generate density estimates, we estimated relative abundances using a Poisson regression (with a log-link function) (Hamrick et al. 2006). Pairwise random effects were included based on paired CP33 and control fields. Data sets with a consistent number of survey repetitions were treated with repeated measures random effects. Because some states within a BCR had only one repetition and others had multiple repetitions, we used the mean count of all repetitions in regional BCR analysis and did not include a repeated measures random effect. Confidence intervals (95%) were generated for all relative abundance data after exponential back-transformation of means.

2006 Breeding Season- State-level

There were not adequate sample sizes to generate state-specific detection functions for each species of interest based solely on within-state data. However, Multiple Covariate Distance Sampling (MCDS) in program Distance allows for the estimation of detection functions at multiple levels. Using this approach, we were able to generate state-level density estimates for bobwhite, indigo bunting, dickcissel, and eastern meadowlark. We first used AIC model selection procedures in standard CDS analysis (uniform+cosine, uniform+simple polynomial, half normal+hermite polynomial and hazard rate+cosine key functions) and determined if stratified (CP33 and control separately) or global detection functions better fit the national data set for each species. If the model selected a stratified detection function, we subsequently ran separate analyses on each of the CP33 and control national data sets for the species. If the model selected a global detection function, we used the entire data set for the species. Within the stratified (CP33 and control) or global national data sets we then used MCDS analysis (half-normal+hermite polynomial, hazard rate+cosine key functions) to fit a global model for the detection function, and used this fitted model to estimate separate average state-level detection functions using states as factor-level covariates. We used these averaged state-level detection functions to generate within-state density estimates for species of interest for CP33 and control groups. We used nonparametric bootstrap (B=1000) to generate variance and 95% confidence intervals around density estimates. We calculated a raw estimate of effect size by subtracting the control group density estimate from the CP33 density estimate within each state. For species of interest that did not have adequate sample sizes to generate state-level density estimates, we instead estimated relative abundances using the Poisson regression methods outlined above. State-level relative abundance estimates and 95% confidence intervals were generated for eastern kingbird, field sparrow, and grasshopper sparrow in 2006.

2006 Fall Covey Counts – BCR-level

For the 2006 fall covey BCR-level analysis, we used CDS methods (outlined above) in program Distance to estimate a detection function based on the probability of detecting a covey at a given radial distance (m) from the survey point (Buckland et al. 2001). The Piedmont (PIED; $k_{(CP33)}=7$, $k_{(control)}=7$), Western Gulf Coastal Plain (WGCP; $k_{(CP33)}=5$, $k_{(control)}=4$), and Prairie Hardwood Transition (PHT; $k_{(CP33)}=3$, $k_{(control)}=3$) BCR's did not have adequate sample sizes to generate BCR-specific detection functions or density estimates within program Distance; however samples from PIED,WGCP, and PHT were included in state-level analysis. We accounted for outliers in the data (which cause difficulties in model-fitting) by right-truncating the 10% of observations with largest detection distances prior to analysis (Buckland et al. 2001). Analysis was conducted on ungrouped data (i.e., using exact distances) on all but one BCR. The Central Mixed Grass Prairie (CMP; also Texas) data exhibited a substantial amount of heaping, and was therefore analyzed using 6 distance intervals with truncation at 380 m.

Within each BCR, we used AIC to evaluate the fit of four key-function models with series expansions (uniform +cosine, uniform+simple polynomial, half-normal+hermite polynomial, hazard rate+cosine) to determine if global (pooled CP33 and control) or stratified (separate CP33 and control) detection functions best fit the data. Similar to the breeding season analysis, we based model selection on both

the minimum AIC value and on evaluation of the fit of the detection probability and probability density plots generated for each model. The stratified detection function (separate detection functions for CP33 and control fields) exhibited the best model fit in all but two BCR's (Central Hardwoods and Central Mixed Grass Prairie exhibited global detection functions). We then used either the global or stratified detection functions to generate stratified density estimates for CP33 and control groups. We used a nonparametric bootstrap (B=1000) to generate variance and 95% confidence intervals around density estimates. We calculated an estimate of simple effect size by subtracting the control group density estimate from the CP33 density estimate within each BCR.

Incorporating Wellendorf's adjustments.- With apriori knowledge that extraneous factors in the environment will influence calling rate of bobwhite coveys, we also incorporated the adjustments suggested by Wellendorf et al. (2004). We used a logistic regression equation that incorporates the number of adjacent calling coveys, 6-hr change in barometric pressure (1am-7am; in/Hg), % cloud cover, and wind speed (km/hr) during each survey to estimate a calling probability. We interpreted the posterior probability from the logistic regression as a point-specific calling probability. We then divided the number of coveys detected at a point by the point-specific calling probability to generate an adjusted point-specific estimate of total coveys. We then used the global or stratified BCR-level detection functions and the distance-based density estimation equation (Buckland et al. 2001), ran a nonparametric bootstrap (B=1000) and generated an average adjusted density estimate and 95% confidence intervals based on the 1000 bootstrap repetitions.

2006 Fall Covey Counts – State-level

Similar to the breeding season analysis, there were not adequate sample sizes to generate state-specific detection functions based solely on within-state data. We used MCDS in program Distance to estimate multiple level detection functions to generate state-specific density estimates. We first used AIC model selection procedures in CDS (uniform+cosine, uniform+simple polynomial, half normal+hermite polynomial and hazard rate+cosine key functions) and determined that stratified detection functions (CP33 and control specific) better fit the national covey data set. We subsequently ran separate analyses on each of the CP33 and control national data sets. Within each of the CP33 and control national data sets we used MCDS to fit a global model for the detection function, and used this fitted model to estimate separate average state-level detection functions using states as factor-level covariates. We used these averaged state-level detection functions to generate within-state density estimates for CP33 and control groups. We used nonparametric bootstrap (B=1000) to generate variance and 95% confidence intervals around density estimates. We calculated a raw estimate of effect size by subtracting the control group density estimate from the CP33 density estimate within each state.

Incorporating Wellendorf's adjustments.-Finally, we used the logistic regression equation of Wellendorf et al. (2004) to incorporate the number of adjacent calling coveys, 6-hr change in barometric pressure (1am-7am; in/Hg), % cloud cover, and wind speed (km/hr) during each survey to estimate a calling probability. We interpreted the posterior probability from the logistic regression as point-level calling probability. We then divided the number of coveys detected at a point by the point-level calling

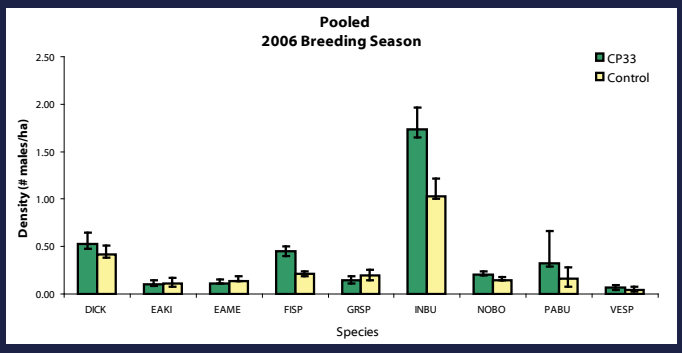
probability to generate an adjusted estimate of total coveys for each state. We then used the average state-level detection functions generated by MCDS in program Distance and the distance-based density estimation equation (Buckland et al. 2001) in a nonparametric bootstrap (B=1000) to generate average adjusted state-level density estimates and 95% confidence intervals based on the 1000 bootstrap repetitions.

Results

2006 Breeding Season

There were 98 total bird species detected in CP33 fields across all monitored states, 32 of which were grassland obligate or early-successional specialist species. There were 87 total species detected in control fields, 26 of which were grassland obligates or early-successional specialists. Response to CP33 varied among species and among BCR's. Northern bobwhite, indigo bunting, dickcissel, field sparrow, painted bunting, and vesper sparrow had variable positive responses to CP33, whereas eastern kingbird, eastern meadowlark, and grasshopper sparrow had relatively little or negative response to CP33 (Figure 3). Significance of response was determined by 95% confidence intervals on raw effect sizes.

Figure 3. Density estimates (# males/ha) of species of interest within all monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).



Northern bobwhite had a notable increase in density with an average regional effect size of 0.05 males/ha (range -0.18-0.12) and an average state-level effect size of 0.02 males/ha (range -0.13 – 0.07) (Figure 3; Appendix 1). Regional relative effect size was an average 36.7% increase in males/ha on CP33 (range -20.7%-171.6%), whereas state-level relative effect size was an average 20.1% increase in males/ha on CP33 (range -33.5% - 209.1%). An average increase of 0.05 males/ha, converts to an average increase of 1.2 male bobwhites per 10 acres on CP33 fields compared to control fields. The Central Mixed-Grass Prairie, which comprised Texas samples only, had the greatest density of northern bobwhite, but also showed negative response to CP33 in the 2006 breeding season (Figures 4 and 5). However, low sample size in the CMP (<40 sample points per treatment) resulted in a large degree of variation and an effect size that did not differ from zero. Bobwhite in the Southeastern Coastal Plain exhibited the greatest positive response to CP33, whereas those in the Central Hardwoods showed slightly positive response, and in the Eastern Tallgrass Prairie had little to no response (Figure 4). Bobwhite densities were significantly greater on CP33 fields than control in Georgia, Illinois, Kentucky, Mississippi and Missouri (Figure 5). Point estimates of density were greater but confidence intervals overlapped in Indiana, Iowa, South Carolina, and Tennessee (Figure 5). In Ohio

Figure 4. BCR-level density estimates (# males/ha) of northern bobwhite within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

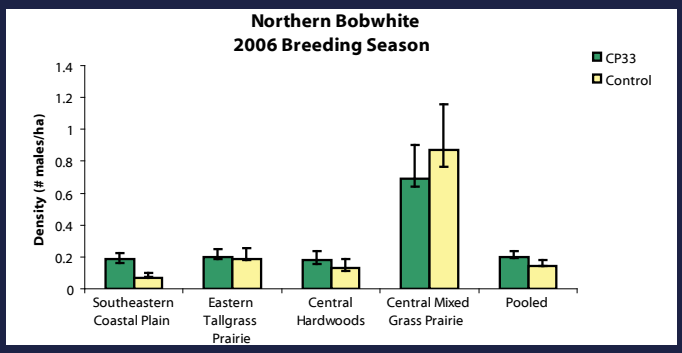
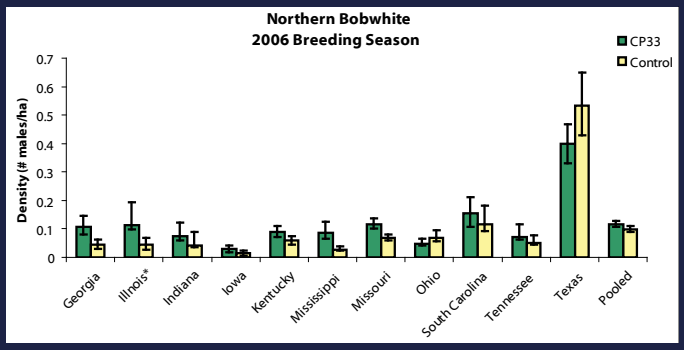


Figure 5. State-level density estimates (# males/ha) of northern bobwhite within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).



*The bootstrap confidence interval for Illinois control was not plausible; therefore the confidence interval presented for IL control was generated using program Distance.

and Texas, point estimates of density were lower on CP33 fields than control, but confidence intervals overlapped (Figure 5). Note the difference in density estimates for CMP (Figure 4) and Texas (Figure 5). These densities are estimated from the same data set (because CMP comprises only the Texas samples), however, this is a good example of the difference between estimating a detection function based on the given data set alone (as in CMP; Figure 4), compared to estimating the detection function in MCDS as an averaged state-level detection function based on a global detection function (as in TX; Figure 5). When sample size is adequate we recommend estimating the detection function in CDS based off the data set alone (as in CMP), and only using the MCDS 2-level detection function method to estimate densities for data-sets with sample sizes too low to be estimated in CDS.

At both the regional level and state-level, dickcissel exhibited an average relative effect size of 28% on CP33, but confidence intervals included zero (Figure 3; Appendix 1). Relative effect sizes ranged from -20.7% to 171.6% at the regional level and -33.5% to 209.1% at the state level. Average raw effect size at the regional level was 0.12 males/ha (range –0.04-0.35), and at the state level 0.06 males/ha (-0.16-0.28) on CP33 fields when compared to control fields. . Dickcissel displayed a substantive positive response to CP33 in the Eastern Tallgrass Prairie, and positive but not significant response in the Southeastern Coastal Plain and Central Hardwoods (Figure 6). Dickcissel showed a negative response to CP33 in the Central Mixed-Grass Prairie (Figure 6). Dickcissels in Illinois and Indiana exhibited a strong positive response to CP33, whereas those in Iowa, Kentucky, and Mississippi showed a positive but insignificant response (Figure 7). Dickcissels in Tennessee, Texas and Missouri had a negative but insignificant response to CP33 (Figure 7).

Eastern meadowlark exhibited a negative response overall to CP33, with an average regional decrease in density of 20.4% (range -63.7%-66%) and an average state-level decrease in density of 19% (range -88.9%-88.3%) on CP33 fields when compared to control fields (Figure 3; Appendix 1). There was consistent lack of or negative response of eastern meadowlark to CP33 across all BCR's except the Central Hardwoods, and across all states

Figure 6. BCR-level density estimates (# males/ha) of dickcissels within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

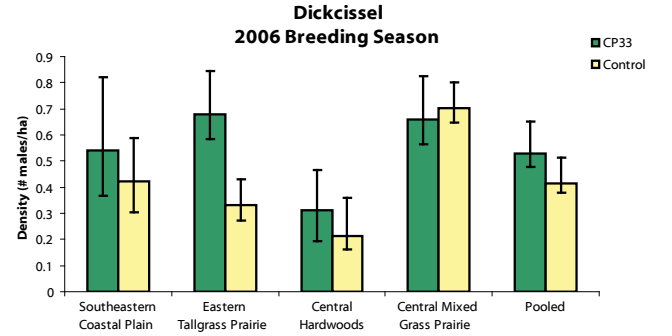
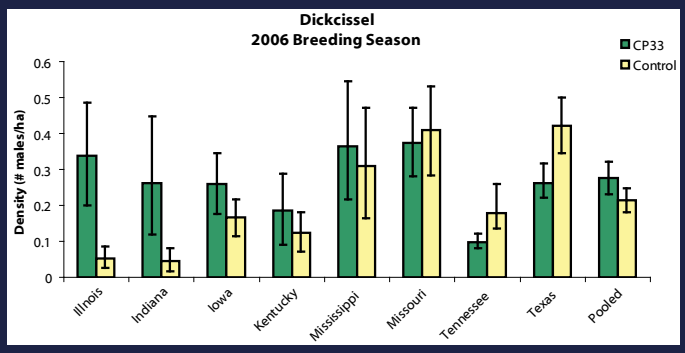


Figure 7. State-level density estimates (# males/ha) of dickcissels within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).



except Indiana and South Carolina (Figures 8 and 9). There were very few observations within each state, resulting in high variability and large confidence intervals, particularly in Georgia, South Carolina, and Illinois. Georgia only had 1 eastern meadowlark observed in CP33 and 9 in control, and South Carolina only had 5 observations in CP33 and 3 in control; therefore it is important to use caution when drawing conclusions for these two states.

Indigo bunting and field sparrow were the 2 passerine species that showed the greatest positive response to CP33. Indigo buntings had the greatest density (# males/ha) of all species of interest in both CP33 and control fields and also showed the greatest positive response to CP33 (Figure 3). Measured as increase in number of males/ha, raw effect size for indigo buntings ranged from 0.39 to 0.71 with an average effect size of 0.70 regionally. Expressed as relative effect size, this translates into an average 68.2% increase in male indigo buntings/ha (range 18.9% to 161.9%) on CP33 versus control fields (Appendix 1). Indigo buntings had strong

Figure 8. BCR-level density estimates (# males/ha) of eastern meadowlarks within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

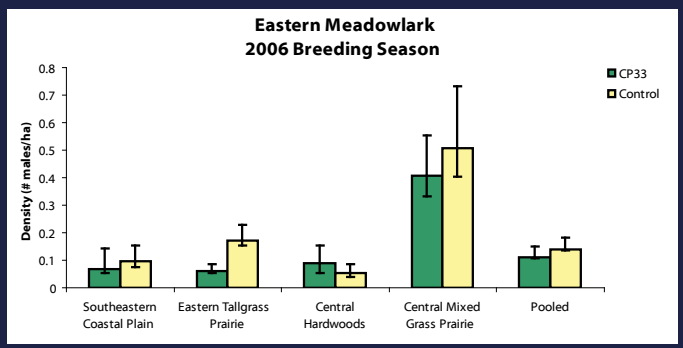


Figure 9. State-level density estimates (# males/ha) of eastern meadowlarks within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

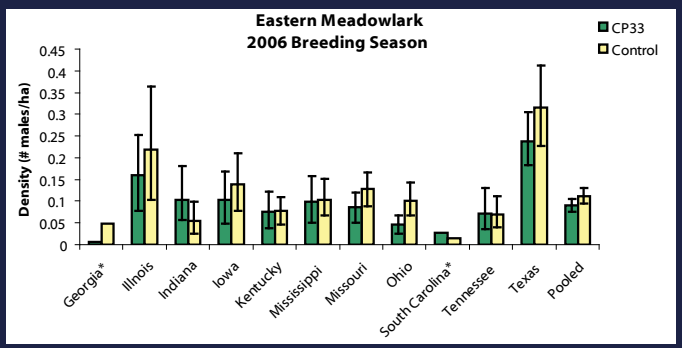


Figure 10. BCR-level density estimates (# males/ha) of indigo buntings within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

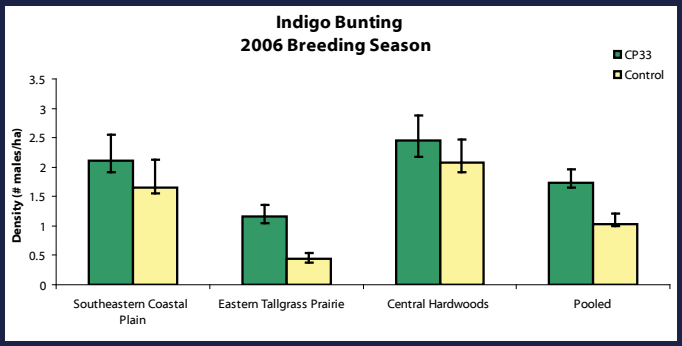
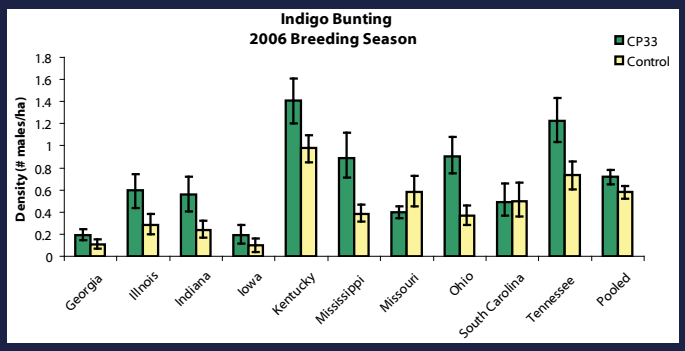


Figure 11. State-level density estimates (# males/ha) of indigo buntings within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).



positive response in the Eastern Tallgrass Prairie, and substantial but not significant positive response in the Southeastern Coastal Plain and the Central Hardwoods (Figure 10). Kentucky had the highest densities of indigo bunting in both CP33 and control (Figure 11). Indigo buntings in Illinois, Indiana, Kentucky, Mississippi, Ohio, and Tennessee exhibited very significant positive response to CP33 (Figure 11). In Georgia and Iowa indigo buntings showed a slight positive response, whereas South Carolina showed nearly no response at all of indigo buntings to CP33 (Figure 11). Missouri was the only state with a significant negative response of indigo buntings to CP33 (Figure 11).

Field sparrows exhibited a strong positive response to CP33 overall (Figure 3), with an average effect size of 0.24 males/ha regionally (range 0.12-0.25), and 0.34 number of males/point at the state-level (range 0.02-0.66) (Appendix 1). Relative abundance was estimated instead of density at the state level due to low numbers of detections. Converted to relative effect sizes, field sparrows had an increase on average of 111.5% males/ha on CP33 versus control fields regionally, and a 50% increase in mean number of males/point at the state-level. Field sparrows exhibited very strong positive response to CP33 in the Eastern Tallgrass Prairie and the Central Hardwoods, and a positive but insignificant response in the Southeastern Coastal Plain (Figure 12). Although small sample size resulted in high state-level variability, there was a significant positive response to CP33 in Illinois, Iowa, and Kentucky, and a positive but insignificant trend in Georgia, Indiana, Mississippi, Missouri, Ohio, South Carolina, and Tennessee (Figure 13).

There were too few observations of eastern kingbirds and grasshopper sparrows to estimate BCR or state level densities. Therefore, densities were estimated overall and relative abundances were estimated at the BCR and state level. Overall, eastern kingbird had a negative but insignificant response to CP33 (Figure 3; Appendix 1). However, eastern kingbirds in the Eastern Tallgrass Prairie, Central Hardwoods, and Southeastern Coastal Plain all exhibited positive but insignificant response in relative abundance to CP33 (Figure 14; Appendix 1). Variability was high at the state level due to small numbers of observations; however, eastern kingbirds in Iowa and South Carolina showed significant positive response to CP33 (Figure 15). Eastern

Figure 12. BCR-level density estimates (# males/ha) of field sparrows within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

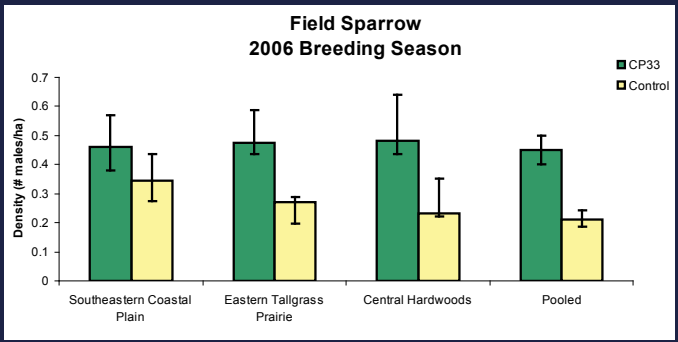
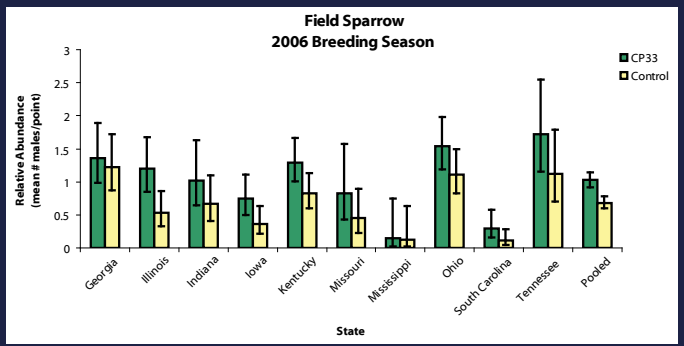


Figure 13. State-level relative abundance estimates (mean # males/point) of field sparrows within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% confidence intervals.



kingbirds in Georgia had a negative but highly variable response and Indiana had a slightly negative response to CP33 (Figure 15).

Due to a small number of observations, variability of density and relative abundance estimates for grasshopper sparrow was fairly large. Overall, grasshopper sparrow showed a negative, but insignificant response to CP33 with an average relative decrease in relative abundance of 6.2% at the regional level (range -8%-0%), and 6.6% at the state-level (range -45.5%-137.5%) (Figure 3; Appendix 1). Grasshopper sparrows consistently showed no or slightly negative but insignificant response in relative abundance to CP33 across BCR's and all states (Figures 16 and 17). However, due to the high variability of relative abundance estimates, we use caution to draw conclusions about response or lack thereof of grasshopper sparrows to CP33.

Painted buntings and vesper sparrows both had measurable increases in density overall on CP33

Figure 14. BCR-level relative abundance estimates (mean # males/point) of eastern kingbirds within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% confidence intervals.

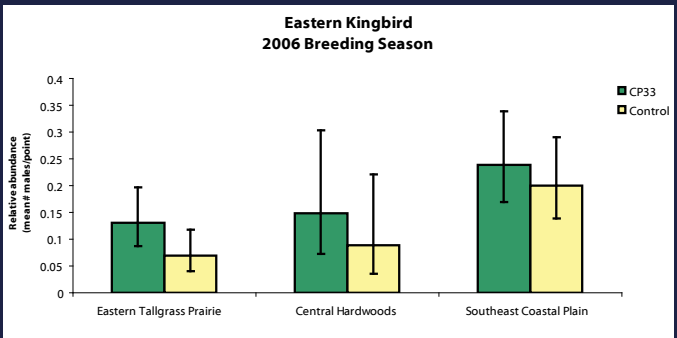


Figure 15. State-level relative abundance estimates (mean # males/point) of eastern kingbirds within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% confidence intervals.

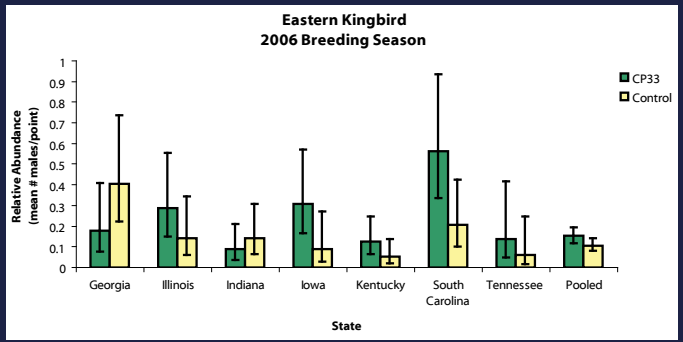


Figure 16. BCR-level relative abundance estimates (mean # males/point) of grasshopper sparrows within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% confidence intervals.

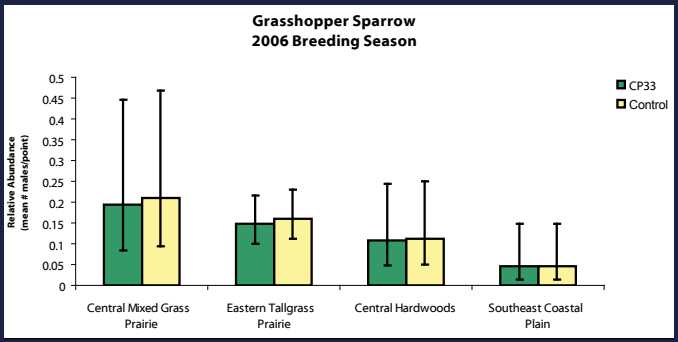
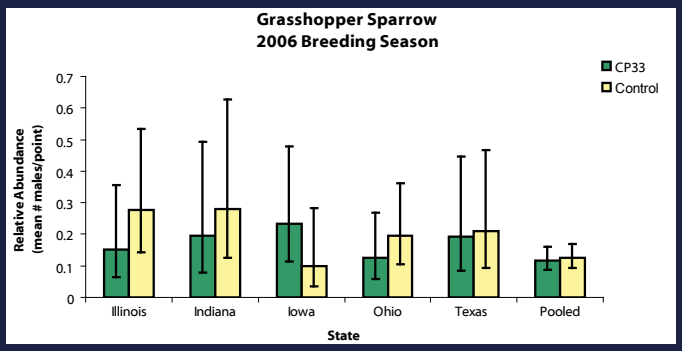


Figure 17. State-level relative abundance estimates (mean # males/point) of grasshopper sparrows within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% confidence intervals.



fields compared to control fields (Figure 3; Appendix 1), although neither increase was significant due to high variability of the density estimates. Painted buntings were only present in South Carolina, Texas, and Mississippi and had an average increase of 0.16 males/ha on CP33 pooled across these three states. When expressed as relative effect size, painted buntings demonstrated a 94% increase in males/ha on CP33 fields compared to control fields. Vesper sparrows were low in number across CP33 and control fields and were only present in Illinois, Indiana, Iowa and Ohio. Although numbers were low, vesper sparrows showed an average but insignificant increase of 0.024 males/ha and an average 57.1% increase in males/ha on CP33 fields compared to control fields pooled across these 5 states.

2006 Fall Covey Counts

In general, we observed measurable and substantive differences in fall local abundance of bobwhite coveys between CP33 and control fields across the range of participating states. However, the magnitude of effect varied among states and BCRs (Figures 18-21; Appendix 2). Following incorporation of Wellendorf's adjustments (Wellendorf et al. 2004), raw effect sizes, measured as increase in bobwhite coveys/ha relative to control fields, varied from -0.02 to 0.06 among states and -0.008 to 0.07 among regions. Average effect size was 0.026 coveys/ha. Expressed as relative effect sizes, this represents a range of -14 to 83.6 and an average of 44.9 % increase in local covey density associated with CP33. Incorporation of Wellendorf's adjustments for calling probability based on weather conditions and number of adjacent calling coveys expectedly increased density estimates in both CP33 and control fields, and subsequently increased effect size regionally by 0.008 coveys/ha regionally and at the state-level (Appendix 2).

Covey densities in both CP33 and control fields were greatest in the Central Mixed-Grass Prairie (i.e., Texas), and showed a positive but insignificant response to CP33 both prior to and after incorporation of Wellendorf's adjustments (Figures 18 and 20). Covey densities in the Southeastern Coastal Plain and the Eastern Tallgrass Prairie were

Figure 18. BCR-level density estimates (# coveys/ha) of calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).

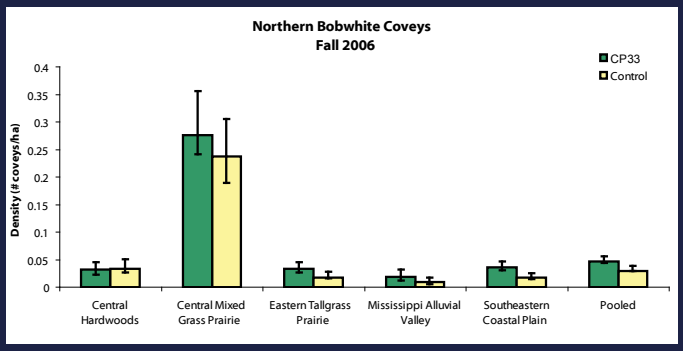
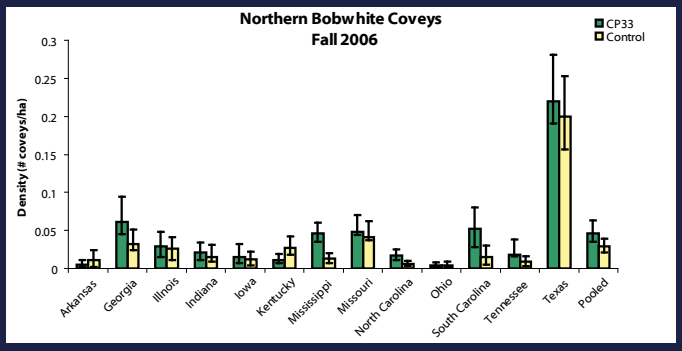


Figure 19. State-level density estimates (# coveys/ha) of calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 breeding season. Error bars represent 95% bootstrap confidence intervals (B=1000).



significantly greater in CP33 fields than in control fields both prior to and following Wellendorf's adjustments. The Central Hardwoods showed a slightly negative but insignificant response to CP33, whereas coveys in the Mississippi Alluvial Valley showed a slightly positive but insignificant response to CP33 (Figures 18 and 20). Mississippi had a very sharp increase in covey densities in response to CP33 prior to and after incorporation of Wellendorf's adjustments, whereas North Carolina and Tennessee also both showed a significant positive response (Figures 19 and 21). South Carolina showed a strong but insignificant positive response in covey density due to variability of the density estimate (Figures 19 and 21). Georgia, Illinois, Indiana, Iowa, Missouri and Texas all has positive but insignificant responses to CP33, whereas Ohio had virtually no response, and Arkansas and Kentucky showed negative response in covey density (Figures 19 and 21).

Figure 20. BCR-level density estimates (# coveys/ha) of calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 breeding season adjusted for number of adjacent calling coveys, % cloud cover, wind speed, and 6-hr change in barometric pressure (Wellendorf et al. 2004). Error bars represent 95% bootstrap confidence intervals (B=1000).

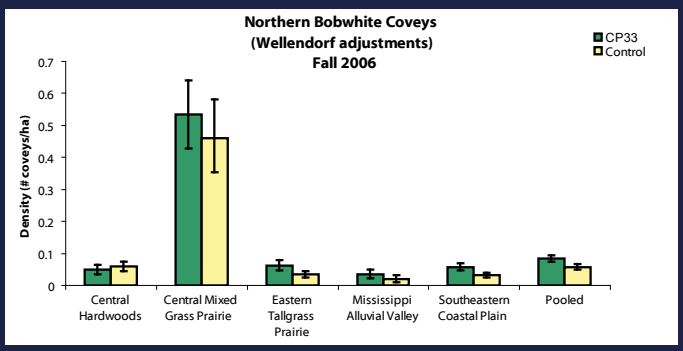
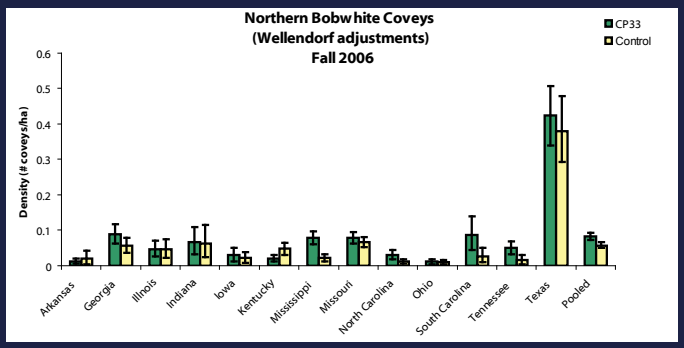


Figure 21. State-level density estimates (# coveys/ha) of calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 breeding season adjusted for number of adjacent calling coveys, % cloud cover, wind speed, and 6-hr change in barometric pressure (Wellendorf et al. 2004). Error bars represent 95% bootstrap confidence intervals (B=1000).



Interpretation

Upland habitat buffers are just one of many available USDA conservation practices; however, the CP33 practice is unique in that its central focus is increasing abundance and diversity of grassland avifauna in the agricultural landscape. Prior to implementation of the CP33 monitoring program, there had never been a large scale effort to measure response of priority bird species' to a USDA conservation practice. Though they provided important contributions to the understanding of population response to agricultural conservation practices, the majority of studies that examined the effects of conservation buffers on wildlife populations have been conducted at the farm or local landscape scale, and have limited inferential space (e.g., Marcus et al. 2000, Puckett et al. 2000, Smith 2004, Conover 2005, Smith et al. 2005a, 2005b). Johnson and Igl (2001) used a regional approach as they examined response of grassland birds to the Conservation Reserve program, but were still limited in that they only examined CRP fields in 9 counties in eastern Montana, North and South Dakota, and Western Minnesota. With the implementation of CP33 Habitat Buffers for Upland birds, and the CP33 monitoring program, we are now able to contribute a large-scale multi-state monitoring effort to the literature base.

We observed a positive overall response to establishment of CP33 habitat buffers on northern bobwhite populations, as well as populations of several priority songbird species. Population response varied, quite expectedly, by BCR and state. This variation in response is likely due to a multitude of factors, which include variation of the establishment and growth of the buffers in their first growing season due to weather conditions, lack of dispersal to and colonization of buffers by local avifauna, or differences in regional habitat preferences by the bird community. There have been several anecdotal accounts involving lack of cover establishment or growth of buffers in the 2006 breeding season, often due to drought conditions. Often the establishment of cover in the first year, and on occasion in the second year, was critically dependent on the amount of rainfall received in that region.

The greatest densities of male bobwhite and calling bobwhite coveys during 2006 on both CP33 and control sites occurred in the CMP (i.e., Texas). However, the greatest significant positive response to CP33 habitat buffers occurred in the SCP in the 2006 breeding season and in the SCP and ETP the following fall. It is important to note that there was virtually no effect on density of calling males in the ETP during the 2006 breeding season, but there was a significant positive effect on density of calling coveys during the following fall. Additionally, although the response in both

Northern Bobwhite

Dickcissel

Eastern Meadowlark

the breeding season and fall was variable, there was a shift in the CMP from greater densities in the control fields in the 2006 breeding season, to greater densities in the CP33 fields the following fall. This may support previous suggestions that fall populations of bobwhite are more responsive to field border practices than breeding populations (Puckett et al. 2000, Smith 2004, Palmer et al. 2005). If these differences in local abundance represent actual increases in recruitment/population levels attributable to CP33, instead of merely redistribution of extant populations, CP33 has achieved remarkable success in just its first 2 years of implementation. A population response of this magnitude is substantive, given that at the field and farm scale CP33 typically represents only a 2 – 10% change in land use.

Translating field-level effect sizes into programmatic contributions to national bobwhite populations is more problematic and requires some assumptions regarding factors as yet unknown. The following discussion is based on robust estimates of field-level densities, but speculative with regard to the total contribution of CP33 to national bobwhite populations. As such, it should be taken as an illustration of potential effect, not an estimate of actual effect. Our estimates of effect size (0.026 coveys/ha) reflect differences in bobwhite covey density at the spatial scale of the enrolled field. Assuming an effective survey radius of 500 m or 78.5 ha (194 ac) this 0.026 coveys/ha difference translates to an average 2.04 coveys more in the 194 ac region surveyed around CP33 enrolled fields. Given a mean October covey size of 12 birds, this would mean 24.48 more birds around CP33 fields than control fields. The FSA national database report that as of September 2007, 168,743 acres were enrolled in CP33. However, although the total number of contracts is known, the number of fields enrolled in CP33 and the average number of buffer acres/field is unknown. From our stratified sample of contracts we will be able to use a cluster sampling approach to estimate the total and mean number of fields/contract and the mean acreage/buffered field. We have not yet pursued that analysis. However, for illustrative purposes, a hypothetical 40 ac square field buffered with a 60' buffer would have 6.9 acres of buffer. The national enrollment of 168,743 acres could accommodate 24,456 such hypothetical 40 ac fields with 60' buffers. Assuming 24.48 additional birds in the fall population/CP33 field and no overlap of 194 ac regions around CP33 fields (unrealistic given aggregated distribution of CP33) this would translate to 598,671 additional birds, or 3.5 birds/ac CP33 enrolled.

It must be noted that ideally during the fall covey surveys, coveys would be located and number of individuals within each covey counted. However, this is a very difficult and labor intensive task, and also subjects the birds to unnecessary disturbance and stress. Although counting the number of calling coveys alone can provide useful estimates of covey abundance, without flushing coveys it is impossible to ascertain the number of individuals in a covey


Indigo Bunting


Field Sparrow


Eastern Kingbird


Grasshopper Sparrow

(e.g., is it two coveys with 3 birds each or one covey of 6 birds). This may limit our ability to extrapolate information relative to population size.

Although bobwhite populations are experiencing one of the most severe declines of all grassland bird species, in reality it is an entire suite of species that are dependent on grasslands or early successional habitat for all or part of their life cycle. Some early-successional species responded dramatically to CP33, whereas others showed virtually no or consistently negative response. Dickcissel, field sparrow, indigo bunting and painted bunting all showed positive response to CP33 with regional relative effect sizes reaching up to a 162% increase in density relative to control fields. Additionally, although the number of vesper sparrow detections was low across CP33 and control fields in their range, they showed a significant and very promising positive response to establishment of CP33 buffers. Relative effect size for vesper sparrow resulted in an average 51% increase in the number of males/ha on CP33 in 2006. These five species, which cover a range of habitat preferences from grassland obligate to grass-shrub species, all exhibit a distinct preference for crop fields bordered by CP33 compared to edge-to-edge cropping methods. This positive response may be the result of increased and variable nesting or foraging cover provided by, or the changing insect community or seed base associated with CP33 buffers.

Eastern meadowlark and grasshopper sparrow were the only two species of interest that consistently exhibited greater densities in control rather than CP33 sites. These results are discouraging in that both eastern meadowlark and grasshopper sparrow populations are experiencing sharp range-wide declines (3.1% and 3.4% annually respectively; Sauer et al. 2006). However, this result is not unexpected, because both species have a tendency to be area-sensitive (Herkert 1994, Vickery et al. 1994, Johnson and Igl 2001, Bakker et al. 2002), and thus show preferences for large tracts of continuous grassland. However, there have also been some instances where area sensitivity was not an issue for these species, and densities were either highly dependent on vegetation characteristics (grasshopper sparrow) or did not depend on either amount of area or vegetation characteristics (eastern meadowlark) (Winter and Faaborg 1999). Herkert (1994) estimated the area requirement for an

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

individual eastern meadowlark to be 5 ha and for an individual grasshopper sparrow to be 30 ha. Using Herkert's estimated area requirement, this means that eastern meadowlark and grasshopper sparrow would have a 50% probability of occurrence on grassland fragments of approximately 12 acres and 74 acre tracts of continuous grassland, respectively. Vickery et al. (1994) reported an estimated area requirement for grasshopper sparrows to be 100 ha (247 ac), and also found low incidence (<40%) of eastern meadowlark on sites <500 ha, both of which are much larger than Herkert's (1994) estimation. The majority of CP33 buffers do not provide the minimum area requirement to attract/support eastern meadowlark and grasshopper sparrow, unless the surrounding landscape matrix provides the additional grassland area required.

It is important to note that we believe that CP33 is not necessarily causing a reduction in eastern meadowlark and grasshopper sparrow populations, but instead these species are not showing a preference for this type of habitat. Also note that Henslow's sparrows were also a priority species of interest that did not have enough detections to conduct analysis, but they have been shown to be area sensitive as well, with an estimated area requirement of 55 ha (136 ac) (Herkert 1994; Winter and Faaborg 1999), and therefore would most likely demonstrate a similar response to CP33 as grasshopper sparrows. Vesper sparrow, another priority species, has also been shown to exhibit area sensitivity, with an estimated area requirement of 20 ha (50 ac) (Vickery et al. 1994), but, in contrast to grasshopper sparrow, displayed a positive response to CP33.

With the exception of eastern meadowlark and grasshopper sparrow, it appears that populations of northern bobwhite and other priority songbird species increase, to varying degrees, in response to the establishment of CP33 buffers. These results report only on the first year of the survey, where "ideal" cover conditions may have yet to be established on CP33 buffer sites. There are also a myriad of other factors affecting the success of the CP33 program as a means to increase wildlife populations. Weather conditions and proper mid-contract management practices over the 10-year duration of the CP33 contracts will affect the quantity and quality of cover established on CP33 buffers, thus affecting wildlife populations. Nevertheless, the positive results witnessed in the first year of this study suggest that further research is critical to understanding exactly what effects CP33 buffers will have on populations of bobwhite and other priority species.

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

Diverse mixture of native grasses and forbs in CP33 buffers provide nesting and brood rearing habitat for grassland birds.

Acknowledgements

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During winter, native grasses in CP33 buffers provide roosting, foraging, and escape habitat for grassland birds.

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

Bird Conservation Region	Species
19 - Central Mixed-grass Prairie	Bell's Vireo, Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Grasshopper Sparrow, Indigo Bunting, Northern Bobwhite, Painted Bunting, Scissor-tailed Flycatcher, Upland Sandpiper
21 - Oaks and Prairies	Bell's Vireo, Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Indigo Bunting, Northern Bobwhite, Painted Bunting, Scissor-tailed Flycatcher
22 - Eastern Tallgrass Prairie	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Grasshopper Sparrow, Indigo Bunting, Northern Bobwhite, Vesper Sparrow, Upland Sandpiper
23 - Prairie Hardwood Transition	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Indigo Bunting, Northern Bobwhite, Vesper Sparrow
24 - Central Hardwoods	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Indigo Bunting, Northern Bobwhite
25 - Western Gulf Coast Plain	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Indigo Bunting, Northern Bobwhite, Painted Bunting
26 - Mississippi Alluvial Valley	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Grasshopper Sparrow, Indigo Bunting, Northern Bobwhite, Painted Bunting
27 - Southeast Coastal Plain	Dickcissel, Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Grasshopper Sparrow, Indigo Bunting, Northern Bobwhite, Painted Bunting
29 - Piedmont	Eastern Kingbird, Eastern Meadowlark, Field Sparrow, Indigo Bunting, Northern Bobwhite

Table 2. Distribution of CP33 monitoring during 2006 and 2007 breeding season and fall covey counts.

Breeding Season and Fall Covey Counts	CP33 monitoring (SEQSG protocol)	CP33 monitoring (other protocol)	No CP33 monitoring
2006 Breeding Season	GA, IA, IL, IN, KY, MO, MS, OH, SC, TN, TX	--	AL, AR, FL, KS, LA, NC, NE, OK, VA
2006 Fall Covey Counts	AR, GA, IA, IL, IN, KY, MO, MS, NC, OH, SC, TN, TX	KS	AL, FL, LA, NE, OK, VA
2007 Breeding Season	AR, GA, IA, IL, IN, KY MO, MS, NC, OH, SC, TN, TX	--	AL, FL, LA, OK, VA
2007 Fall Covey Counts	AR, GA, IA, IL, IN, KY, MO, MS, NC, NE, OH, SC, TN, TX	KS	AL, FL, LA, OK, VA

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

	Density (# males/ha)								
Dickcissel	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	0.53924	0.148190	0.368 - 0.821	0.42094	0.095406	0.304 - 0.588	0.1183	-0.227 - 0.464	0.281037678
Eastern Tallgrass Prairie	0.68002	0.129890	0.585 - 0.845	0.33007	0.070134	0.274 - 0.430	0.34995	0.061 - 0.639	1.060229648
Central Hardwoods	0.31355	0.073891	0.193 - 0.465	0.21426	0.047797	0.162 - 0.361	0.09929	-0.073 - 0.272	0.463408942
Central Mixed Grass Prairie	0.65968	0.171840	0.565 - 0.825	0.70333	0.174390	0.647 - 0.803	-0.04365	-0.524 - 0.436	-0.062061906
Pooled	0.52933	0.059141	0.478 - 0.650	0.41355	0.043277	0.379 - 0.512	0.11578	-0.028 - 0.259	0.279966147
Illinois	0.33731	0.087074	0.200 - 0.486	0.052348	0.017834	0.026 - 0.085	0.284962	0.111 - 0.459	5.443608161
Indiana	0.26168	0.088247	0.120 - 0.447	0.044815	0.017109	0.017 - 0.081	0.216865	0.041 - 0.393	4.839116367
Iowa	0.25871	0.049491	0.176 - 0.345	0.16703	0.035110	0.113 - 0.217	0.09168	-0.027 - 0.211	0.548883434
Kentucky	0.18471	0.054898	0.091 - 0.287	0.12406	0.030602	0.072 - 0.180	0.06065	-0.063 - 0.184	0.48887635
Mississippi	0.36429	0.087136	0.217 - 0.546	0.31064	0.088675	0.165 - 0.471	0.05365	-0.190 - 0.297	0.172707958
Missouri	0.37325	0.060408	0.281 - 0.473	0.40931	0.070376	0.283 - 0.532	-0.03606	-0.218 - 0.146	-0.088099484
Tennessee	0.098774	0.016755	0.080 - 0.121	0.17822	0.036084	0.135 - 0.259	-0.079446	-0.157 - 0.001	-0.445774885
Texas	0.26242	0.045542	0.221 - 0.318	0.42176	0.070673	0.344 - 0.499	-0.15934	-0.324 - 0.005	-0.3777978
Pooled	0.2766582		0.231 - 0.323	0.2153145		0.182 - 0.249	0.0613438		0.284903246

Appendix 1. BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Northern Bobwhite	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	0.18513	0.032171	0.164 - 0.223	0.068158	0.016298	0.072 - 0.098	0.116972	0.046 - 0.188	1.716188855
Eastern Tallgrass Prairie	0.19611	0.061183	0.187 - 0.250	0.18782	0.058238	0.181 - 0.257	0.00829	-0.157 - 0.174	0.044138004
Central Hardwoods	0.18081	0.031311	0.156 - 0.238	0.1281	0.024291	0.110 - 0.186	0.05271	-0.025 - 0.130	0.41147541
Central Mixed Grass Prairie	0.69102	0.091853	0.640 - 0.903	0.87162	0.174450	0.763 - 1.156	-0.1806	-0.567 - 0.206	-0.207200385
Pooled	0.19998	0.019360	0.195 - 0.235	0.14622	0.017689	0.144 - 0.179	0.05376	0.002 - 0.105	0.367665162
Georgia	0.1086	0.020023	0.082 - 0.145	0.046133	0.009580	0.030 - 0.063	0.062467	0.019 - 0.106	1.354063252
Illinois	0.11182	0.022650	0.097 - 0.194	0.043913	0.010370	0.028 - 0.070	0.067907	0.019 - 0.117	1.546398561
Indiana	0.073853	0.014651	0.060 - 0.123	0.041987	0.008861	0.037- 0.088	0.031866	-0.002 - 0.065	0.758949199
Iowa	0.03084	0.008633	0.019 - 0.043	0.014571	0.005238	0.007 - 0.024	0.016269	-0.004 - 0.036	1.116532839
Kentucky	0.0893	0.011627	0.070 - 0.111	0.058492	0.008326	0.045 - 0.073	0.030808	0.003 - 0.059	0.526704507
Mississippi	0.085138	0.015163	0.066 - 0.126	0.027548	0.004106	0.025 - 0.040	0.05759	0.027 - 0.088	2.090532888
Missouri	0.11613	0.010782	0.101 - 0.136	0.069807	0.006382	0.061 - 0.081	0.046323	0.022 - 0.071	0.663586746
Ohio	0.046495	0.006858	0.042 - 0.064	0.0699	0.010617	0.057 - 0.096	-0.023405	-0.048 - 0.001	-0.334835479
South Carolina	0.1543	0.029218	0.108 - 0.211	0.11598	0.028557	0.092 - 0.181	0.03832	-0.042 - 0.118	0.330401793
Tennessee	0.072516	0.012314	0.064 - 0.117	0.051786	0.008792	0.043 - 0.076	0.02073	-0.009 - 0.050	0.40030124
Texas	0.3989	0.041371	0.332 - 0.468	0.53222	0.067814	0.428 - 0.648	-0.13332	-0.289 - 0.022	-0.250497914
Pooled	0.11708		0.106 - 0.128	0.097486		0.090 - 0.111	0.019594		0.200992963

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Eastern Meadowlark	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	0.069322	0.069322	0.053 - 0.143	0.096448	0.019960	0.075 - 0.152	-0.027126	-0.169 - 0.114	-0.28125
Eastern Tallgrass Prairie	0.061646	0.061646	0.052 - 0.086	0.16988	0.034266	0.152 - 0.229	-0.108234	-0.246 - 0.030	-0.63712032
Central Hardwoods	0.08852	0.025583	0.055 - 0.152	0.053334	0.015964	0.041 - 0.084	0.035186	-0.024 - 0.094	0.659729253
Central Mixed Grass Prairie	0.40643	0.071076	0.333 - 0.553	0.50736	0.092309	0.404 - 0.732	-0.10093	-0.330 - 0.127	-0.198931725
Pooled	0.11099	0.013440	0.108 - 0.150	0.13944	0.015723	0.135 - 0.184	-0.02845	-0.069 - 0.012	-0.204030407
Georgia	0.0053009	0.012103		0.047553	0.034393		-0.0422521	-0.114 - 0.029	-0.888526486
Illinois	0.16014	0.054457	0.077 -0.253	0.21805	0.070978	0.104 - 0.363	-0.05791	-0.233 - 0.117	-0.265581289
Indiana	0.10223	0.028040	0.058 - 0.181	0.054282	0.020208	0.026 - 0.098	0.047948	-0.020 - 0.116	0.883313069
Iowa	0.10242	0.037325	0.049 - 0.168	0.13783	0.035984	0.077 - 0.211	-0.03541	-0.137 - 0.066	-0.256910687
Kentucky	0.074838	0.023554	0.038 - 0.121	0.076816	0.018506	0.047 - 0.110	-0.001978	-0.061 - 0.057	-0.25749844
Mississippi	0.097902	0.032549	0.050 - 0.158	0.10232	0.024443	0.067 - 0.151	-0.004418	-0.084 - 0.075	-0.043178264
Missouri	0.085297	0.020948	0.051 - 0.120	0.12777	.023832	0.089 - 0.165	-0.042473	-0.105 - 0.020	-0.332417625
Ohio	0.046156	0.013165	0.025 - 0.068	0.10172	0.022025	0.067 - 0.144	-0.055564	-0.106 - -0.005	-0.546244593
South Carolina	0.026567	0.020555		0.015382	0.015025		0.011185	-0.039 - 0.061	0.727148615
Tennessee	0.072518	0.025519	0.035 - 0.130	0.069759	0.022003	0.040 - 0.112	0.002759	-0.063 - 0.069	0.039550452
Texas	0.23802	0.040288	0.184 - 0.306	0.31504	0.056940	0.227 - 0.412	-0.07702	-0.214 - 0.060	-0.244476892
Pooled	0.0909934		0.076 - 0.106	0.1123929		0.096 - 0.130	-0.213995		-0.190399038

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Indigo Bunting	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	2.1048	0.190730	1.916 - 2.549	1.6507	0.154820	1.549 - 2.126	0.4541	-0.027 - 0.936	0.275095414
Eastern Tallgrass Prairie	1.154	0.132990	1.045 - 1.351	0.44063	0.053839	0.380 - 0.534	0.71337	0.432 - 0.995	1.618977373
Central Hardwoods	2.4614	0.333780	2.179 - 2.881	2.0698	0.341980	1.907 - 2.465	0.3916	-0.545 - 1.328	0.189197024
Pooled	1.7336	0.120470	1.647 - 1.963	1.0308	0.083169	1.002 - 1.215	0.7028	0.416 - 0.990	0.681800543
Georgia	0.19005	0.035091	0.142 - 0.242	0.10605	0.025594	0.071 - 0.150	0.084	-0.001 - 0.169	0.792079208
Illinois	0.59406	0.101800	0.438 - 0.743	0.286	0.062391	0.198 - 0.385	0.30806	0.074 - 0.542	1.077132867
Indiana	0.56274	0.085809	0.404 - 0.721	.023734	0.044715	0.166 - 0.345	0.3254	0.136 - 0.515	1.371028904
Iowa	0.19022	0.054827	0.113 - 0.282	0.097408	0.039539	0.039 - 0.162	0.092812	-0.040 - 0.225	0.952817017
Kentucky	1.4056	0.127910	1.201 - 1.610	0.98035	0.086202	0.850 - 1.097	0.42525	0.123 - 0.728	0.433773652
Mississippi	0.89119	0.110430	0.714 - 0.115	0.38038	0.045950	0.316 - 0.465	0.50811	0.274 - 0.743	1.3268913
Missouri	0.39623	0.040362	0.345 - 0.450	0.58421	0.083741	0.449 - 0.727	-0.18798	-0.370 - -0.006	-0.321767857
Ohio	0.90744	0.096872	0.752 - 1.079	0.36791	0.049722	0.285 - 0.462	0.53953	0.326 - 0.753	1.466472779
South Carolina	0.4908	0.092121	0.370 - 0.662	0.49661	0.108170	0.358 - 0.670	-0.00581	-0.284 - 0.273	-0.011699321
Tennessee	1.2291	0.128180	1.038 - 1.435	0.73216	0.079833	0.601 - 0.856	0.49694	0.201 - 0.793	0.678731425
Pooled	0.719601		0.654 - 0.781	0.5816384		0.524 - 0.638	0.137963		0.2371972

Density (# males/ha)									
Painted Bunting	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Pooled	0.31996	0.096515	0.288 - 0.664	0.16493	0.055208	0.078 - 0.278	0.15503	-0.063 - 0.373	0.939975

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Field Sparrow	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	0.46154	0.080726	0.381 - 0.570	0.34351	0.146030	0.275 - 0.435	0.11803	-0.209 - 0.445	0.343599895
Eastern Tallgrass Prairie	0.47576	0.057275	0.435 - 0.587	0.27017	0.034397	0.196 - 0.287	0.20559	0.075 - 0.337	0.760965318
Central Hardwoods	0.48364	0.098229	0.436 - 0.640	0.23114	0.041034	0.222 - 0.353	0.2525	0.044 - 0.461	1.092411525
Pooled	0.44854	0.035339	0.402 - 0.499	0.21198	0.021391	0.188 - 0.242	0.23656	0.156 - 0.318	1.115954335
Relative Abundance (mean # males/point)									
Georgia	1.36121	0.218100	0.983 - 1.885	1.222311	0.204500	0.870 - 1.717	0.138899	-0.447 - 0.725	0.1136382
Illinois	1.195272	0.198600	0.854 - 1.674	0.5340577	0.124000	0.334 - 0.855	0.6612143	0.202 - 1.120	1.238095247
Indiana	1.0242981	0.240400	0.643 - 1.631	0.6683923	0.166700	0.408 - 1.096	0.3559057	-0.217 - 0.929	0.532480251
Iowa	0.7442467	0.145900	0.500 - 1.107	0.3656037	0.099960	0.210 - 0.636	0.378661	0.032 - 0.725	1.035714354
Kentucky	1.2947591	0.166100	1.005 - 1.667	0.8280304	0.131900	0.605 - 1.134	0.4667288	0.051 - 0.882	0.563661431
Mississippi	0.1435784	0.119700	0.028 - 0.749	0.1205777	0.101300	0.023 - 0.637	0.0230007	-0.284 - 0.330	0.190754178
Missouri	0.8280039	0.269900	0.435 - 1.575	0.4521398	0.155200	0.230 - 0.890	0.3758641	-0.234 - 0.986	0.831300629
Ohio	1.5347284	0.197300	1.186 - 1.986	1.1141975	0.162500	0.832 - 1.493	0.4205309	-0.080 - 0.922	0.377429405
South Carolina	0.2966639	0.096120	0.154 - 0.572	0.1076583	0.052020	0.040 - 0.287	0.1890056	-0.025 - 0.403	1.755606395
Tennessee	1.7178154	0.343500	1.156 - 2.553	1.1182041	0.264800	0.700 - 1.787	0.5996113	-0.250 - 1.450	0.536227063
Pooled	1.0257947	0.057820	0.918 - 1.146	0.6834729	0.044740	0.601 - 0.777	0.3423219	0.199 - 0.486	0.500856581

Density (# males/ha)									
Vesper Sparrow	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Pooled	0.06709	0.015221	0.044 - 0.095	0.042717	0.013128	0.028 - 0.074	0.024373	-0.015 - 0.064	0.570569

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Eastern Kingbird	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Pooled	0.097824	0.016409	0.085 - 0.142	0.10872	0.019095	0.253 - 0.425	-0.0109	-0.060 - 0.038	-0.10022
Relative Abundance (mean # males/point)									
Southeastern Coastal Plain	0.2389091	0.041970	0.169 - 0.338	0.2006611	0.037770	0.138 - 0.291	0.038248	-0.072 - 0.149	0.190609939
Eastern Tallgrass Prairie	0.13067	0.026930	0.087 - 0.196	0.0686153	0.068620	0.040 - 0.118	0.0620548	-0.082 - 0.207	0.904387214
Central Hardwoods	0.1480813	0.052980	0.072 - 0.303	0.0888488	0.040520	0.036 - 0.222	0.0592325	-0.071 - 0.190	0.666666291
Georgia	0.1777406	0.072550	0.078 - 0.404	0.4062624	0.119300	0.224 - 0.738	-0.2285236	-0.502 - 0.045	-0.562499969
Illinois	0.2870823	0.092960	0.149 - 0.553	0.1435412	0.062270	0.060 - 0.346	0.1435411	-0.076 - 0.363	0.999999303
Indiana	0.0887031	0.038810	0.037 - 0.211	0.1428158	0.055360	0.066 - 0.308	-0.0541126	-0.187 - 0.078	-0.378897853
Iowa	0.3067465	0.094100	0.165 - 0.571	0.0894677	0.048720	0.030 - 0.270	0.2172788	0.010 - 0.425	2.428572546
Kentucky	0.1255536	0.043140	0.064 - 0.247	0.0534303	0.025780	0.021 - 0.138	0.0721232	-0.026 - 0.171	1.349855793
South Carolina	0.5610347	0.142100	0.336 - 0.973	0.2071605	0.073810	0.101 - 0.426	0.358742	0.040 - 0.667	1.708212714
Tennessee	0.1394139	0.076800	0.047 - 0.415	0.0627135	0.043490	0.016 - 0.248	0.0767003	-0.096 - 0.250	1.22302694
Pooled	0.1524523	0.019140	0.119 - 0.195	0.1065891	0.015570	0.080 - 0.142	0.0458632	-0.003 - 0.094	0.430280395

Appendix 1. (continued) BCR and state-level density (# males/ha) or relative abundance (mean # males/point) estimates, standard error, raw effect size, 95% confidence intervals for effect size, and relative effect size for species of interest within monitored CP33 fields and control fields during the 2006 breeding season.

Density (# males/ha)									
Grasshopper Sparrow	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Pooled	0.14142	0.026382	0.112 - 0.186	0.19654	0.050089	0.148 - 0.256	-0.05512	-0.166 - 0.056	-0.28045
Relative Abundance (mean # males/point)									
Southeastern Coastal Plain	0.046875	0.027060	0.015 - 0.149	0.046875	0.027060	0.015 - 0.149	0	-0.075 - 0.075	0
Eastern Tallgrass Prairie	0.147426	0.028330	0.101 - 0.215	0.1602218	0.029660	0.111 - 0.231	-0.0127957	-0.093 - 0.068	-0.079862416
Central Hardwoods	0.1075446	0.043920	0.047 - 0.244	0.1116029	0.045010	0.050 - 0.251	-0.0040583	-0.127 - 0.119	-0.03636375
Central Mixed Grass Prairie	0.1935484	0.079020	0.084 - 0.446	0.2096774	0.082240	0.094 - 0.467	-0.016129	-0.240 - 0.207	-0.07692293
Illinois	0.1508207	0.064040	0.064 - 0.357	0.2765046	0.089400	0.144 - 0.532	-0.1256839	-0.341 - 0.090	-0.454545422
Indiana	0.1957228	0.091130	0.078 - 0.493	0.2805623	0.113900	0.125 - 0.628	-0.0848395	-0.371 - 0.201	-0.302390948
Iowa	0.2343774	0.082400	0.115 - 0.478	0.0986852	0.051120	0.035 - 0.282	0.1356922	-0.054 - 0.326	1.375000507
Ohio	0.1242424	0.047530	0.058 - 0.268	0.1944444	0.060010	0.105 - 0.361	-0.070202	-0.220 - 0.080	-0.36103894
Texas	0.1935484	0.079020	0.084 - 0.446	0.2096774	0.82240	0.094 - 0.467	-0.016129	-0.240 - 0.207	-0.07692293
Pooled	0.1176597	0.018160	0.087 - 0.159	0.1259627	0.018870	0.094 - 0.169	-0.008303	-0.060 - 0.043	-0.065916339

Appendix 2. BCR and state-level density estimates (# coveys/ha), 95% bootstrap confidence intervals (B=1000), and raw and relative effect sizes for calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 fall of 2006 and BCR and state-level density estimates adjusted for number of adjacent calling coveys, % cloud cover, wind speed, and 6-hr change in barometric pressure (Wellendorf et al. 2004). 95% confidence intervals on effect size were included for unadjusted density estimates.

Density (# coveys/ha)									
	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
Southeastern Coastal Plain	0.035373	0.005210	0.031 - 0.047	0.016761	0.003210	0.014 - 0.025	0.018512	0.007 - 0.031	1.110434938
Eastern Tallgrass Prairie	0.033586	0.004710	0.027 - 0.045	0.017934	0.003538	0.015 - 0.028	0.015652	0.004 - 0.027	0.87275566
Central Hardwoods	0.031371	0.006551	0.023 - 0.046	0.033511	0.006627	0.027 - 0.051	-0.00214	-0.020 - 0.016	-0.063859628
Mississippi Alluvial Valley	0.018307	0.005777	0.012 - 0.032	0.0094458	0.004735	0.005 - 0.017	0.0088612	-0.006 - 0.024	0.938110059
Central Mixed Grass Prairie	0.27575	0.047957	0.241 - 0.355	0.23698	0.045317	0.190 - 0.306	0.03877	-0.091 - 0.1680	0.163600304
Pooled	0.046998	0.003395	0.044 - 0.056	0.029511	0.002673	0.029 - 0.039	0.017487	0.009 - 0.026	0.592558707
Arkansas	0.0053835	0.002220	0.002 - 0.011	0.011166	0.007928	0.002 - 0.024	-0.0057825	-0.022 - 0.010	-0.517866738
Georgia	0.061364	0.013337	0.045 - 0.094	0.032155	0.008116	0.024 - 0.052	0.029209	-0.001 - 0.060	0.908381278
Illinois	0.028855	0.009311	0.015 - 0.048	0.026286	0.010383	0.011 - 0.041	0.002569	-0.025 - 0.030	0.097732633
Indiana	0.020612	0.006475	0.011 - 0.034	0.015354	0.006100	0.009 - 0.031	0.005258	-0.012 - 0.023	0.342451478
Iowa	0.014826	0.006482	0.007 - 0.032	0.012114	0.005405	0.004 - 0.022	0.002712	-0.014 - 0.019	0.223873205
Kentucky	0.011461	0.002907	0.007 - 0.020	0.026928	0.006686	0.018 - 0.042	-0.015467	-0.030 - -0.001	-0.574383541
Mississippi	0.046299	0.008192	0.036 - 0.061	0.013241	0.003684	0.007 - 0.020	0.033058	0.015 - 0.051	2.496639227
Missouri	0.048303	0.006104	0.044 - 0.070	0.041281	0.005799	0.037 - 0.062	0.007022	-0.009 - 0.024	0.170102468

Appendix 2 (continued). BCR and state-level density estimates (# coveys/ha), 95% bootstrap confidence intervals (B=1000), and raw and relative effect sizes for calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 fall of 2006 and BCR and state-level density estimates adjusted for number of adjacent calling coveys, % cloud cover, wind speed, and 6-hr change in barometric pressure (Wellendorf et al. 2004). 95% confidence intervals on effect size were included for unadjusted density estimates.

Density (# coveys/ha)									
	CP33	SE	95% CI	Control	SE	95% CI	Effect Size	95% CI (ES)	Relative ES
North Carolina	0.0171	0.004614	0.011 - 0.025	0.0059257	0.001946	0.003 - 0.010	0.0111743	0.001 - 0.021	1.885735019
Ohio	0.0037073	0.001543	0.002 - 0.008	0.0037913	0.001551	0.002 - 0.009	-8.40E-05	-0.004 - 0.004	-0.022155989
South Carolina	0.052367	0.015179	0.028 - 0.080	0.014594	0.007265	0.005 - 0.030	0.037773	0.005 - 0.071	2.588255447
Tennessee	0.018136	0.005539	0.016 - 0.038	0.0086315	0.004018	0.003 - 0.016	0.0095045	-0.004 - 0.023	1.101141169
Texas	0.21993	0.028016	0.191 - 0.281	0.19925	0.030597	0.157 - 0.253	0.02068	-0.061 - 0.102	0.10378921
Pooled	0.046547		0.035 - 0.063	0.029228		0.021 - 0.039	0.017319		0.592548241

Appendix 2. (continued) BCR and state-level density estimates (# coveys/ha), 95% bootstrap confidence intervals (B=1000), and raw and relative effect sizes for calling bobwhite coveys within monitored CP33 fields and control fields during the 2006 fall of 2006 and BCR and state-level density estimates adjusted for number of adjacent calling coveys, % cloud cover, wind speed, and 6-hr change in barometric pressure (Wellendorf et al. 2004). 95% confidence intervals on effect size were included for unadjusted density estimates.

Wellendorf Adjusted Density (# coveys/ha)						
	CP33	95% CI	Control	95% CI	Effect Size	Relative ES
Southeastern Coastal Plain	0.0581011	0.048 - 0.069	0.0316484	0.024 - 0.040	0.0264527	0.835830563
Eastern Tallgrass Prairie	0.0622711	0.047 - 0.079	0.0339953	0.025 - 0.044	0.0282758	0.831756155
Central Hardwoods	0.0505744	0.036 - 0.065	0.0590077	0.044 - 0.074	-0.0084332	-0.142916941
Mississippi Alluvial Valley	0.0351431	0.022 - 0.050	0.0197091	0.009 - 0.032	0.0154341	0.783095118
Central Mixed Grass Prairie	0.5349347	0.428 - 0.641	0.4604973	0.355 - 0.581	0.0744374	0.161645682
Pooled	0.0832295	0.073 - 0.093	0.0574417	0.049 - 0.066	0.0257878	0.448938663
Arkansas	0.0124013	0.005 - 0.021	0.0208256	0.004 - 0.043	-0.0084242	-0.404511755
Georgia	0.0896804	0.062 - 0.117	0.0567014	0.037 - 0.078	0.032979	0.581625851
Illinois	0.0473364	0.027 - 0.070	0.0470681	0.022 - 0.075	0.0002683	0.005700251
Indiana	0.0662972	0.032 - 0.110	0.063309	0.024 - 0.114	0.0029882	0.04720024
Iowa	0.029644	0.012 - 0.051	0.021619	.008 - 0.038	0.008025	0.371201258
Kentucky	0.0201186	0.012 - 0.029	0.0476885	0.030 - 0.066	-0.0275699	-0.578124705
Mississippi	0.0777828	0.060 - 0.096	0.0222938	0.013 - 0.033	0.055489	2.48898797
Missouri	0.0785282	0.063 - 0.095	0.0665985	0.052 - 0.081	0.0119296	0.179127158
North Carolina	0.0306529	0.019 - 0.044	0.0113568	0.006 - 0.018	0.0192962	1.699087771
Ohio	0.0111293	0.005 - 0.018	0.0096691	0.004 - 0.016	0.0014603	0.1510275
South Carolina	0.0876843	0.044 - 0.140	0.0272137	0.009 - 0.050	0.0604706	2.222064622
Tennessee	0.0498978	0.032 - 0.069	0.0155757	0.005 - 0.030	0.0343221	2.203567095
Texas	0.4233418	0.339 - 0.507	0.3802692	0.293 - 0.480	0.0430726	0.113268705
Pooled	0.0832587	0.073 - 0.093	0.057521	0.050 - 0.066	0.0257377	0.447448758