Effects of the Conservation Reserve Program on Priority Mixed-grass Prairie Birds

A Conservation Effects Assessment Project

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INTRODUCTION

In 2003, a multi-agency effort initiated the Conservation Effects Assessment Project (CEAP) to quantify environmental benefits of U.S. Department of Agriculture (USDA) conservation programs such as the Conservation Reserve Program (CRP), Wetland Reserve Program (WRP), and Environmental Quality Improvement Program (EQIP). This project is part of the Wildlife Component of CEAP which was created to quantify effects of conservation programs on wildlife in agricultural landscapes. The Playa Lakes Joint Venture (PLJV), Natural Resources Conservation Service (NRCS), and Farm Service Agency (FSA) designed this CEAP project to evaluate the effects of the CRP on priority birds in the mixed-grass prairie Bird Conservation Region (BCR 19).

Background

The PLJV is a non-profit partnership of federal and state wildlife agencies, conservation groups, private industry, and landowners dedicated to conserving bird habitat in the Southern Great Plains. We provide science-based guidance and decision-support tools for all-bird conservation throughout the region, as well as outreach, coordination and financial support to our partners and local groups to conduct on-the-ground habitat work. The PLJV works in the Southern Great Plains which includes eastern Colorado and New Mexico, western Nebraska, Kansas, and Oklahoma, and the Texas Panhandle (Figure 1). The region largely encompasses the shortgrass and mixed-grass Bird Conservation Regions (BCR18 and 19, respectively; Figure 1). The PLJV also works cooperatively with Rainwater Basin Joint Venture (RWBJV) which spans the northern portion the BCR19.

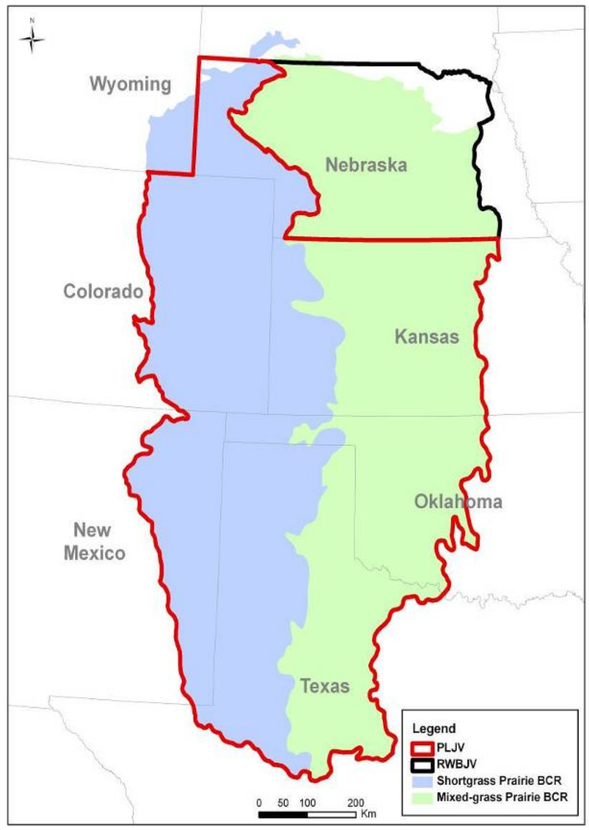


Figure 1. The shortgrass prairie and mixed-grass prairie Bird Conservation Regions (BCRs 18 and 19) and the boundaries of the Playa Lakes Joint Venture (PLJV) and Rainwater Basin Joint Venture (RWBJV).

The PLJV is uniquely qualified and equipped to conduct regional bird analyses such as evaluating the effects of habitat change or conversion on bird population goals, developing spatially explicit models that locate suitable/critical bird habitat, and spatially targeting on-the-ground conservation efforts to maximize benefits to birds. The PLJV has compiled resources, developed tools, and established working partnerships that serve to further all-bird conservation in and around the JV. Chief examples are:

- <u>Species for Management Action (SMA) database</u> – This tool compiles and stores conservation status information from multiple sources (including federal, regional, and state-based sources such as U.S. Fish and Wildlife Service (USFWS) and Partners in Flight (PIF)) for all species breeding, wintering, or migrating in BCRs 18 and 19. This tool allows user to identify/classify species according to conservation information.

- *A Review of Distribution, Habitat Use, and Population Density Data for the Hierarchical All Bird System (HABS) Database* (Dobbs 2007) – This document is an exhaustive literature review (updated frequently) that serves as a one-stop resource guide for demographic and ecological information on bird species occurring in BCRs18 and 19. This document provides data for the Hierarchical All Bird System (HABS) database, including bird density and use-day data specific to geographic location, season of the year, habitat, and its condition.
- Hierarchical All Bird System (HABS) database – HABS is a tool developed to calculate a landscape's capacity to achieve population objectives for priority species, both currently (i.e., based on current habitat availability), and in the future (i.e., based on alternative scenarios of future habitat availability based on conservation and management work). HABS allows its user to determine how much conservation work needs to be done for individual species as well as predict the potential impacts of habitat change or conversion on bird population goals.
- Great Plains GIS Partnership (G^2P^2) - The PLJV is part of the Great Plains GIS Partnership (G^2P^2). G^2P^2 is a collaborative group of GIS professionals from the U.S. Fish and Wildlife Service (USFWS), Rainwater Basin Joint Venture (RWBJV), PLJV, Nebraska Game and Parks Commission (NGPC), and Central Platte Natural Resources District (CPNRD). The Partnership is dedicated to the development, evaluation, and integration of GIS data into biological and landscape level planning models for the Central Great Plains region.

Justification

The CRP is a USDA program, established in 1985, under which private landowners voluntarily remove highly erodible and other environmentally sensitive land from crop production and establish vegetative cover on it. Landowners are paid for enrolling their land through an annual, per-acre rental rate and enrollment contracts span 10 to 15 years. The main goals of the CRP are to reduce soil erosion, improve water and air quality, and provide wildlife habitat. Over 35 million acres of marginal cropland are currently enrolled in CRP nation-wide. Of those, more than 25 million acres are planted to vegetation dominated by grasses (U.S. Department of Agriculture 2004), including nearly 3.4 million acres in the mixed-grass prairie BCR (BCR19; Figure 1).

Considering its programmatic size and geographic extent, the CRP has great potential to affect prairie wildlife, including grassland birds. Grassland birds are declining faster than any other guild of North American birds (Samson and Knopf 1994) as a cumulative effect of habitat loss, fragmentation, and degradation of remnant grasslands (World Wildlife Fund Canada 1998, Brennan and Kuvlesky 2005). More than 80% of native grasslands in North America have been lost since the mid-1800's (Samson and Knopf 1994).

Consequently, grassland wildlife habitat has become a priority conservation concern. Some even predict the decline of grassland species "to become a prominent wildlife conservation crisis of the 21st century (Brennan and Kuvlesky 2005)." These predictions seem even more plausible with increasing demand being put on grasslands from biofuels, wind-based, and petroleum-based energy needs.

Some consider the CRP a vehicle for reversing declining population trends of grassland birds (Johnson and Igl 1995). Many studies have investigated the effects of CRP on grassland birds, typically by comparing abundance measures, diversity indices, or nest success on CRP fields with other habitat types. The magnitude and direction (i.e., positive or negative) of effect varies by species, ecological region, characteristics of CRP land and the landscape in question. In Nebraska, King and Savidge (1995) found bird abundance was 4 times greater in CRP fields than crop fields (1995). In Kansas, avian abundance was lower in CRP than pasture (Klute and Robel 1997). In six mid-western states, Best et al. found that CRP supported 13.5 times as many nests as rowcrop fields (1997). In the Prairie Pothole Region, Reynolds et al. found that nest success of five duck species was higher in CRP than any other habitat used by ducks (2001). In Kansas, Ring-necked Pheasants used wheat stubble more than CRP fields (Rodgers 1999).

Yet no studies, to our knowledge, have quantified the effects of CRP on regional bird populations, explicitly asking the question 'How many birds does CRP support?' PLJV, NRCS, and FSA developed this CEAP project to address that question. For 12 priority species we estimate: 1) how many birds CRP currently supports, 2) how many birds would be supported if CRP acres were replaced with cropland, and 3) how do those numbers compare to the regional population goals.

Acronyms
This report uses acronyms listed and defined in the following table.

Table 1. List of acronyms used in this report and their definitions.

Acronym	**Definition**
ABC	American Bird Conservancy
BBS	Breeding Bird Survey
BCR	Bird Conservation Region
BCR18	Shortgrass Prairie Bird Conservation Region
BCR19	Mixed-grass Prairie Bird Conservation Region
FSA	Farm Service Agency
NRCS	Nature Resources Conservation Service
PIF	Partners in Flight
PLJV	Playa Lakes Joint Venture
RWBJV	Rainwater Basin Joint Venture
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service

METHODS

Project Area: Mixed-grass Prairie Bird Conservation Region (BCR19)

BCR19 is located in the central Great Plains of North America, encompassing portions of four states including Kansas, Nebraska, Oklahoma, and Texas (Figure 1). BCR19 spans over 97 million acres of gently sloping terrain comprised of a variety of habitats, both naturally occurring (e.g., prairie, wetlands, streams) and man-made (e.g., cropland, urban areas, reservoirs). Mixed-grass prairie vegetation is of an integration of the shortgrass species to the west (e.g., blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*)) and the tallgrass species to the east (e.g., little bluestem (*Schizachyrium scoparium,* Indian grass (*Sorghastrum nutans*)). Common shrub species occurring in BRC19 are sand sagebrush (*Artemisia filifolia*) and sand shinnery oak (*quercus havardii rydb.*) Woodland habitat ranges from scattered cottonwood trees (*Populus* spp.), to small clustered plantings of Siberian elm (*Ulmus pumila*), Russian olive (*Elaeagnus angustifolia*), and eastern red-cedar (*Juniperus virginiana*), to large expanses of honey mesquite (*Prosopis glandulosa)*, juniper (*Juniperus* spp.), and eastern red-cedar. Historically dominated by mixed-grass prairie, BCR19 is now dominated by cropland (comprising about 48% of its total landcover). Major crops are corn (primarily in the north), soybeans, wheat, sorghum, sunflowers, and alfalfa. Nearly 3.4 million acres of the cropland in BCR19 (about 7%) is currently enrolled in CRP.

Priority Species

Priority bird species included in this analysis are those which use CRP and/or cropland habitat within BCR19 during the breeding season (Table 2) and for which adequate density data are available. The PLJV Landbird Team identified priority species in BCR19 by consolidating several regional and continental lists of species of concern including: 1) the Partners in Flight (PIF) North American Landbird Conservation Plan (Rich et al. 2004), 2) high priority birds from the U.S. Shorebird Conservation Plan (Brown et al. 2001) and Waterbird Conservation for the Americas plan (Kushlan et al. 2002), 3) species from the U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (BCC) lists, and 4) species for which habitat work is targeted within BCR19 (e.g. upland game birds such as Ring-necked Pheasants). They also classified a species as a priority when 10% of its population occurs in BCR18 and BCR19 combined and it has a declining population trend, according to the U.S. Geological Service (USGS) Breeding Bird Survey (BBS; Sauer et al. 2006). The Landbird Team identified a total of 31 priority species for BCR19 of which 19 occur in CRP and/or cropland habitat (Appendix A). Density data were available for 12 of the 19 species so this analysis includes a total of 12 priority bird species (Table 2). These 12 species include 6 landbirds, 4 game-birds, 1 raptor, and 1 shorebird (Table 2). See Appendix A for a comprehensive list of all birds breeding in BCR19, its priority species, and for further explanation on why particular species were or were not included in this analysis.

Table 2. List of priority bird species analyzed in this project including common name, scientific name, and description.

Common Name	Scientific Name	Description
Cassin's Sparrow	*Aimophila cassinii*	migratory landbird
Dickcissel	*Spiza americana*	migratory landbird
Eastern Meadowlark	*Sturnella magna*	resident landbird
Grasshopper Sparrow	*Ammodramus savannarum*	migratory landbird
Greater Prairie-Chicken	*Tympanuchus cupido*	resident upland game-bird
Lark Bunting	*Calamospiza melanocorys*	migratory landbird
Lesser Prairie-Chicken	*Tympanuchus pallidicinctus*	resident upland game-bird
Northern Bobwhite	*Colinus virginianus*	resident upland game-bird
Ring-necked Pheasant	*Phasianus colchicus*	resident upland game-bird
Swainson's Hawk	*Buteo swainsoni*	migratory raptor
Upland Sandpiper	*Bartramia longicauda*	migratory shorebird
Western Kingbird	*Tyrannus verticalis*	migratory landbird

Data Analysis

To quantify the effects of the CRP on priority birds in the mixed-grass prairie, we calculated and compared the carrying capacities of two landcover scenarios for the mixed-grass prairie BCR for individual species. One landcover scenario depicts current CRP fields (in context of other landcover types) and the other scenario depicts those same CRP fields as cropland. The amount of each crop type apportioned to these cropland acres was based on 2004 National Agricultural Statistics Service county-level data. The underlying assumption of this method is that all CRP fields were once cropland.

To create and compare the scenarios we used four integrated components: (1) a seamless spatial landcover layer, (2) bird densities, (3) bird population goals, and (4) the Hierarchical All Bird System (HABS). These components are analogous to the four steps of our analysis: (1) calculate the number of acres of each habitat within each state of BCR19 and the availability and suitability of each habitat to each bird species, (2) link bird species to those habitats via bird densities, (3) step-down the national population goals of each species to each state of the BCR, and (4) determine how much of the population goal is being lost/gained by comparing the carrying capacities of the two landscape scenarios. We analyzed each state within the BCR separately because bird population goals and bird-to-habitat links (i.e., densities) are most appropriately related at this spatial scale. Each of the four steps is described below in detail.

<u>Step 1: Calculate Habitat Acres</u>

The first step to quantifying the effects of CRP on priority bird species was to determine how many acres of each habitat, including CRP, occurred in each state of the BCR. Using a Geographic Information System (GIS), PLJV developed a seamless landcover layer for the entire mixed-grass prairie BCR (Figure 2). The seamless landcover is classified into a system of habitat Associations and Conditions that are used to determine the amount and types of habitat available to birds. Associations are landcover classes generally considered to be mappable at the landscape scale (e.g., mixed-grass prairie). Conditions are recognized as having distinctive characteristics important to birds but are not necessarily mappable with current GIS data (e.g., few shrubs/high grass).

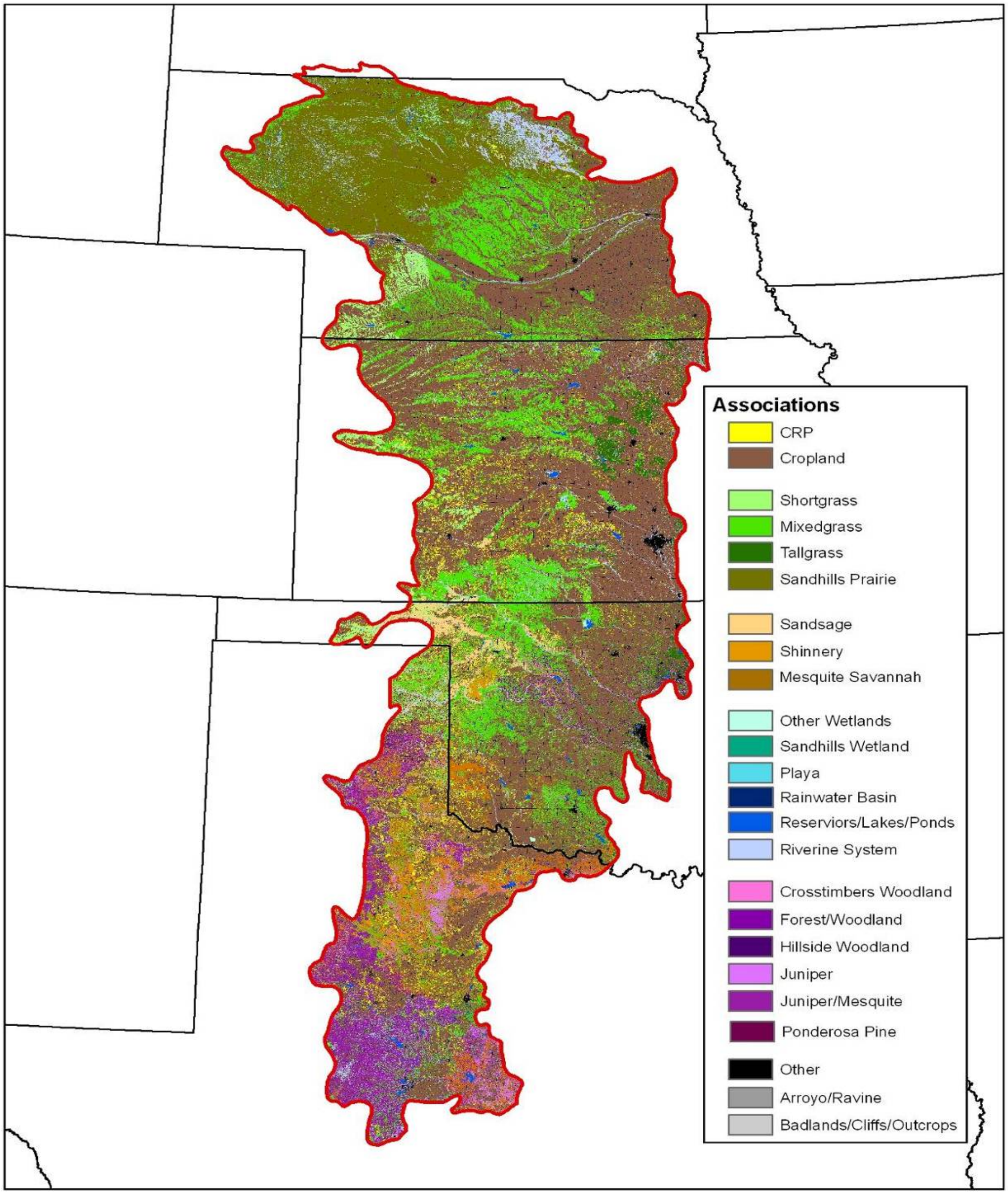


Figure 2. Seamless landcover of the mixed-grass prairie Bird Conservation Region (BCR19).

Previous to this CEAP project, spatial CRP data were unavailable so we updated the landcover layer with the CRP field polygons, taken from the Common Land Unit Layer (CLU) provided by FSA. We partitioned the CRP Association into six Conditions according to Conservation Practice (CP): grass, trees in upland, trees in riparian, wetland, playas/non-floodplain wetland, and other CRP practice. Although there are CPs distinguishing between native grass plantings (CP2) and a CP designating non-native grass plantings (CP1), these were not used in the Condition classes because there is uncertainty regarding the definition of a native planting. Through interviewing CRP professionals and researchers, we determined that native plantings (CP2) did not necessarily indicate species native to the area but rather to North America. For example, mixed-grass or tallgrass species planted in the shortgrass prairie may be considered a CP2 but they are not truly native to the area. In addition, there is also a practice designating existing/established grass (CP10) which does not indicate native or non-native planting, creating more uncertainty. So we applied assumed proportions of native to non-native plantings specific to each state in BCR19 based on opinions of CRP professionals and researchers. In Kansas, we assumed all CRP grass plantings were native. In Nebraska, Oklahoma, and Texas we assumed 10% were native and 90% non-native. We also updated the landcover layer with the crop field boundaries delineated in the CLU layer as it was the most current data available. Detailed information on the landcover layer including its development and list of Associations and Conditions are documented in "Habitat Assessment Procedures Technical Companion Document to the PLJV Implementation Planning Guide" (Playa Lakes Joint Venture 2007).

Once the landcover was updated with the CLU data, we calculated the total number of acres of each Association and Condition within each state area. These acres were then used in HABS to determine carrying capacities (discussed in *Step 4*) for the priority bird species. However, for some species, habitat acres were further refined using a *Range*, *Suitability*, and/or *Large Block Factor*. We applied *Factors* when the overall BCR habitat acreage did not adequately reflect the amount of habitat actually available and/or suitable to the species because of its restricted range (i.e., the species/habitat occurs within a limited portion of the BCR) or because of special habitat requirements (i.e., the species may require large blocks). Refer to *Step 4*, Table 4 for an example of each *Factor*.

Determining a *Large Block Factor* requires developing and running a spatial model, specific to the species' habitat needs, on the landcover. We determined *Large Block Factors* for two species, Greater and Lesser Prairie-Chicken, and because of their limited range in BCR19, we also applied a *Range Factor*. For example, the range of the Lesser Prairie-Chicken extends only into a limited portion of BCR19 (Figure 3) so we determine a *Range Factor* by calculating the number of habitat acres with a 10-mile buffer of the known range and compared it to the overall acres. For instance, if there were 500,000 acres of suitable habitat for Lesser Prairie-Chickens in BCR19 but only 20,000 acres were within its range, then we would apply a *Range Factor* of 0.04 when estimating carrying capacity in HABS. This species also requires large, unfragmented blocks of habitat, so including acres of small, fragmented parcels of habitat in the acres calculations would over-inflate the carrying capacity for this species. So we developed a spatial model within a GIS to identify large blocks of habitat within its known range (Figure 3). Then we compared the number of large block acres to the overall habitat acres within its range to determine a *Large Block Factor*. For instance, if there were 20,000 acres of habitat within the Lesser Prairie-Chicken range but only 5,000 acres were in large block configuration, we applied a *Large Block Factor* of 0.25 when estimating carrying capacity in HABS. Altogether, carrying capacity for Lesser Prairie-Chicken would be calculated as follows: carrying capacity = 500,000ac * 0.04 * 0.25 *density. We ran this model on both landscape scenarios (with and without CRP) because the number of large block acres, and thus the *Large Block Factor*, would be different (Figure 4).

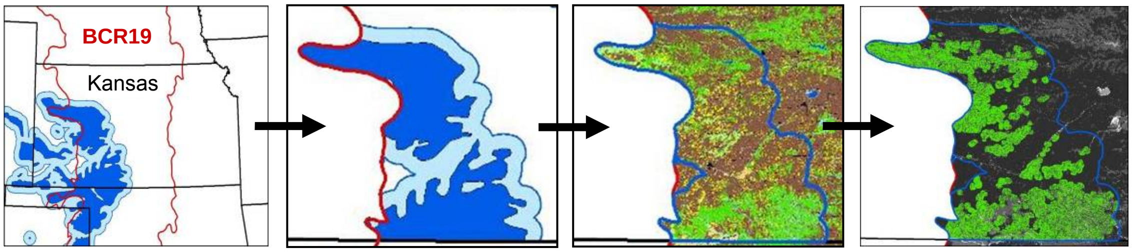


Figure 3. Illustration of the process used to identify large-blocks of suitable Lesser Prairie-Chicken habitat, BCR19 portion of Kansas: a) Lesser Prairie-Chicken range (dark blue) and 10-mile buffer (light blue) and BCR19 boundary (red), b) buffered range within BCR19 portion of Kansas only, c) landcover layer with 10-mile buffer on which large-block model is applied, and d) large-block acres as identified by model.

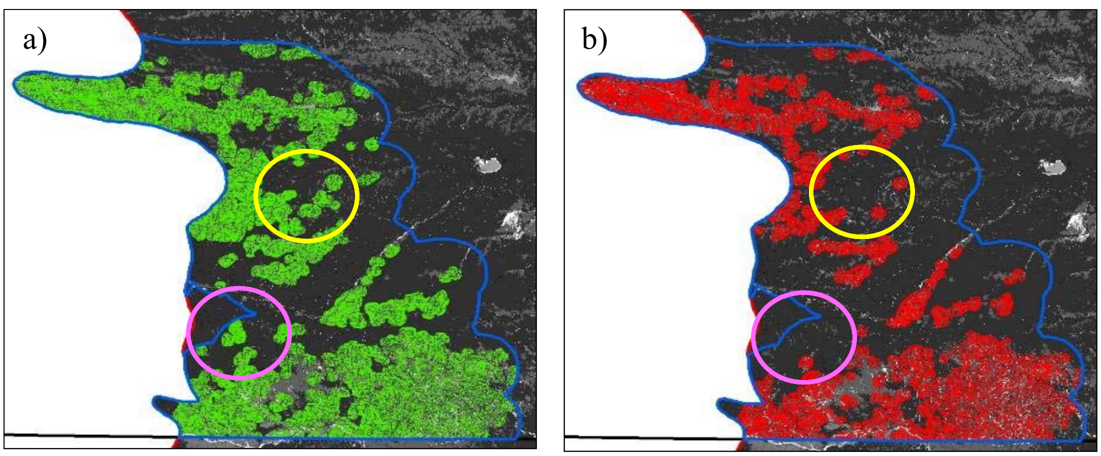


Figure 4. An example of the amount of large blocks of suitable Lesser Prairie-Chicken habitat (within its range in BCR19-KS) when: a) CRP is included in the landcover (large block acres are green), and (b) CRP is reclassified to cropland (large block acres are red). Notice the change in large block acres inside the yellow and pink circles.

Step 2: Link Birds to Habitats with Densities

To calculate the carrying capacities of the two landscape scenarios, we needed to link bird species to habitat acres with species densities. The PLJV Landbird Team and Waterbird Team assigned priority species to habitats Associations and Conditions. Then we conducted an exhaustive literature review to determine at which densities species occurred in their assigned habitat Associations and Conditions (Dobbs 2007). Data sources included peer-reviewed journals, theses and dissertations, government publications, unpublished reports, species accounts in the Birds of North America (BNA) series, state bird books and breeding bird atlases, published and unpublished (courtesy of Cornell Lab of Ornithology) Breeding Bird Census (BBC) data (1982-1996), and world wide web-publications. Where density data were not available for a species, those densities that were most similar in location and habitat Condition were assigned and adjusted using Breeding Bird Survey (BBS) relative abundance maps when necessary (BBS is a U.S. Geological Survey (USGS) long-term (>30 years) monitoring program under which volunteers conducts annual, fixed, road-based point count surveys nation-wide). Densities are stored in HABS and related to the habitat acres to calculate carry capacities (discussed further in *Step 3*). All densities used in this project are documented in "A Review of Distribution, Habitat Use, and Population Density Data in the Hierarchical All Bird System (HABS) Database" (Dobbs 2007).

Step 3: Bird Population Goals

The PLJV Landbird Team developed population goals for all priority species in BCR19. They followed the recommendation of Partners in Flight (PIF) which aims to return bird population numbers back to the same levels as 30 years ago. They determined population goals using two factors, estimated current carrying capacity and BBS population trend (specific to each BCR). The current carrying capacity of each species was determined by multiplying their habitat-specific densities (Step 2) by the number of acres of habitat in the landcover (Step 1). We calculated population goals as follows. If the species' population trend is > 0 (a growing population), the population goal equaled the estimated current carrying capacity (a goal of maintaining the population). If the species' trend is < 0 (a declining population), we applied the following formula to determine a population goal:

$$\frac{\textit{Current Estimated Carrying Capacity}}{(\textit{1-Absolute Value [Trend]})^{29}}.$$

To ensure robust data were used, BBS trend data were limited to those trends where the P-value was < 0.1 and the number of routes within the BCR on which the bird was detected was ≥ 14. If these criteria were not met, then a survey-wide (national) trend was used instead of the BCR-based trend. For some species, there were no appropriate trend, in which case population goals were developed through expert opinion. For example, Lesser Prairie-Chicken population goals were determined by members of the Lesser Prairie-Chicken Interstate Working Group. Trends used for each priority species are stored in HABS.

Step 4: Hierarchical All Bird Systems (HABS)

The Hierarchical All Bird System (HABS) database is a tool developed by PLJV to store parameters and calculate a landscape's capacity to achieve population objectives for priority species. The carrying capacity can be based on current conditions (i.e., current habitat availability) and/or potential future conditions (i.e., alternative scenarios of future habitat availability resulting from conservation and management work). In HABS, data are stored in a hierarchical manor such that each bird density is specific to not only a species but also to a geographic area, a habitat within that area, a condition of that habitat, and a season of the year. For example, Lesser Prairie-Chickens occur at a density of 0.0125 birds/ac in the BCR19 region of Kansas in CRP with native plant species during the breeding season. The hierarchical levels on which HABS functions are described in the following table.

Table 3. Each of the five hierarchical levels of the Hierarchical All Bird System (HABS), a description, and an example (listed from highest to lowest level of order).

Hierarchical Level	Description	Example
Area	where a Bird Conservation Region (BCR) intersects a state	BCR19 portion of Kansas
Association	a mappable habitat	CRP
Condition	management condition or a more specific, potentially un-mappable, habitat	Native grasses
Season/Period	breeding, wintering, migratory	Breeding
Species	priority bird species	Lesser Prairie-Chicken

To better reflect a species' full range of spatial-temporal distribution and habitat use within the PLJV region, HABS also stores data on the availability and suitability of habitat acres. HABS incorporates three factors regarding spatial-temporal variation among species: *Range Factor, Suitability Factor, and Large Block Factor*. These are described in the following table and, in *Step 1*, additional examples of *Range Factor* and *Large Block Factor* are provided.

Table 4. List of spatial and temporal factors condisered in the Hierarchical All Brid System (HABS) database, inclduing a description, and an example.

Factor Type	Description	Example
Range Factor	Proportion of total acres of an Association or Condition (see Table 3) that are within a species range.	In BCR19-KS, there are 3.8 million acres of mixed-grass prairie but only 96,700 acres are within Lark Bunting range. *Range Factor* = 0.0254
Suitability Factor	Proportion of total acres of an Association or Condition that are suitable for species use during the specified Season/Period (see Table 3).	In BCR19-TX, there are 3.8 million acres of wheat; however, because of early Spring harvest, this habitat Condition is no longer suitable to Grasshopper Sparrows during their breeding season. *Suitability Factor* = 0

Factor Type	Description	Example
Large Block Factor	Proportion of acres of an Association or Condition that are in large block configuration. Criteria for large blocks are determined in a spatial model developed for each Species and Area (see Table 3).	In BCR19-OK there are 900,000 acres of sand sage but only 403,000 acres are in large block configuration. *Large Block Factor* = 0.4470

RESULTS

We present statistics describing BCR19 landcover, including CRP, to first familiarize the reader with the landscape. Then we present results for each priority species describing the effects of CRP on the population goals.

Landscape Statistics

The mixed-grass prairie BCR spans approximately 97.8 million acres. Nebraska and Kansas contain the largest portions of BCR19, 30.2 and 27 million acres, respectively. Texas contains about 22.1 million acres and Oklahoma contains the smallest portion, about 18.6 million acres.

Landcover composition of BCR19 varies most noticeably along a longitudinal gradient (Figure 2) that becomes evident when comparing landcover among the four states within the BCR (Figure 5). Grassland is most abundant in the north. Over half (56%) of all grassland acres in BCR19 (27.6 million acres) are in Nebraska, largely comprised of sandhills grassland (10 million acres) and mixed-grass prairie (4.7 million acres). Kansas and Oklahoma contain much smaller portions of BCR19 grassland, 18% and 15%, respectively. Texas contains the fewest grassland acres, less than 10%. Conversely, shrubland is most abundant in the south and grows sparser moving north. Texas contains 73% of the 6 million acres of shrubland in BCR19. Oklahoma contains about 25% of BCR19 shrubland while Kansas and Nebraska contain <2% combined. Woodlands are also most abundant in the southern regions of BCR19 with Texas containing 85% of all woodland acres, Oklahoma containing 11%, and Kansas and Nebraska containing less than 4% combined. Wetlands are most abundant in the northern regions of BCR19 with Nebraska containing 50% of all wetland acres, Kansas containing 35%, and Oklahoma and Texas containing less than 10% each.

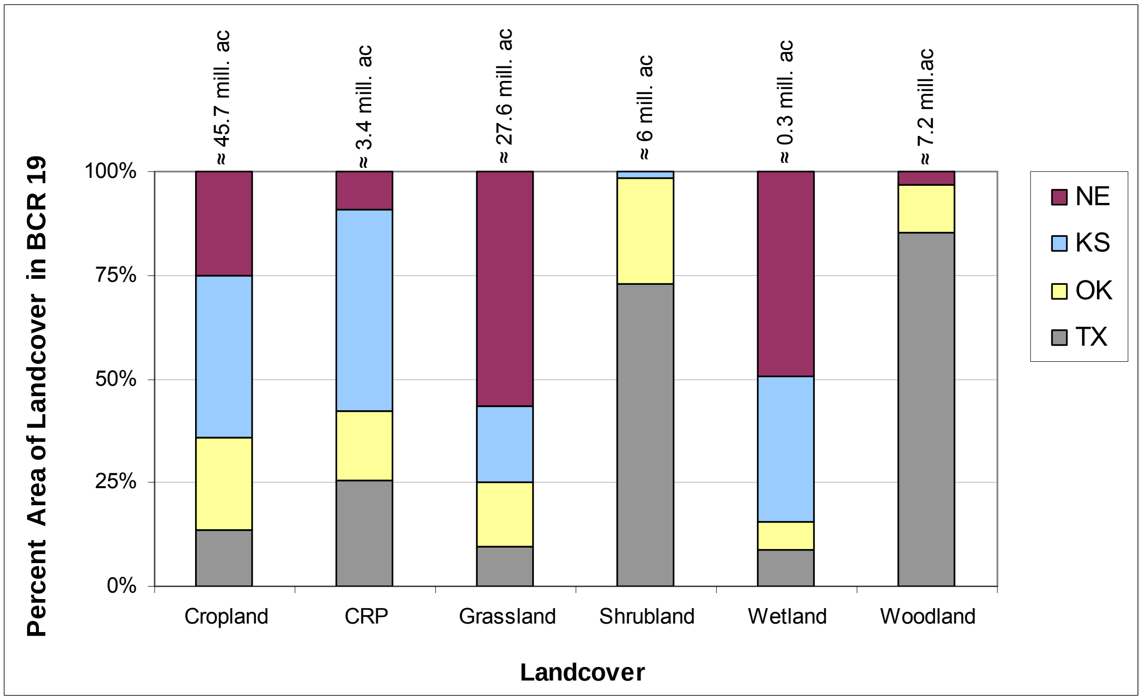


Figure 5. For each of several general landcover types, the percent of total landcover area of the mixed-grass prairie Bird Conservation Region (BCR19) occurring in each state. Approximate total acreage of each landcover type in BCR19 is noted at the top of each column.

Thirty-nine percent of all cropland in BCR19 (about 45.7 million acres in total) occurs in Kansas (Table 5). Kansas also contains the largest percent of CRP acres in BCR19, about 48% of the 3.4 million acres. Nebraska and Oklahoma have similar portions of BCR19 cropland, 25% and 22%, respectively. Oklahoma contains about 17% of CRP acres while Nebraska contains the fewest CRP acres, about 9%. Texas has the smallest portion of cropland acres (14%) yet Texas contains 25% of all CRP acres in BCR19. Of the 3.4 million acres of CRP in BCR19, 99% are planted to grass (3.36 million acres). About 16,000 acres are planted to trees (e.g., shelter belts, riparian buffers), about 12,000 acres are planted to wetland habitat (e.g., wetland restoration, playa buffers), and about 11,000 acres are planted to practices not considered bird habitat (e.g., diversion and erosion control structures). The amount of CRP fields planted to native and non-native grasses in each state is not clear because of the ambiguity of the Conservation Practice called ‘Existing grasses’ (i.e., CRP Conservation Practice 10), which constitutes many CRP acres in each state. Therefore, the percent of acres of native and non-native CRP grass (a Condition in HABS) is based on opinion of CRP experts within each state (see *Step 1* for more details).

Table 5. Estimated acres of CRP in each state within the mixed-grass prairie Bird Conservation Region (BCR19) by general planting type and summed to include all CRP acres. CRP acres were estimated using the Common Land Unit Layer (CLU), a spatial data layer provided by Farm Service Agency (FSA).

Area	**Native Grass**	**Non-native Grass**	**Trees (upland)**	**Trees (riparian)**	**Wetland**	**Wetland (non-floodplain)**	**Other Practices**	**All CRP**
NE	30,506	274,492	4,154	1,522	6,089	0	349	**317,112**
KS	1,630,842	0	2,962	987	3,456	329	7,406	**1,645,982**
OK	57,347	515,833	749	692	1,095	115	519	**576,350**
TX	85,280	767,689	432	5,179	1,726	0	2,762	**863,068**
BCR19	**1,803,975**	**1,558,014**	**8,297**	**8,380**	**12,366**	**444**	**11,036**	**3,402,512**

Landcover composition of each state is highly variability (Figure 6). In brief, Kansas and Oklahoma are dominated by cropland, Nebraska is dominated by grasslands, and Texas is dominated by shrubland and woodland. Kansas has the largest percent of landcover in CRP (6%) followed by Texas (4%), Oklahoma (3%), and Nebraska (1%). Additionally, the type of crop cover also varies among states (Figure 7), most notably between Nebraska and the other three states. Cropland in Nebraska is dominated by corn, 47% of all crop cover, while all other states are dominated by wheat, at least 35% of crop cover.

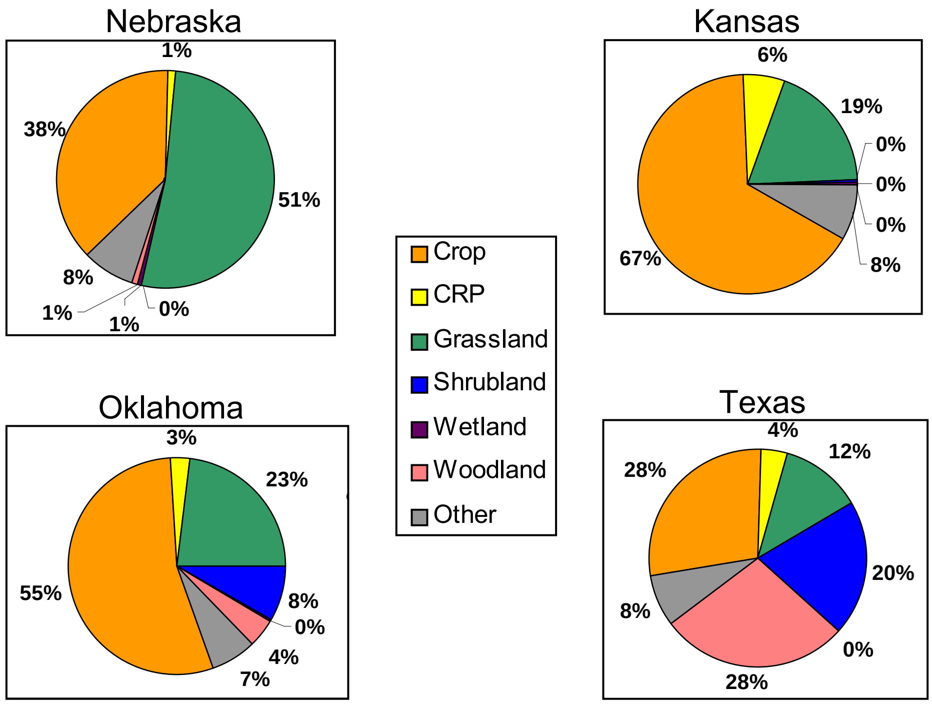


Figure 6. Landcover composition as a percent of area for each state within the mixed-grass prairie Bird Conservation Region (BCR19).

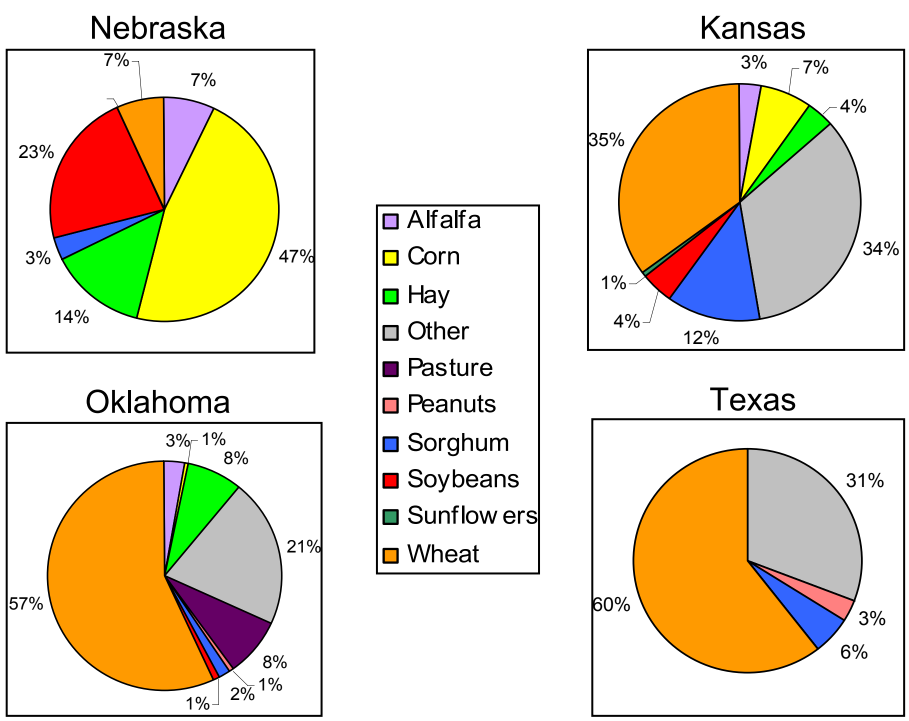


Figure 7. Crop type composition as a percent of cropland acres for each state within the mixed-grass prairie Bird Conservation Region (BCR19).

Effects of CRP on priority mixed-grass prairie birds

Summary

The contribution of CRP to the population goals of the priority species ranged widely, from 0% to 62%. Species showing the greatest benefit from CRP were Dickcissel, Eastern Meadowlark, and Grasshopper Sparrow. For these three species, CRP contributed more than 15% of the population goal for at least one state in the BCR. Seven of the 12 species analyzed showed an evident benefit from CRP (i.e., CRP contributes at least 10-15% of the population goal) in at least one of the four states comprising BCR19. These seven species include: Dickcissel, Eastern Meadowlark, Grasshopper Sparrow, Greater Prairie-Chicken, Lark Bunting, Northern Bobwhite, and Ring-necked Pheasant. Several species showed moderate benefit from CRP (i.e., CRP contributes 5-10% of the population goal) in at least one state, including Cassin's Sparrow, Lesser Prairie-Chicken, Upland Sandpiper, and Western Kingbird. One species, Swainson's Hawk, showed no benefit from CRP.

Species-by-species Results

Results for the 12 species are presented individually. For each species, we first give a brief description of its conservation status, distribution, and habitat use. Conservation status includes classification from several sources including the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004), the U.S. Shorebird Conservation Plan (Brown et al. 2001), Waterbird Conservation for the Americas plan (Kushlan et al. 2002), and species from state (NE, KS, OK, TX) and federal (USFWS) threatened, endangered, and species of concern lists. PIF classifications include Watch List Species (species having multiple reasons for conservation concern across their range) and Stewardship Species (species that warrant concern due to their restricted range; Rich et al. 2004). All other classifications are self-explanatory. Distribution is described in the text and illustrated with maps produced using BBS relative abundance data (Sauer et al. 2006).

We then describe the general effect of CRP on the species population goal within each state area. Results are presented in a subsequent table(s) and table headings are described below in Table 6.

Table 6. List and description of the column headings presented in the results tables. Carrying capacity is the number of birds supported by a habitat(s) in a given area.

Column Headings in the Results Tables and their Definitions

State Area

Population Goal - species total population goal for that state area

Carrying Capacity - estimated carrying capacity based on all habitats

% Pop. Goal - percent of total population goal achieved through all habitats

CRP

Carrying Capacity - estimated carrying capacity of CRP

% Pop. Goal - percent of total population goal achieved through CRP

CRP to Cropland

Carrying Capacity Lost/Gained - estimated carrying capacity lost or gained when CRP acres were reclassified to cropland

% Pop. Goal Lost/Gained - percent of total population goal lost or gained when CRP acres were reclassified to cropland

CRP in Large Blocks

Carrying Capacity Lost/Gained - estimated carrying capacity of CRP acres in large block configuration (based on spatial model parameters)

% Pop. Goal Lost/Gained - percent of total population goal achieved through CRP acres in large block configuration

Non-CRP Habitat in Large Blocks

Carrying Capacity Lost/Gained - estimated carrying capacity of suitable habitat that is not CRP and is in large block configuration

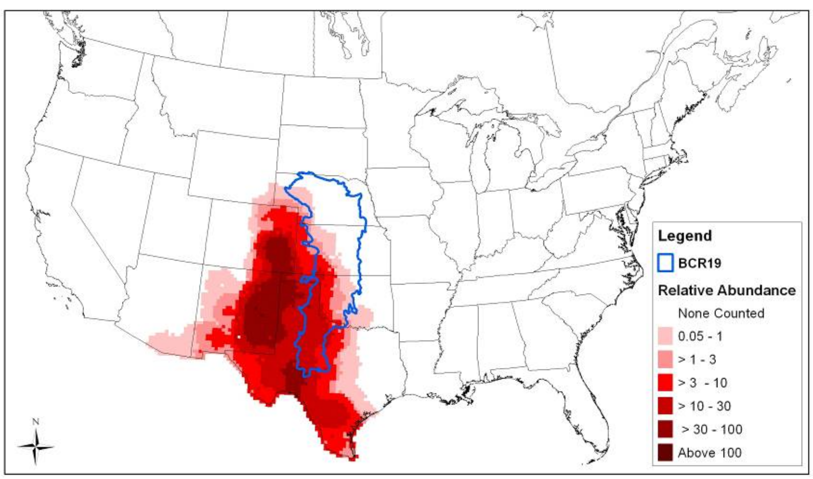
% Pop. Goal Lost/Gained - percent of total population goal achieved through suitable habitat that is not CRP and is in large block configuration

Cassin's Sparrow *(Aimophila cassinii)*

Cassin's Sparrows, a PIF Stewardship Species, breed in western regions of Kansas and Oklahoma and throughout Texas in BCR19. Cassin's Sparrows use a wide range of grassland habitats from short to moderate grass with sparse to moderate shrub cover or small trees (e.g., mesquite, oak) (Dunning et al. 1999). They also use cropland including wheat (Thompson and Ely 1992).

In Nebraska, Cassin's Sparrows occur only along the extreme western edge of BCR19. Effects of CRP on this species in this area are small and no analysis was conducted. There were inadequate data available for the BCR19 portion of Kansas, so an analysis for this region was not conducted. Cassin's Sparrows primarily occur in the south west region of BCR19 in Kansas where CRP is abundant and grassland acres are far fewer than in Nebraska. CRP may have a noticeable effect on this sparrow in Kansas but lack of density data prohibits analysis.

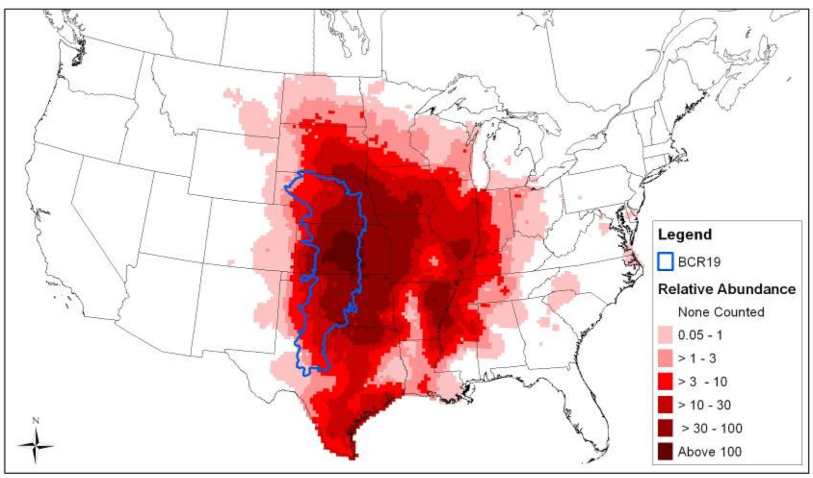
The estimated carrying capacity of Oklahoma and Texas combined is about 800,000 Cassin's Sparrows and the goal is to double the current population level in the BCR. Texas has a much greater carrying capacity for Cassin's Sparrow than Oklahoma (550,000 vs. 251,000 birds, respectively) and Texas is where the species is most abundant and widely distributed within the BCR. Accordingly, CRP contributes substantially to the population goal in Texas (9%) compared to Oklahoma (3%). Cassin's Sparrow shows a 7% loss in population goal in Texas when CRP acres are replaced with cropland and a 2% loss in Oklahoma.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
OK	493,607	251,376	51%	13,710	2.8%	-11,321	**-2.3%**
TX	1,080,852	550,438	51%	102,015	9.4%	-77,185	**-7.1%**

Dickcissel (*Spiza americana*)
Dickcissel is a PIF Watch List species that breeds throughout all of BCR19 with highest abundance in Kansas. It uses grasslands, fallow and no-till farmland, pastures and hay fields, and CRP (Temple 2002, Dechant et al. 2002). Dickcissels prefer moderate to tall grass, and moderately deep litter (Dechant et al. 2002).

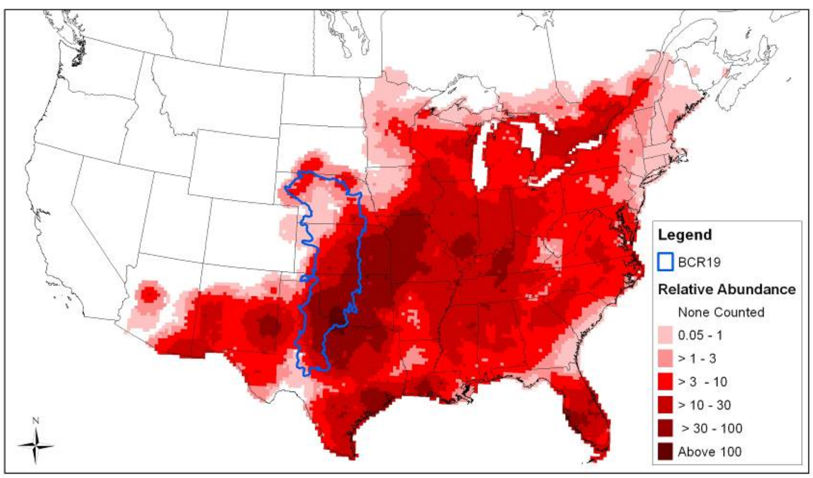
The estimated carrying capacity of BCR19 is about 8.26 million Dickcissels and the population goal is to maintain current population levels in the BCR. Carrying capacity is greatest in Kansas (over 6 million birds) which is where this species is most abundant in the BCR, according to BBS relative abundance data. CRP habitat contributes substantially (>36%) to the population goal of Dickcissel in Kansas, Oklahoma, and Texas and the effects of CRP appear to follow a longitudinal gradient, showing the greatest effects in Texas and fewest in Nebraska. We estimate a 61% loss in population goal in Texas when CRP acres are reclassified as cropland. This loss may be a result of the low number of grassland acres (12% of total area) and high number of CRP acres (4% of total area) in Texas, relative to the other states. Dickcissels do not use shrubland or woody habitat types which are a large component of the native habitat in BCR19 Texas (48% of total area). Loss in population goal is also large in Oklahoma (42%) which consists of about 23% grassland, 8% shrubland, and 3% CRP landcover. Conversely, the relatively large number of grassland acres (51% of total area) and few acres of CRP (1% of total area) in Nebraska likely account for the lesser effect of CRP on Dickcissel in Nebraska (a 17% loss).



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	1,082,364	1,082,364	100%	207,399	19.2%	-189,928	-17.6%
KS	6,009,523	6,009,523	100%	2,217,946	36.9%	-2,179,530	-36.3%
OK	894,026	894,026	100%	389,763	43.6%	-381,456	-42.7%
TX	309,634	309,634	100%	193,283	62.4%	-190,994	-61.7%

Eastern Meadowlark (*Sturnella magna*)
This landbird breeds throughout all of BCR19, showing increasing abundance from the north to south. Eastern Meadowlarks are most common in native grasslands, typically with moderate to tall grass and low woody vegetation. It also uses fallow cropland, pastures, hay, alfalfa, and CRP (Lanyon 1995, Hull 2002).

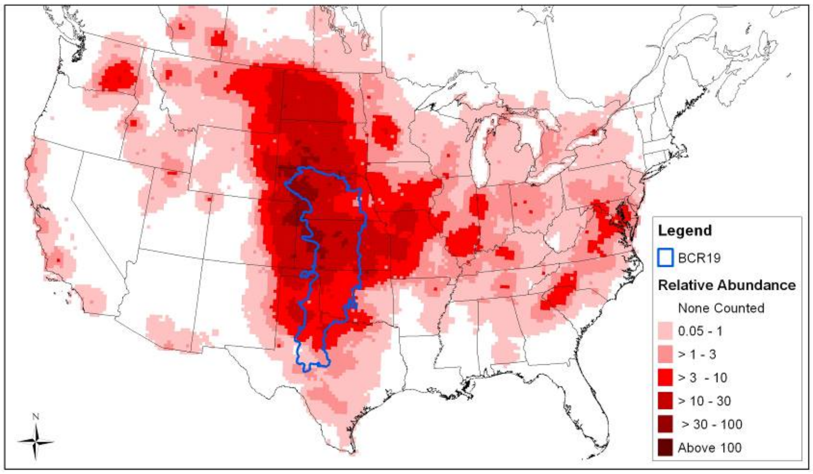
Estimated carrying capacity of BCR19 is about 816,000 Eastern Meadowlarks and the population goal is to increase the current population level by about 27% throughout the BCR. Carrying capacity is greatest in Oklahoma (over 400,000 birds) and Texas (about 197,000 birds). CRP habitat contributes more than 25% of the population goal in Kansas and Texas and nearly all that contribution is lost when CRP is reclassified as cropland. The high contribution of CRP to population goal in Kansas and Texas is likely due to the combination of relatively low number of grassland acres and high number of CRP acres in these two states. CRP contributes to a lesser but still noteworthy degree to the population goals in Oklahoma (18%) and Nebraska (9%). Grassland acres are more abundant in Oklahoma (23% of landcover) than in Kansas (19%) and Texas (12%) and CRP acres are less abundant in Oklahoma (3%) than in Kansas (6%) and Texas (4%). In Nebraska, the species is much less abundant and there are many more grassland acres (51% of landcover) and fewer CRP acres (1%).



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	91,148	66,136	73%	8,540	9.4%	-7,537	-8.3%
KS	183,580	133,204	73%	54,209	29.5%	-52,175	-28.4%
OK	577,498	419,028	73%	105,924	18.4%	-98,276	-17.0%
TX	272,813	197,951	73%	71,649	26.3%	-71,649	-26.3%

Grasshopper Sparrow (*Ammodramus savannarum*)
Grasshopper Sparrow is a PIF Stewardship Species. It breeds throughout BCR19, showing increasing abundance from south to north. Grasshopper Sparrows occur in native prairie, cropland, and CRP and prefer grass of intermediate height, moderately deep litter, and sparse woody vegetation (Dechant et al. 2002b). They also use hayfields and pasture, and occasionally cultivated cropland (e.g., corn, oats), but at much lower density (Dechant et al. 2002b).

Estimated carrying capacity of BCR19 is about 5.8 million Grasshopper Sparrows and the population goal is to increase current population levels in the BCR by a third. Carrying capacity is greatest in Nebraska and Kansas which is where this species is most abundant in the BCR, according to BBS relative abundance data. CRP habitat contributes most to the population goals in Texas (31%) and Kansas (16%) and nearly all this contribution is lost when CRP acres are reclassified to cropland. The large impact of CRP acres in Texas and Kansas is likely due to the small amount of grassland habitat (<12% and 19% each state's landcover, respectively) and large number of CRP acres (4% and 6% of each state's landcover, respectively) in these states. In Nebraska and Oklahoma, CRP acres contribute considerably less to the population goal (3 % and 6%, respectively) but nearly all the contribution is lost when CRP is reclassified to cropland.

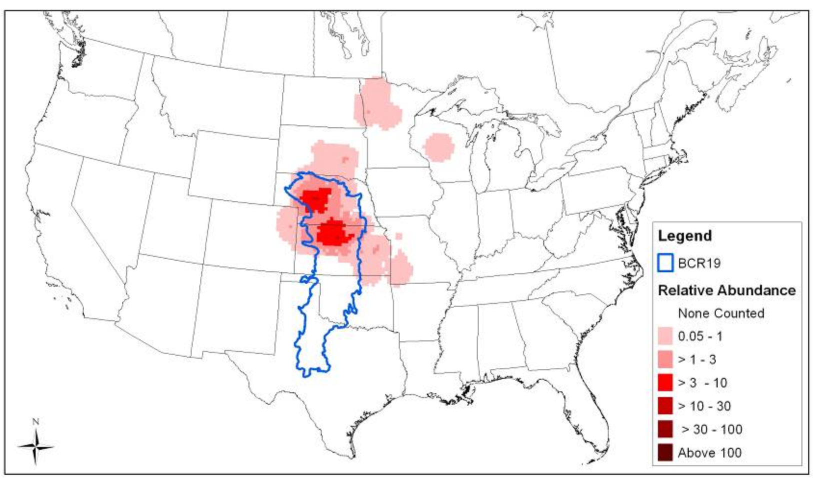


	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	4,305,387	2,860,505	66%	128,709	3.0%	-122,467	**-2.8%**
KS	3,063,510	2,035,400	66%	496,265	16.2%	-485,590	**-15.9%**
OK	1,093,858	726,761	66%	66,088	6.4%	-59,551	**-5.4%**
TX	318,259	211,452	66%	98,347	30.9%	98,347	**-30.9%**

Greater Prairie-Chicken (*Tympanuchus cupido*)

This game bird is a PIF Watch List species. It is a resident species of northern BCR19, including all of Nebraska and much of Kansas. In Nebraska, Greater Prairie-Chickens use sand sage, sandhills grasslands, and mixed grass prairie (Dinan and Johnsgard 2004). Greater Prairie-Chicken nest success decreases dramatically when woody shrub cover increases over 5 %. Overgrazing affects Greater Prairie-Chickens negatively; breeding density is highest where grazing pressure is relaxed by either limiting grazing to winter or idling pastures in some years (Svedarsky et al. 2003).

Estimated carrying capacity of BCR19 is about 443,000 Greater Prairie-Chickens and the population goal is to maintain current population levels in the BCR. Carrying capacity is greatest in Nebraska (about 355,000 birds). CRP contributes most to the to the population goal of Kansas (12%) and less in Nebraska (2%) and all that contribution is lost when CRP acres are reclassified as cropland. Additionally, because this species requires large blocks of suitable habitat, the species experiences additional loss in population goal as a result of large blocks of non-CRP habitat becoming fragmented when CRP is reclassified as cropland (see second table). In Nebraska, the additional loss is small <1%, 288 birds) because there are fewer acres of CRP in Nebraska compared to Kansas but also because Nebraska has many more acres of unfragmented suitable habitat than Kansas (see second table). Conversely, in Kansas there is an additional 4% loss in population goal because of resulting habitat fragmentation. The positive effect of CRP on Greater Prairie-Chickens is most evident in Kansas where CRP acres are numerous and planted to native grass species.



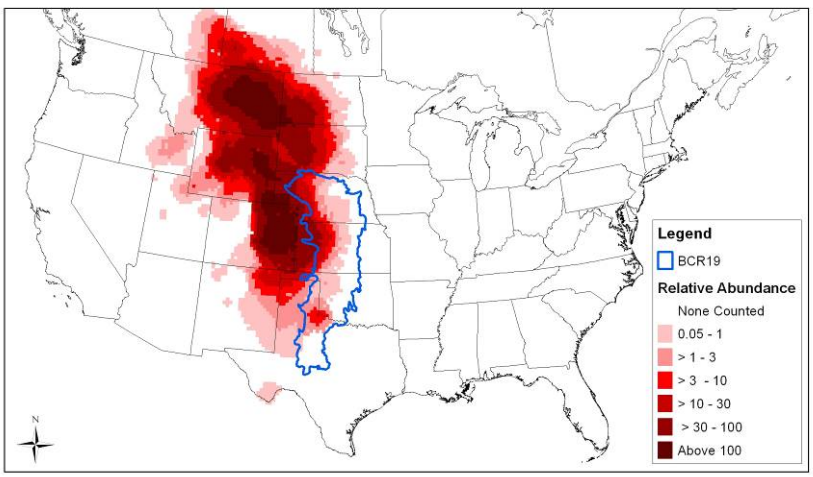
	State Area			CRP in Large Blocks		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	355,602	355,602	100%	5,549	2%	-5,549	**-2%**
KS	87,583	87,538	100%	10,766	12%	-10,766	**-12%**

State Area	State Area			Non-CRP Habitat In Large Block Acres		CRP to Cropland	
	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	355,602	355,602	100%	288	0%	-288	**0%**
KS	87,583	87,538	100%	3,900	4%	-3,900	**-4%**

Lark Bunting (*Calamospiza melanocorys*)

Lark Buntings is a PIF Stewardship Species that breeds along the western edge of BCR19. This species uses grasslands of low to moderate height, often with some shrubs, weedy fallow fields, CRP, hay, pasture, and alfalfa (Dechant et al. 2002c, Sparks et al. 2005). Breeding is associated primarily with shortgrass, sand sage, and mixed grass prairie in Kansas and Nebraska (Kingery 1998, Busby and Zimmerman 2001, Dinan and Johnsgard 2004), plus sand hills prairie in Nebraska (Dinan and Johnsgard 2004). It is also known to use fallow cropland and stubble, cultivated crops (e.g., wheat), and alfalfa in Oklahoma and Kansas (Busby and Zimmerman 2001, Reinking 2004).

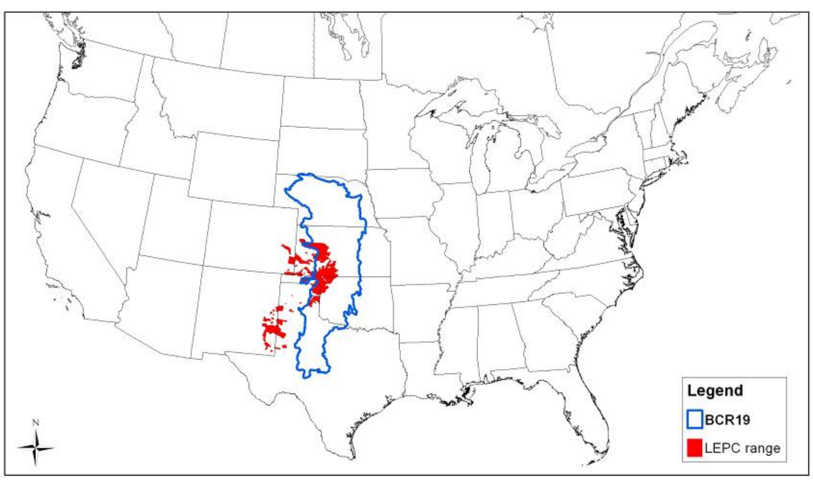
Estimated carrying capacity of BCR19 is about 570,000 Lark Buntings and the population goal is to double current population levels in the BCR. Carrying capacity is greatest in Nebraska (about 227,000 birds) and Kansas (about 316,000 birds). CRP contributes considerably to the population goals of Texas (18%), Kansas (17%), and Oklahoma (14%) and most of that contribution is lost when CRP acres are reclassified to cropland (18%, 14%, and 13%, respectively). The noticeable effect of CRP on Lark Buntings in Kansas and Texas is likely a result of the large number of CRP acres and few acres of grassland. In Oklahoma, most CRP acres occur in the west, concurrent with this species' range, thus, increasing the impact of CRP in this state.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	446,582	227,428	51%	19,832	4.4%	-19,058	**-4.3%**
KS	621,062	316,284	51%	106,054	17.1%	-89,022	**-14.3%**
OK	12,948	6,594	51%	1,765	13.6%	-1,709	**-13.2%**
TX	38,098	19,402	51%	6,704	17.6%	-6,704	**-17.6%**

Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*)
This resident game bird is a PIF Watch List species, a species of Highest Continental Concern according to the American Bird Conservancy, a State Threatened species in Colorado, and is currently listed as a candidate under the federal Endangered Species Act. Lesser Prairie-Chickens are patchily distributed in western portions of BCR 19 in Kansas, Oklahoma, and Texas. They are most common in southwestern portion of Kansas (Price et al. 1995). Their habitat use varies across their range, but generally consists of dwarf shrub-mixed grass vegetation types associated with sandy soils, which may be interspersed with short grass or mixed grass prairie (Taylor and Guthery 1980; see Hagan 2005). Habitat is comprised primarily of sand sage prairie in Kansas (Andrews and Righter 1992, Giesen 1994, Busby and Zimmerman 2001), and primarily shinnery oak prairie in Oklahoma and Texas (Riley et al. 1992, Jackson and DeArment 1963; see Hagan 2005). This species also uses CRP in some areas, including Kansas, (Fields 2004), as well as cropland (Crawford and Bolen 1976).

Estimated carrying capacity of BCR19 is about 30,000 Lesser Prairie-Chickens and the population goal is to double current population levels in Kansas and increase population levels by 66% in Oklahoma and Texas. Carrying capacity is greatest in Kansas (about 22,000 birds). CRP contributes about 7% to the population goal of Kansas and all that contribution is lost when CRP acres are reclassified as cropland. Additionally, because this species requires large blocks of suitable habitat, the species experiences an additional 2% loss in population goal as a result of large blocks of non-CRP habitat becoming fragmented when CRP is reclassified as cropland (see second table). In Texas and Oklahoma, CRP does not contribute much to the population goal (<1%) because CRP in these states is planted to non-native grasses that are unsuitable to Lesser Prairie-Chickens. However, non-native CRP does help form large blocks of appropriate habitat (i.e., habitat the species does not avoid although it does not prefer) in Texas and Oklahoma so when CRP is reclassified as cropland, some blocks become fragmented. Thus, there is a 6% and 2% loss in population goal in Oklahoma and Texas, respectively, when CRP is reclassified as cropland (see second table).



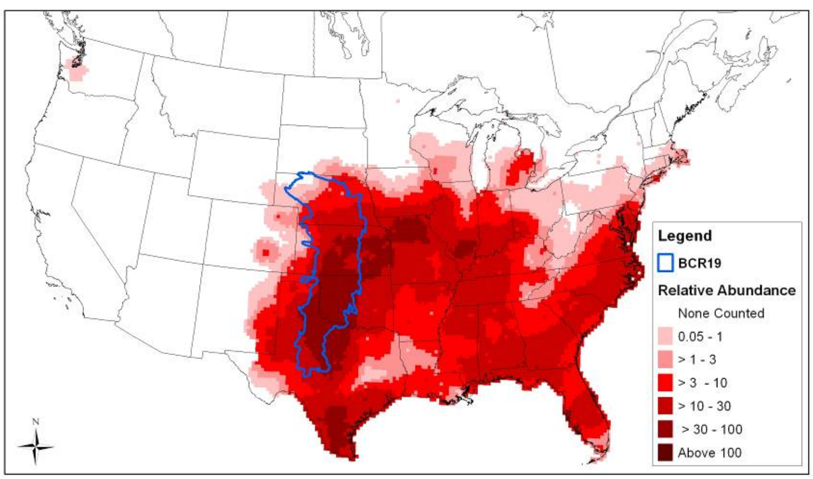
	State Area			CRP in Large Blocks		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
KS	42,976	21,886	50%	2,822	6.6%	-2,822	**-6.6%**
OK	24,801	8,064	33%	103	0.4%	-103	**-0.4%**
TX	240	78	33%	1	0.4%	-1	**-0.4%**

	State Area			Non-CRP Habitat in Large Blocks		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
KS	42,976	21,886	50%	19,064	44%	-1,005	**-2%**
OK	24,801	8,064	33%	7,961	32%	-1,544	**-6%**
TX	240	78	33%	77	32%	-4	**-2%**

Northern Bobwhite (*Colinus virginianus*)

This resident game bird is a Tier II At-risk Species according to the Nebraska Natural Legacy Plan. It occurs throughout BCR19 showing greater abundance in the south. Northern Bobwhites use a mix of cropland and native habitats with brushy areas (e.g., fencerows, woodlots). They predominately occur in riparian woodland and riparian shrub associations in Nebraska (Dinan and Johnsgard 2004), western Kansas (Busby and Zimmerman 2001), western Oklahoma (Schemnitz 1994, Sutton 1967), and northern Texas (Seyffert 2001). They also uses wet meadow and hayfields in central Nebraska (Faanes and Lingle 1995), and CRP in eastern Nebraska (King and Savidge 1995) and elsewhere.

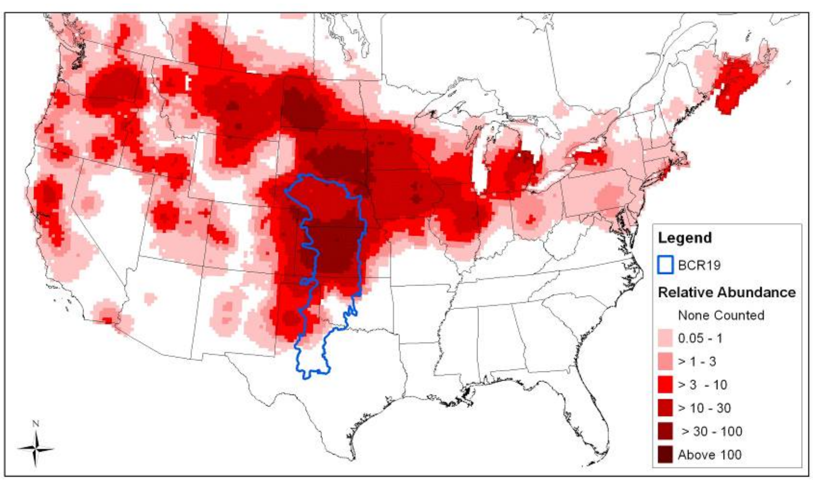
Estimated carrying capacity of BCR19 is about 2.35 million Northern Bobwhites and the population goal is to maintain current population levels in the BCR. Carrying capacity is greatest in Texas (over 900,000 birds), is similar between Kansas (about 684,000 birds) and Oklahoma (about 678,000 birds), and is far less in Nebraska (about 83,000 birds). CRP habitat contributes 7-12% to the population goal of each state and losses in population goal range from 4 to 10% when CRP acres are reclassified as cropland. CRP may show an even greater benefit to this species if woody species were included in planting mixes or drilled in to established stands. Generally, CRP planting mixes do not contain woody species, so CRP often lacks a woody component that this species prefers.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	83,847	83,847	100%	9,760	11.6%	-8,182	**-9.8%**
KS	684,806	684,806	100%	52,187	7.6%	-27,005	**-4.0%**
OK	678,183	678,183	100%	55,026	8.1%	-37,462	**-5.5%**
TX	902,658	902,658	100%	81,885	9.1%	-58,932	**-6.5%**

Ring-necked Pheasant (*Phasianus colchicus*)
This resident exotic game bird occurs predominately in the Nebraska and Kansas portions of BCR19 but also in smaller areas of northern Oklahoma and western Texas. Ring-necked Pheasants use a wide variety of habitats but are most common in areas having a mix of cultivated cropland, grassland and/or CRP, with areas of heavy cover (e.g., roadside ditches, fencerows) (Giudice and Ratti 2001). They use small-grain fields, fallow fields, and alfalfa (Mollhoff 2001), as well as hayfields and pasture (Thompson and Ely 1989). Wetlands with emergent vegetation and wet meadows provide important habitat during winter (Giudice and Ratti 2001, Dinan and Johnsgard 2004).

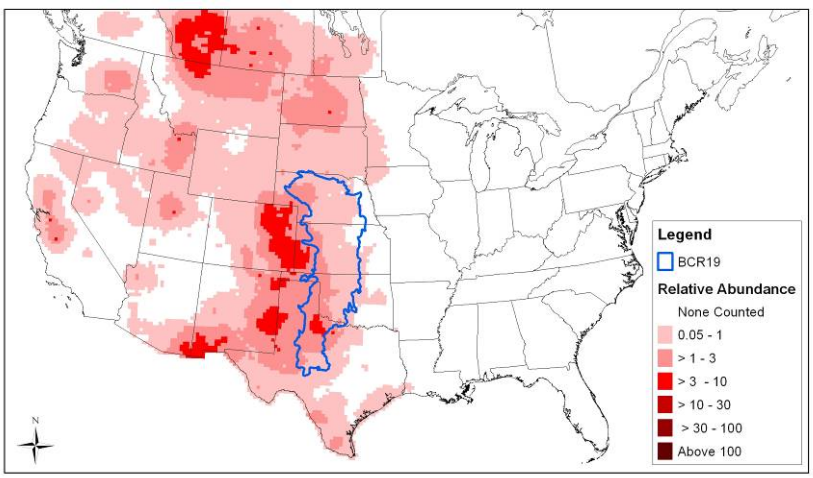
The carrying capacities, and hence, population goals for Ring-necked Pheasants are underestimated by as much as half in this analysis, judging by harvest data published for each state. We believe this error is because the density data used in this calculation are low due to inadequate survey methods (regarding Ring-necked Pheasant detection only). Density data were derived from point counts and walking-line transects which are not effective detection methods for this species; however, they were the only density data available. Regardless of the underestimated carrying capacity, the *percent* of population goal provided through CRP habitat and the *percent* of population goal lost or gained are credible, as they are percents. Estimated carrying capacity of BCR19 is about 1.1 million Ring-necked Pheasants and the population goal is to maintain current population levels in the BCR. Carrying capacity is greatest in Kansas (about 823,000 birds) and Nebraska (about 188,000 birds). Effects of CRP vary among the four BCR19 states with the greatest effect occurring in Texas and Kansas where CRP contributes 12% and 6% of the population goals, respectively. Much some of that contribution (4% and 2%, respectively) is lost when CRP acres are reclassified to cropland but because this species uses cropland in similar densities as CRP, some of the population goal is provided through cropland. However, it should be noted that Ring-necked Pheasants are known to use CRP for winter cover, when many crop fields are of unsuitable vegetative stature, so CRP's full benefit to this species is not reflected here.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	187,539	187,539	100%	7,043	3.8%	-4,272	**-2.3%**
KS	823,084	823,084	100%	49,766	6.1%	-16,971	**-2.1%**
OK	59,821	59,821	100%	2,855	4.8%	-793	**-1.3%**
TX	35,123	35,123	100%	4,125	11.7%	-1,229	**-3.5%**

Swainson's Hawk (*Buteo swainsoni*)
This migratory raptor is a PIF Watch List Species, a Tier II At-risk Species in Nebraska, a Category II Species of Special Concern in Oklahoma, and a species experiencing Declines of High Threats according to the ABC. Swainson's Hawks breed throughout BCR19 and use a wide variety of habitats including native grassland and shrubland, hay fields, pasture, cultivated land with scattered trees, riparian woodland, and shelterbelts (Thompson and Ely 1989, England et al. 1997, Busby and Zimmerman 2001, Johnson et al. 2004). Research suggests that they prefer some cultivated cropland and tolerates extensive areas of cultivated cropland in territories (Dechant et al. 2001a) but requires sparsely available or aggregations (e.g., associated with riparian areas, homesteads) of trees for nest sites (Olendorff 1973).

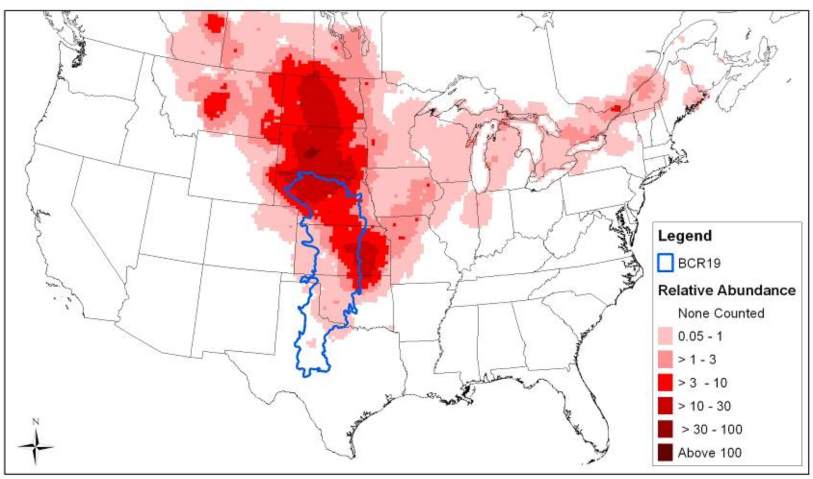
Estimated carrying capacity of BCR19 is about 30,000 Swainson's Hawks and the population goal is to double current population levels in the BCR. Carrying capacity is greatest in Nebraska and Texas (about 11,000 in each). Swainson's Hawks are not documented as using CRP in BCR19; therefore, we assume a density of zero for this habitat. Consequently, CRP does not contribute to the population goal of Swainson's Hawks in any state. Swainson's Hawks are documented occurring in several crop types throughout the BCR and density estimates were available so this species shows gains in population goal when CRP acres are reclassified as cropland; however, the impact is marginal at best (<2%).



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	21,184	10,788	51%	0	0.0%	17	**0.1%**
KS	6,342	3,230	51%	0	0.0%	124	**2.0%**
OK	9,211	4,691	51%	0	0.0%	86	**0.9%**
TX	21,653	11,027	51%	0	0.0%	463	**2.1%**

Upland Sandpiper (*Bartramia longicauda*)
This migratory shorebird is listed under the U.S. Shorebird Conservation Plan as a species of concern. It breeds in the northern regions of BCR19 with highest abundance in Nebraska and Kansas. For nesting, Upland Sandpipers prefer grasslands with moderate grass cover, low woody cover, moderate-high litter cover, and little bare ground (Dechant et al. 2002a). In Nebraska, they occur in sand hills prairie, wet meadow, hay, alfalfa, and cropland (e.g., wheat) (Faanes and Lingle 1995, Dinan and Johnsgard 2004), as well as various types of pasture, fallow cropland, and CRP (Houston and Bowen 2001, Dechant et al. 2002a).

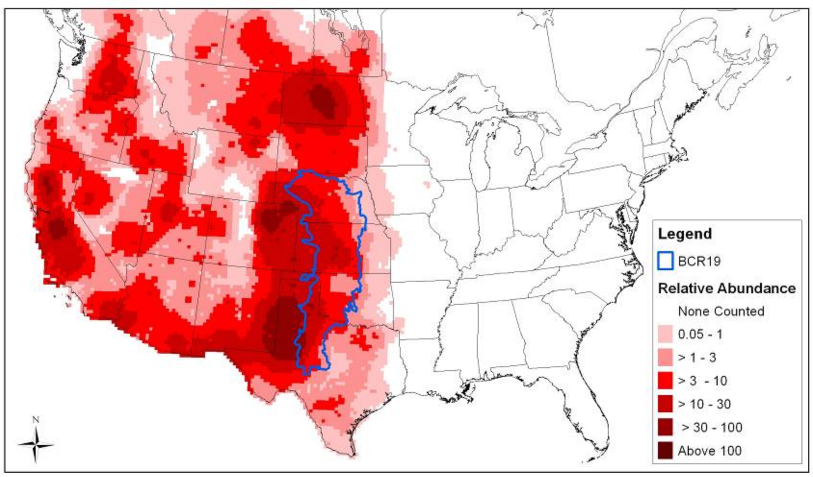
Analysis for Upland Sandpiper was restricted to Nebraska, Kansas, and Oklahoma because this species is extremely rare in Texas. The estimated carrying capacity of BCR19, excluding Texas, is about 307,000 Upland Sandpipers and the population goal is to maintain current population levels in the BCR. Carrying capacity is greatest in Nebraska (about 222,000 birds) which is where this species is most abundant in the BCR, according to BBS relative abundance data. CRP marginally contributes (<1%) to the population goals in both Nebraska and Oklahoma where CRP is planted primarily to non-native grass species. Conversely, in Kansas, where nearly all CRP grasses are native, CRP contributes 5% to the population goal, and nearly all that is lost when CRP acres are reclassified to cropland. Upland Sandpiper is one of the few species for which it is documented that they occur in greater numbers on native CRP versus non-native CRP. This preference accounts for the loss of population goal in Kansas but the gain in Nebraska and Oklahoma.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	222,274	222,274	100%	732	0.3%	1,409	**0.6%**
KS	74,287	74,287	100%	3,914	5.3%	-3,622	**-4.9%**
OK	12,264	12,264	100%	37	0.3%	175	**1.4%**

Western Kingbird (*Tyrannus verticalis*)
This migratory landbird breeds throughout BCR19 using a wide variety of open habitats (e.g., grasslands, desert shrub, pastures, agricultural land) where trees or other structures are available for nesting (Gamble and Bergin 1996). In Nebraska, they use sand sage, shortgrass, mixed grass, and sand hills prairie, badlands, and woodland (e.g., riparian) edge in Nebraska (Dinan and Johnsgard 2004), as well as hay and alfalfa fields in central (BCR19) NE (Faanes and Lingle 1995).

Estimated carrying capacity of BCR19 is about 1.5 million Western Kingbirds and the population goal is to double current population levels in the BCR. Carrying capacity is greatest in Kansas (about 1 million birds) which is where this species is most abundant in the BCR, according to BBS relative abundance data. CRP habitat contributes <10% to the population goal of each state and nearly all that contribution is lost when CRP acres are reclassified as cropland. The small effect of CRP on Western Kingbirds is likely because this species using a wide variety of habitats from urban areas, to grasslands, riparian zones, and shrubland. As a tree-associated species, Western Kingbirds are one of the few grassland bird species that is likely positively affected by CRP land on which trees are planted, although their population goals are also increased through grassland plantings.



	State Area			CRP		CRP to Cropland	
State Area	Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity	% Pop. Goal	Carrying Capacity Lost/Gained	% Pop. Goal Lost/Gained
NE	750,374	382,138	50%	18,438	2.4%	-17,764	-2.4%
KS	1,056,762	539,698	50%	98,087	9.3%	-95,339	-9.0%
OK	295,790	150,635	50%	11,492	3.9%	-11,249	-3.8%
TX	819,763	417,475	50%	51,515	6.3%	-51,515	-6.3%

DISCUSSION

CRP and Wildlife Conservation

When CRP was developed in 1985, its primary objectives were to reduce soil erosion and surplus commodities. Little consideration was given to CRP as potential wildlife habitat. Many CRP fields in the Great Plains were planted to monocultures or mixtures of introduced grass species and, as mandated by law; most CRP fields remained virtually undisturbed for the life of their contracts (10 – 15 years or longer for re-enrolled fields). As a result, CRP fields planted to grass may have dissimilar vegetation composition and structure relative to surrounding native prairie (McIntyre and Thompson 2003, Kamler et al. 2003, Samson et al. 2004, Kamler et al. 2005). A difference in habitat characteristics indicates a potential difference in benefits to wildlife. For instance, some biologists suggest that CRP in the shortgrass prairie BCR provides poor quality habitat to shortgrass dependent wildlife (Milchunas et al. 1998, McIntyre and Thompson 2003, Kamler et al. 2003, Samson et al. 2004, Kamler et al. 2005) because of the disproportionately taller vegetation in undisturbed and/or non-native CRP fields (McIntyre and Thompson 2003, Kamler et al. 2003, Samson et al. 2004, Kamler et al. 2005).

In recent years, however, the focus of the CRP has expanded to include wildlife habitat as an additional program objective (Allen 1994). Beginning in 1996, eligible CRP offers were ranked according to an Environmental Benefits Index (EBI). The EBI is a rating system aimed at maximizing the value of erosion reduction and wildlife habitat. Since then, the EBI has been refined to improve the quality of wildlife habitat by encouraging establishment of diverse native vegetation over monocultures of introduced species, and to promote restoration of rare and declining wildlife habitat. Additionally, in recognition of the need for periodic disturbance and management of CRP land, the USDA authorized managed haying and grazing in 2002 (which is to occur no more frequently than one out of every three years) to improve the quality of CRP land for wildlife (U.S. Department of Agriculture 2004b). Managed haying and grazing are particularly important additions to the program as they allow the opportunity to alter the vegetation structure of existing CRP habitat to suit the requirements of target wildlife. These changes to CRP are promising for wildlife conservation, especially for grassland birds, considering the impressive number of CRP acres enrolled in the Great Plains.

Still there are other factors that continue to affect, and likely limit, the benefits of CRP to grassland wildlife. Two chief factors are the spatial (e.g., size, shape) and landscape (e.g., juxtaposition, neighboring habitats) characteristics of CRP fields. CRP fields are often located in highly fragmented landscapes dominated by cropland and can take any number of shapes and sizes from long, narrow strips, to triangular corner plots, to 690-acre blocks. These are important habitat features when considering conservation of grassland birds because many are thought to be sensitive to habitat fragmentation (O'Connor 1999, Brennan and Kuvlesky 2005), size and shape of habitat patches (Johnson and Temple 1986, Herkert 1994, Vickery 1994, Johnson and Igl 2001, Brennan and Kuvlesky 2005, Cunningham 2005), and landscape composition (Rotenberry and Wiens 1980, Knick and Rotenberry 1995, Cunningham and Johnson 2006).

In this CEAP project, we went to great lengths to incorporate as many habitat parameters as possible when evaluating the effect of CRP on priority mixed-grass prairie birds, including spatial and landscape characteristics. The biggest hindrance was the availability of reliable and current data. Data on the vegetation composition or management activities (i.e., vegetation structure) for individual CRP fields are not available in regional data sets but are stored at county-level field offices. Considering the large spatial scale of this project, acquiring these data for the nearly 100,000 CRP fields in the study area was infeasible. So we applied assumptions based on expert opinions about the proportion of CRP fields that are planted to native or non-native species (discussed in Methods). Furthermore, for many grassland bird species, the relative importance of these factors in defining an individual species' habitat requirements is not well understood nor well documented. When data were available for species, they were incorporated into calculations of carrying capacity and noted in the individual species results.

Benefits of CRP to Mixed-grass Prairie Birds

Our analysis indicates that CRP is contributing significantly to the population goals of several priority mixed-grass prairie birds. The degree of benefit varies by species and geographic area. Several species stood out as having evident benefit from CRP in at least one area of their range (Dickcissel, Eastern Meadowlark, and Grasshopper Sparrow). For these species, it appears CRP is making substantial impacts on their populations. For other species, the benefit of CRP is moderate by comparison but still significant in terms of conservation of the species (Lesser Prairie-Chicken, Greater Prairie-Chicken, Lark Bunting, Northern Bobwhite, and Ring-necked Pheasant).

For other species, Swainson's Hawk and Upland Sandpiper (in all states except Kansas), there is no benefit from CRP. For Upland Sandpiper, this lack of benefit is related to the type of species planted in CRP fields (i.e., native vs. non-native). Upland Sandpipers benefit from CRP in Kansas because it has native grass plantings, unlike the majority of CRP in the other three states. For Swainson's Hawk, the tall, dense vegetation structure relative to shortgrass prairie may limit the benefit of CRP. Swainson's Hawks, require relatively short stature grasses which make prey more visible (England et al. 1997) and they reach their highest densities in North America's shortgrass prairies (Sauer et al. 2006).

Comparing the overall effect of CRP among the states, CRP in Kansas and Texas often produced the most benefit for priority birds. CRP is most abundant in Kansas (48% of all CRP in BCR19) and Texas (25% of all CRP in BCR19) and these two states have the fewest number of grassland acres available to birds. Furthermore, Kansas showed greater benefit to four species that are either documented as or thought by experts as using native CRP plantings more than non-native, including Cassin's Sparrow, Greater Prairie-Chicken, Lesser Prairie-Chicken, and Upland Sandpiper. In Kansas, nearly all its CRP grass is planted with native species as opposed to the mostly non-native CRP grass in the other states. Native grasses generally provide more suitable habitat for grassland birds, and, thus, they occur at greater densities on this habitat.

CRP also proved beneficial to both prairie-chicken species in providing large blocks of suitable habitat. Our spatial models showed than CRP contributed to and connected large blocks of suitable habitat for both species, and, consequently, when CRP was reclassified to cropland, it resulted in fragmentation of that previously suitable habitat. In addition to the prairie-chickens, other priority birds in this study are area and/or disturbance sensitive including Grasshopper Sparrow and Upland Sandpiper. However, the area requirements (i.e., size of habitat block) are much smaller for Grasshopper Sparrow (20-30 ac in Nebraska; Helzer 1996, Helzer and Jelinski 1999) relative to the average size of a CRP field in BCR19 which is about 125 ac (for grass and wildlife habitat plantings). So we did not develop spatial models nor apply *Large Block Factors* for Grasshopper Sparrow to evaluate CRP. For Upland Sandpiper, research suggests an area requirement of about 125-150ac in Nebraska (Helzer 1996, Helzer and Jelinski 1999). We did not develop a spatial model for Upland Sandpiper because average CRP size is similar to its area requirement and because this species uses predominantly native CRP fields occurring mostly in Kansas, where area requirements may be different because of the highly fragmented crop-dominated landscape.

Overall, CRP is positively affecting a variety of priority mixed-grass prairie bird species. Although some species benefit more than others, in general, CRP is providing most of these species with an alternative suitable habitat typically preferred over otherwise present cropland. CRP is particularly important in connecting and enlarging existing blocks of fragmented prairie habitat. This is a critical landscape component (i.e., habitat corridors and buffers) for both area-sensitive and ground birds such as the Lesser and Greater Prairie-Chicken. Below we suggest ways to increase these benefits of CRP even more for grassland birds.

Recommendations

To maximize benefits of CRP to grassland birds, we recommend that CRP be delivered in a strategic approach that focuses on three central factors: 1) species of greatest conservation need, 2) spatial targeting of acres, and 3) managed native plantings.

CRP delivery should be aimed at benefiting species that are of highest conservation concern as well as species for which action will benefit the most number of species (i.e., umbrella species or groups instead of single species). Priority species can be identified, as they were in this CEAP project, by consolidating federal, regional, and state species conservation lists and determining which species occur in the planning area. (PLJV developed the Species for Management Action (SMA) database to identify species in BCRs 18 and 19 and this tool can be expanded to include any region in North America). It is also important to determine if CRP is an appropriate tool for conserving each priority species, as it will not always be the case. Wildlife habitat is only one of several goals of the CRP, and the management required to benefit a particular species may conflict with other goals such as reducing soil erosion. For example, the Mountain Plover is a high priority species of the shortgrass prairie that requires bare ground and very short stature grassland vegetation. Managing CRP for such conditions may increase erosion. Therefore, it is necessary to determine and consider the habitat requirements of identified priority species.

CRP should be spatially targeted according to its context within the landscape (i.e., Is a field surrounded by cropland, urban development, or native habitat?) and according to spatial habitat requirements of priority species (i.e., Does the species require large blocks of habitat or does it tolerate habitat fragmentation?). Spatial targeting can locate and rank existing CRP fields and qualified crop fields based on their potential benefit to priority species. This process answers the question, 'Where is CRP needed to benefit a species'? We suggest development of a Decision Support Tool (DST) that evaluates CRP fields, crop fields, and the habitat requirements of bird species (including spatial parameters) against the landscape through a Geographic Information System (GIS). PLJV developed and used such a DST for this CEAP project to identify suitable habitat for Lesser Prairie-Chickens. The DST evaluated CRP location, acres, and conservation practice within the context of surrounding habitat. The illustration in Figure 8 shows how a DST can rank crop fields into tiers of potential benefit to Lesser Prairie-Chicken considering adjacency to large blocks of native habitat, existing CRP fields, and major roads (no tolerance). When CRP and crop fields are ranked according to potential benefit to birds, it allows strategic enrollment and re-enrollment of fields, creating more and higher quality habitat. To maximize the number of high ranking fields enrolled in CRP, we suggest targeted solicitation of landowners for enrollment and increased financial incentives to landowners of high ranking fields. Landowners of high ranking fields may receive a signing incentive payment, practice incentive payment, or higher rental rates.

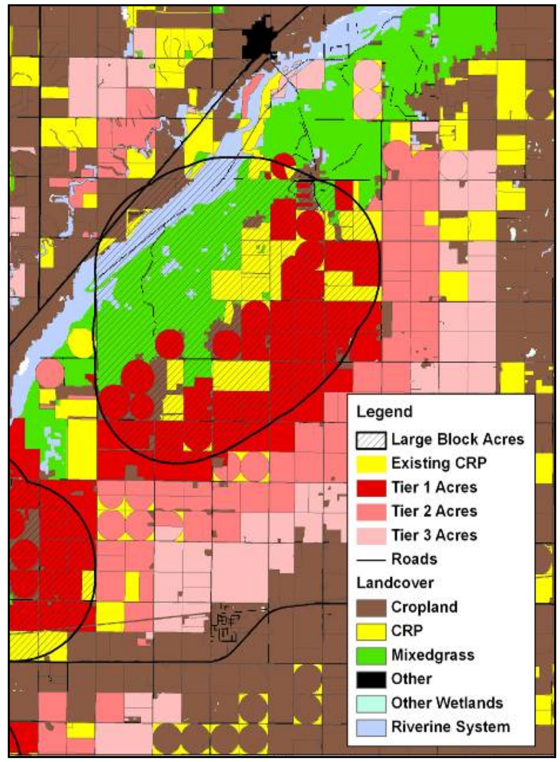


Figure 8. Map produced by a Decision Support Tool showing the rank (Tier 1 = highest priority (red), Tier 2 = medium priority (dark pink), Tier 3 = low priority (light pink)) of crop fields near existing large blocks of suitable Lesser Prairie-Chicken habitat.

Habitat condition of CRP is just as important as its location. If the vegetation composition or structure of CRP is unsuitable, its location is moot. CRP plantings should resemble the native plant communities in which they are imbedded and managed according to the habitat needs of the priority species. This means planting diverse mixtures of native plants, including grasses, forbs, and shrubs that are adapted to particular soil types within the region. Proper stand development may require application of specific maintenance activities such as weed control or re-seeding to encourage full emergence of the planting. It may also require prescribing management activities to achieve more specific desired vegetation structure and composition such as prescribed grazing, haying, or burning.

Strategic CRP delivery will increase conservation benefits to the species that need them the most and will save substantial conservation dollars by using them more effectively. The current opportunistic approach of CRP delivery has certainly provided considerable benefit to many wildlife species, including grassland birds; however, the potential impact of a more targeted approach to CRP and wildlife conservation is tremendous. This CEAP project has shown clear benefit of CRP to several priority mixed-grass prairie bird species. We believe these benefits could be even greater if CRP were delivered in a more strategic approach.

Assumptions and Limitations

Population Goals and Carrying Capacity Estimates

Population goals and carrying capacities presented in this report are estimates and do not reflect a true census of any bird species, and thus, should be viewed with caution. These estimates reflect the potential capacity of the landscape to support bird populations based on the best available spatial landcover and species-to-habitat densities. Furthermore, the species-to-habitat densities used in this analysis are based on bird count data rather than nesting success/density; therefore, carrying capacity represents species occurrence not recruitment. Data on species recruitment is generally very sparse relative to occurrence data and, thus, were not incorporated into our analysis. While the carrying capacities presented in this project must be viewed with caution, the *percent* of the current carrying capacity which CRP holds for each species listed can be viewed with greater confidence because density information has been tied to each specific habitat type found within the region.

Density Data

Density data were gathered through an exhaustive literature search; however, because this analysis considers several habitats simultaneously (and so required several habitat-specific density estimates for a single species) it was sometimes necessary to apply density estimates from multiple sources to a single species. This lack of consistency among density estimates, resulting from various methods authors used in calculating density, can cause discrepancy when comparing habitats. A strong effort was made to identify outliers in the density data to reduce such problems. Furthermore, density data are almost exclusively available for the breeding season so this analysis is limited to those species occurring in BCR19 during the breeding season and its results (i.e., carrying capacity) applied only to the breeding season.

Trend Data

Population goals were derived, in part, from species trend data from the U.S. Geological Survey (USGS) Breeding Bird Survey (BBS). The BBS is a long-term (30+ years) national bird survey from which trend data are calculated for individual species (Sauer et al. 2006). See <http://www.mbr-pwrc.usgs.gov/bbs/trend/tf06.html> for an explanation of the methods used to calculate trends and limitations of BBS data. Using BBS trends to determine population goals may results in goals that are greater than the ability of the current landscape to deliver. This could happen for several reasons: 1) habitat acreages have changed over the last thirty years because of habitat change or conversion, 2) current GIS landcover data do not accurately reflect the true landscape, or 3) factors outside of the breeding range may be affecting trend. For those species where a trend-based population goal required more than doubling the estimated current carrying capacity, the population goal was capped at doubling.

Landcover Data

Carrying capacities presented in this report are based on habitat acres as depicted in a regional (BCR19) landcover developed by PLJV. The landcover is a combination of multiple state-based and regional coverages (see *Step 1* in Methods) reclassified to single classification system to create a continuous landcover across state boundaries. All spatial landcover layers have inherent error so the habitat acres we used in estimating carrying capacity can only be considered estimates themselves. Currently, there is no accuracy assessment for the landcover layer; however, accuracy levels of the source data used in creating it are available in "Habitat Assessment Procedures Technical Companion Document to the PLJV Implementation Planning Guide" (Playa Lakes Joint Venture 2007).

Not all habitat Conditions are spatially explicit (i.e., not mapped) so acres for these Conditions were derived from statistics (e.g., the National Agricultural Statistics Service provided statistics of crop type acres) or assumed based on expert opinion (e.g., 25% of the mixed grass prairie has 'many shrubs' and 'high grass'). The *Range Factors* applied to acres of habitat Associations and Conditions are based on estimated species' range boundaries which have some inherent error as ranges can be dynamic (i.e., change over time, with weather). The *Suitability Factor* is based out of literature or expert opinion. The *Large Block Factors* are based on calculations from spatial models that were developed with criteria based from scientific literature and expert opinion (e.g., Interstate Lesser Prairie-Chicken Working Group).

LITERATRUE CITED

Allen, A. W. 1994. Regional and state perspectives on Conservation Reserve Program contributions to wildlife habitat, report prepared for the Habitat Protection Committee of the International Association of Fish and Wildlife Agencies. Fort Collins, Mid-continent Ecological Science Center, National Biological Survey, Federal Aid in Wildlife Restoration Report.

Andrews, R., and R. Righter. 1992. Colorado birds: a reference to their distribution and habitat. Denver Museum of Natural History, Denver, Colorado, USA.

Best, L.B., H. Campa III, K.E. Kemp, R.J. Robel, M.R. Ryan, J.A. Savidge, H.P. Weeks Jr., and S.R. Winterstein. 1997. Bird abundance and nesting in CRP fields and cropland in the Midwest: a regional approach. Wildlife Society Bulletin 25:864-877.

Brennan, L. A. and W. P. Kuvlesky Jr. 2005. North American grassland birds: An unfolding conservation crisis? Journal of Wildlife Management 69:1-13.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Busby. W. H., and J. L. Zimmerman. 2001. Kansas Breeding Bird Atlas. University Press of Kansas, Lawrence, Kansas, USA.

Crawford, J. A., and E. G. Bolen. 1976. Effects of land use on Lesser Prairie Chickens in Texas. Journal of Wildlife Management 40: 96–104.

Cunningham, M. A. 2005. A Comparison of public lands and farmlands for grassland bird conservation. The Professional Geographer 57:51-65.

Cunningham, M. A. and D. H. Johnson. 2006. Proximate and landscape factors influence grassland bird distributions. Ecological Applications 16:1062-1075.

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, and B. R. Euliss. 2001a (revised). Effects of management practices on grassland birds: Swainson's Hawk. Northern Prairie Wildlife Research Center, Jamestown, ND.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 2001a (revised). Effects of management practices on grassland birds: Short-eared Owl. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 2002a (revised). Effects of management practices on grassland birds:

Upland Sandpiper. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, A. L. Zimmerman, and B.R. Euliss. 2002b. Effects of management practices on grassland birds: Dickcissel. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman, and B.R. Euliss. 2002c. Effects of management practices on grassland birds: Grasshopper Sparrow. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, A. L. Zimmerman, and B. R. Euliss. 2002d (revised). Effects of management practices on grassland birds: Lark Bunting. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Dinan, J., and P. A. Johnsgard. 2004. Habitat associations for Nebraska bird species. Unpublished spreadsheet.

Dobbs, R.C. 2007. A review of distribution, habitat use, and population density data in the Hierarchical All Bird Strategy (HABS) Database. Playa Lakes Joint Venture, Lafayette, Colorado, USA.

Dunning, J.B., Jr., R.K. Bowers, Jr., S.J. Suter, and C.E. Bock. 1999. Cassin's Sparrow (*Aimophila cassinii*). No. 471 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*). No. 265 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Faanes, C.A. and G.R. Lingle. 1995. Breeding birds of the Platte River of Nebraska. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Fields, T. L. 2004. Breeding season habitat use of Conservation Reserve Program (CRP) land by Lesser Prairie-Chickens in west central Kansas. M.Sc., Colorado State University, Fort Collins, Colorado, USA.

Gamble, L. R., and T. M. Bergin. 1996. Western Kingbird (*Tyrannus verticalis*). No. 227 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Giesen, K. M. 1994. Movements and nesting habitat of Lesser Prairie-Chicken hens in Colorado. Southwest Naturalist 39: 96-98.

Giudice, J. H., and J. T. Ratti. 2001. Ring-necked Pheasant (*Phasianus colchicus*). No. 572 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

Hagan, C. A. 2005. Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*). *In* The Birds of North America Online (A. Poole, Ed.). Cornell Laboratory of Ornithology, Ithaca, NY; Retrieved from The Birds of North American Online database.

Helzer, C. J. 1996. The effects of wet meadow fragmentation on grassland birds. M.S. thesis. University of Nebraska, Lincoln, Nebraska, USA.

Helzer, C. J., and D. E. Jelinski. 1999. The relative importance of patch area and perimeter-area ratio to grassland breeding birds. Ecological Applications 9:1448-1458.

Herkert, J. R. 1991a. An ecological study of the breeding birds of grassland habitats within Illinois. Ph.D. dissertation. University of Illinois, Urbana, Illinois, USA.

Herkert, J. R. 1991b. Study suggests increases in restored prairie fragments to conserve breeding bird communities. Restoration and Management Notes 9:107.

Herkert, J. R. 1994. The effects of habitat fragmentation of Midwestern grassland bird communities. Ecological Applications 4:461-471.

Holt, D. W., and S. M. Leasure. 2006. Short-eared Owl (*Asio flammeus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/062doi:bna.62.

Hull, S. D. 2002 (revised). Effects of management practices on grassland birds: Eastern Meadowlark. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Houston, C. S., and D. E. Bowen, Jr. 2001. Upland Sandpiper (*Bartramia longicauda*). No. 580 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

Jackson, A. S., and R. DeArment. 1963. The Lesser Prairie Chicken in the Texas Panhandle. Journal of Wildlife Management 27: 733–737.

Johnson, D.H., and L.D. Igl. 1995. Contributions of the Conservation Reserve Program to populations of breeding birds in North Dakota: Wilson Bulletin 107:.709-718.

Johnson, D. H. and L. D. Igl. 2001. Area requirements of grassland birds: A regional perspective. Auk 118:24–34.

Johnson, D. H., L. D. Igl, and J. A. Dechant Shaffer. 2004. Effects of management practices on grassland birds. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.
perspective. Auk 118:24–34.

Johnson, D.H. and S. A. Temple. 1986. Assessing habitat quality for nesting birds in fragmented tallgrass prairies *in* Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin, Madison, Wisconsin, USA.

Kamler, J. F., W. B. Ballard, E. B. Fish, P.R. Lemons, K. Mote, and C.C. Perchellet. 2003. Habitat use, home ranges, and survival of swift foxes in fragmented landscape: conservation implication. Journal of Mammalogy 84:989-995.

Kamler, J. F., W. B. Ballard, P. R. Lemons, R. L. Gillard, and K. Mote. 2005. Home range and habitat use of coyotes in an area of native prairie, farmland, and CRP fields. American Midland Naturalist 153:394-404.

King, J.W. and J.A. Savidge. 1995. Effects of the Conservation Reserve Program on wildlife in southeast Nebraska. Wildlife Society Bulletin 23:377-385.

Kingery, H. E. (ed.) 1998. Colorado breeding bird atlas. Colorado Bird Atlas Partnership, Denver, Colorado, USA.

Klute, D.S., and R.J. Robel. 1997. Will conversion of Conservation Reserve Program (CRP) lands to pasture be detrimental for grassland birds in Kansas? American Midland naturalist 137: 206-212.

Knick, S. T, and J. T. Rotenberry. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. Conservation Biology 9:1059-1071.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul ,R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC, USA.

Lanyon, W. E. 1995. Eastern Meadowlark (*Sturnella magna*). No. 160 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

McIntyre, N. E. and T. R. Thompson. 2003. A comparison of Conservation Reserve Program habitat plantings with respect to arthropod prey for grassland birds. American Midland Naturalist 150:291-301.

Milchunas, D. G., Lauenroth, W. K., and Burke, I.C. 1998. Livestock grazing: animal and plant biodiversity of shortgrass prairie steppe and the relationship to ecosystem function. Oikos 83:65-74.

Mollhoff, W. J. 2001. The Nebraska breeding bird atlas, 1984-1989. Nebraska Game and Parks Commission, Lincoln, Nebraska, USA.

Nolte, K. R. and T. E. Fulbright. 1996. Nesting ecology of Scissor-tailed Flycatchers in south Texas. Wilson Bulletin 108: 302–316.

O'Connor, R. J. M. T. Jones, R. B. Boone, and T. B. Lauber. 1999. Linking continental climate and land use patterns with grassland bird distribution across the conterminous United States. Studies in Avian Biology 19:35-59.

Olendorff, R. R. 1973. The ecology of the nesting birds of prey of northeastern Colorado. U.S. International Biological Program Technical Report 211.

Playa Lakes Joint Venture. 2007. Habitat assessment procedures technical companion document to the PLJV Implementation Planning Guide. Playa Lakes Joint Venture, Lafayette, Colorado, USA.

Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, San Diego, California, USA.

Regosin, Jonathan V. 1998. Scissor-tailed Flycatcher (*Tyrannus forficatus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/342doi:bna.342.

Reinking, D. L. (ed.) 2004. Oklahoma breeding bird atlas. University of Oklahoma Press, Norman, Oklahoma, USA.

Reynolds, R.E., T.L. Shaffer, R.W. Renner, W.E. Newton, and B.D.J. Batt. 2001. Impact of the Conservation Reserve Program on duck recruitment in the U.S. Prairie Pothole Region. Journal of Wildlife Management 65:765-780.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology, Ithaca, New York, USA.

Riley, T. Z., C. A. Davis, M. Ortiz, and M. J. Wisdom. 1992. Vegetative characteristics of successful and unsuccessful nests of Lesser Prairie Chickens. Journal of Wildlife Management 56: 383–387.

Rodgers, R.D. 1999. Why haven't pheasant populations in western Kansas increased with CRP? Wildlife Society Bulletin 27:654-665.

Rotenberry, J.T., and J.A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. Ecology 61:1228-1250.

Ruth, J.M. 2000. Cassin's Sparrow (*Aimophila cassinii*) status assessment and conservation plan. Biological Technical Publication BTP-R6002-1999. U.S. Department of the Interior, Fish and Wildlife Service, Denver, Colorado, USA.

Samson, F. and F. Knopf. 1994. Prairie Conservation in North America. BioScience 44: 418-421.

Samson, F. B., Knopf, F.L., and Ostlie, W.R. 2004. Great Plains ecosystems: Past, present, and future. Wildlife Society Bulletin 32:6-15.

Sauer, J. R., J. E. Hines, and J. Fallon. 2006. The North American Breeding Bird Survey, Results and Analysis 1966 - 2006. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD, USA.

Schemnitz, S. D. 1994. Scaled Quail (*Callipepla squamata*). No. 106 *in* The Birds of North America (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Schroeder, M. A., and C. E. Braun 1991. Seasonal movement and habitat use by Greater Prairie-Chickens in northeastern Colorado. Colorado Division of Wildlife, Spec. Report 68, Denver, Colorado, USA.

Seyffert, K. D. 2001. Birds of the Texas panhandle: their status, distribution, and history. Texas A & M University Press, College Station, Texas, USA.

Sparks, R. A., D. J. Hanni, and M. McLachlan. 2005. Section-based monitoring of breeding birds within the Shortgrass Prairie Bird Conservation Region (BCR 18). Rocky Mountain Bird Observatory, Brighton, Colorado, USA.

Sutton, G. M. 1967. Oklahoma birds: their ecology and distribution, with comments on the avifauna of the southern Great Plains. University of Oklahoma Press, Norman, Oklahoma, USA.

Svedarsky, W. D., J. D. Toepfer, R. L. Westemeier, and R. J. Robel. 2003. Effects of management practices on prairie birds: Greater Prairie-Chicken. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA.

Taylor, M. A., and F. S. Guthery. 1980. Status, ecology, and management of the Lesser Prairie Chicken. U.S. Dep. Agric. Forest Service Gen. Tech. Rep. RM-77, Rocky Mountain Forest and Range Experimental Station, Fort Collins, Colorado, USA.

Thompson, M. C., and C. Ely. 1989. Birds in Kansas, Vol. 1. Museum of Natural History, University of Kansas. Lawrence, Kansas, USA.

Thompson, M. C., and C. Ely. 1992. Birds in Kansas, Vol. 2. Museum of Natural History, University of Kansas, Lawrence, Kansas, USA.

Temple, S. A. 2002. Dickcissel (*Spiza americana*). No. 703 *in* The Birds of North America (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

U.S. Department of Agriculture Farm Service Agency. 2004a. Conservation Reserve Program Fiscal year Summary 2003. U. S. Department of Agriculture Farm Service Agency.

U.S. Department of Agriculture Farm Service Agency. 2004b. Fact Sheet: Conservation Reserve Program Haying and Grazing of Acreage. Farm Service Agency Online, www.fsa.usda.gov/pas/publications/facts/haygraze04.htm.

Vickery, P. D. 1994. Effects of habitat area of the distribution of grassland birds in Maine. Conservation Biology 8:1087-1097.

World Wildlife Fund Canada. 1988. Prairie Conservation Action Plan. World Wildlife Fund Canada, Toronto, Ontario, Canada.

APPENDIX A

Comprehensive list of bird species that breed in the mixed-grass prairie Bird Conservation Region (BCR19), indicating priority species and species included in analysis for this project. To be included in analysis, a species must be a priority species that occurs in Conservation Reserve Program (CRP) land and/or cropland. Priority species are defined as those breeding species which meet one of the following sets of criteria: 1) species is a Partners in Flight (PIF) species of Continental Concern (CC) needing BCR-level management action (MA), immediate action (IM), or critical action (CR), 2) species has PIF status of CC, Regional Concern (RC), Continental Stewardship (CS), or Regional Stewardship (RS) and has both a declining population trend and >10% of its population occurs in the mixed-grass and shortgrass prairie BCRs combined (according to PIF population estimation database), 3) species is a CS or RS species that occupies a habitat not occupied by any species fitting the previous criteria, 4) species for which management work is being conducted, or 5) species is a high priority bird under the U.S. Shorebird Conservation Plan (Brown et al. 2001) which are best dealt with under riparian or grassland planning. See the Notes column for additional information on why some species were or were not included in this analysis (USSCP = U.S. Shorebird Conservation Plan Regional priority).

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Priority Species Included in Analysis											
Cassin's Sparrow		1			MA	-3.6	31.83%	1	1	1	
Dickcissel	1	1	1	1	MA	0.4	31.44%	1	1	1	
Eastern Meadowlark		1		1	MA	-1.1	11.38%	1	1	1	
Grasshopper Sparrow		1	1	1	MA	-1.4	41.46%	1	1	1	
Greater Prairie-Chicken	1	1	1	1	MA	-15	83.28%	1	1	1	
Lark Bunting		1			IM	-5.3	34.37%	1	1	1	
Lesser Prairie-Chicken	1	1	1	1	IM		100%	1	1	1	
Northern Bobwhite				1	PR	-0.1	26.85%	1	1	1	Intensive habitat work conducted
Swainson's Hawk	1	1			MA	-4	29.73%	1	1	1	
Ring-necked Pheasant						0.1	35.01%	1	1	1	Intensive habitat work conducted
Upland Sandpiper						2.1	18.73%	1	1	1	USSCP
Western Kingbird						-2.4	38.46%	1	1	1	

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Priority Species NOT Included in Analysis that Use CRP and/or Cropland											
Henslow's Sparrow	1	1			MA	50.8	2.70%	1	1		Density data unavailable
Lark Sparrow						-2.5	36.21%	1	1		CRP/cropland density data conflicting
Loggerhead Shrike		1			IM	-3.9	18.43%	1	1		Dependent upon non-CRP/crop features
Mississippi Kite		1	1	1	MA	-2.9	71.39%	1	1		Dependent upon non-CRP/crop features
Scaled Quail						-6.3	26.51%	1	1		Limited range in BCR 19
Scissor-tailed Flycatcher		1			MA	-2.3	29.75%	1	1		Dependent upon non-CRP/crop features
Sharp-tailed Grouse		1				1	3.70%	1	1		Limited range in CRP areas of NE
Priority Species NOT Included in Analysis that do NOT Use CRP and/or Cropland											
Baltimore Oriole		1		1	MA	-1.1	15.17%	1			
Bell's Vireo	1	1			IM	-3.9	9.55%	1			
Bewick's Wren						-1.1	13.20%	1			
Black-capped Vireo	1	1			CR		26.48%	1			
Brown Thrasher				1	PR	-3.4	13.85%	1			
Bullock's Oriole		1			MA	-3.8	15.98%	1			
Ferruginous Hawk		1			MA	-3.7	18.21%	1			
Long-billed Curlew							14.24%	1			USSCP – no CRP/crop use in PLJV area
Painted Bunting	1	1			MA	1.5	13.71%	1			
Piping Plover							3.82%	1			USSCP
Red-headed Woodpecker	1			1	PR	-0.3	21.00%	1			
Snowy Plover							16.48%	1			USSCP

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Other Species Occurring in BCR19 During Breeding Season											
American Avocet							0.00%				
American Bittern							0.03%				
American Coot							1.17%				
American Kestrel						6.2	2.74%				
American Redstart						0.1	0.02%				
American Robin						-1	1.08%				
American White Pelican							0.66%				
American Wigeon											
Baird's Sandpiper											
Bald Eagle						-5.8	0.00%				
Barn Swallow						-0.1	6.15%				
Barn Owl		1			MA	0.8	2.40%				
Barred Owl						-0.1	0.53%				
Black Rail							0.34%				
Black Tern							0.30%				
Black Vulture						1	0.23%				
Black-and-white Warbler						-3.7	0.00%				
Black-billed Cuckoo						0.6	1.30%				
Black-chinned Hummingbird						0	4.70%				
Black-crowned Night-Heron							3.49%				
Black-headed Grosbeak						-5.8	0.36%				
Black-necked Stilt							0.74%				
Black-throated Sparrow						-0.9	0.05%				

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Blue Grosbeak						4.5	4.20%				
Blue-winged Teal											
Bobolink						-23.1	0.91%				
Brown-headed Cowbird						2.6	8.05%				
Burrowing Owl						2.3	2.39%				
Cactus Wren						6.1	0.74%				
Canada Goose											
Canvasback							0.10%				
Canyon Towhee						-1.3	4.72%				
Canyon Wren						1.2	0.48%				
Carolina Chickadee						-1.1	2.04%				
Cattle Egret							2.35%				
Cedar Waxwing						-37.3	0.11%				
Chihuahuan Raven						-14.8	3.42%				
Chipping Sparrow						-3.5	0.09%				
Clark's Grebe							0.00%				
Common Grackle						-0.3	6.75%				
Common Moorhen							0.10%				
Common Nighthawk						2.2	13.72%				
Common Poorwill						-0.9	2.33%				
Common Raven						-4.2	0.00%				
Common Yellowthroat						2.7	0.94%				
Cooper's Hawk						-15	1.42%				
Double-crested Cormorant							0.22%				

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Eared Grebe							0.01%				
Eastern Kingbird				1	PR	1	13.28%				
Eastern Screech-Owl						0.4	9.79%				
Eastern Towhee						5.7	0.11%				
Eurasian Collared-Dove											
European Starling						-3.9	3.22%				
Field Sparrow		1			MA	-17	5.97%				
Forster's Tern							1.11%				
Gadwall											
Gray Catbird						-2	0.87%				
Gray Partridge						-8.9	0.04%				
Great Blue Heron							5.90%				
Great Crested Flycatcher						0.6	3.49%				
Great Egret							0.15%				
Greater Roadrunner						1.3	10.60%				
Great-tailed Grackle						2.9	10.26%				
Green Heron							2.64%				
Green-winged Teal							0.10%				
Harris's Hawk						-6.7	0.24%				
Hooded Merganser							0.10%				
House Finch						-2.7	0.95%				
House Sparrow						-4.6	24.11%				
Inca Dove						0.4	1.14%				
Indigo Bunting						-4.9	0.42%				

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Killdeer							3.22%				
King Rail							1.00%				
Lazuli Bunting						-9	0.02%				
Least Bittern							0.08%				
Least Tern							31.00%				
Lesser Goldfinch						-10.6	0.60%				
Lesser Scaup							0.01%				
Little Blue Heron							1.68%				
Long-billed Dowitcher							0.00%				
Louisiana Waterthrush						-4.2	0.16%				
Mallard											
Mourning Dove						1.4	12.37%				
Neotropic Cormorant							0.10%				
Northern Cardinal						5.9	3.21%				
Northern Harrier		1			IM	0.9	4.75%				
Northern Mockingbird						5.5	6.49%				
Northern Pintail							0.10%				
Northern Shoveler							0.10%				
Ovenbird						1.9	0.02%				
Peregrine Falcon						6.1	0.02%				
Pied-billed Grebe							1.00%				
Prairie Falcon						-4.5	0.11%				
Prothonotary Warbler						-2.5	0.03%				
Pyrrhuloxia						0.4	1.32%				

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Redhead							0.10%				
Red-shouldered Hawk						-3.7	0.14%				
Red-tailed Hawk						0.4	21.07%				
Red-winged Blackbird						-3.3	5.43%				
Ring-billed Gull											
Rock Pigeon						2.5	7.92%				
Rock Wren						-2	0.01%				
Rose-breasted Grosbeak						1.1	0.18%				
Ruddy Duck							0.10%				
Rufous-crowned Sparrow		1			MA	7.2	7.91%				
Savannah Sparrow						0.3	0.00%				
Say's Phoebe						1.7	1.48%				
Scott's Oriole		1			MA	11	1.70%				
Sharp-shinned Hawk						-1.5	0.68%				
Short-eared Owl	1				PR		0.95%				
Snowy Egret							0.77%				
Song Sparrow						1.4	0.03%				
Spotted Sandpiper							0.00%				
Spotted Towhee						1	0.38%				
Stilt Sandpiper											
Summer Tanager						1.2	0.29%				
Trumpeter Swan											
Turkey Vulture						5.7	2.29%				
Vermilion Flycatcher						2	1.70%				

Species	PIF CC	PIF RC	PIF CS	PIF RS	PIF Action	BBS Trend	BBS % Breeding Pop. in BCR18 & 19	BCR19 Priority Spp.	Uses CRP/ Crop	Analyzed	Notes
Vesper Sparrow						-1.3	0.09%				
Western Grebe							0.00%				
Western Meadowlark		1		1	MA	9.1	28.22%				
White-faced Ibis							0.74%				
White-rumped Sandpiper							0.00%				
White-winged Dove						-11.2	0.01%				
Wild Turkey						-3	11.30%				
Willet											
Willow Flycatcher	1				PR	-0.9	0.30%				
Wilson's Phalarope											
Wilson's Snipe											
Wood Duck											
Wood Thrush						2.6	0.01%				
Yellow Warbler						-2.5	0.32%				
Yellow-billed Cuckoo		1			MA	1.4	8.88%				
Yellow-breasted Chat						0.4	0.04%				
Yellow-crowned Night-Heron											
Yellow-headed Blackbird						14.7	1.74%				