United States Department of Agriculture
Natural Resources Conservation Service

CEAP Conservation Insight
Conservation Effects Assessment Project

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USDA Conservation Program Contributions to Lesser Prairie-Chicken Conservation in the Context of Projected Climate Change

Summary Findings

Due to dramatic population decline throughout its southern Great Plains range, the lesser prairie-chicken is a candidate for protection under the Federal Endangered Species Act. In response, USDA and other conservation partners are working to restore and protect grassland habitat to benefit the species.

Climate change and dynamic vegetation models were used to project future climate and grassland habitat conditions in the Playa Lakes Joint Venture (PLJV) region, including the current range of the lesser prairie-chicken.

The climate change models predicted that temperatures will increase by approximately 3°C (5°F) and that precipitation will decrease by approximately 32 mm/yr (1.3 in/yr) by 2060. The greatest changes in both temperature and precipitation will occur in the northern portion of the lesser prairie-chicken range, where the largest segment of the current population exists.

The vegetation model predicted a decline in above-ground vegetation across most of the region, suggesting that grassland plant communities will become less productive (i.e., shorter and sparser) by 2060. Such changes in grassland condition could result in less suitable habitat for the lesser prairie-chicken, potentially causing a population decline.

A landscape-scale geospatial analysis showed that spatially and ecologically targeting 10 percent of the land enrolled in the Conservation Reserve Program and planted in long-term conserving cover to benefit the lesser prairie-chicken could offset a projected 1- to 2-percent climate change-induced population decline.

Targeted delivery of USDA conservation programs that establish grassland habitat can help offset potential climate-induced changes to lesser prairie-chickens. Climate and vegetation models can be used to maximize offsets by providing insight as to where and what kind of changes are most likely to occur.

Ecological systems within the Southern Great Plains have evolved to cope with a dynamic climate of drought and wet periods, as have the lesser prairie-chicken and other grassland birds of the region. Key factors influencing abundance, distribution, and vital rates of grassland bird species are changes in food resources (insects, seeds), habitat patch size, and vegetation structure (height of herbaceous layer; presence, height, and structure of shrubs or trees) (Rotenberry and Wiens 1980, Kantrud and Kologiski 1982, Peterjohn 2003, Chapman et al. 2004). These factors are influenced by weather and disturbance events such as wildfire. Population trends and distribution of individual species have been linked to moisture and temperature conditions (Kantrud and Kologiski 1982, Niemuth et al. 2008).

There is mounting concern among stakeholders regarding the continued decline of the lesser prairie-chicken, including the potential implications of its listing as a Federal threatened or endangered species. Climate change appears to be yet another source of habitat degradation because of potential changes in vegetation structure and composition. Stakeholders are looking to conserve the lesser prairie-chicken in its agriculture-dominated landscape.

Two previous Conservation Effects Assessment Project (CEAP) assessments conducted by the Playa Lakes Joint Venture (PLJV) indicated that efforts that establish long-term resource-conserving cover contribute to lesser prairie-chicken conservation in two ways: (1) by providing suitable grassland habitat when retired land is planted to ecologically appropriate native species, and (2) by linking existing patches of grass to form large blocks of suitable habitat out of otherwise fragmented habitat patches. According to the spatial habitat analysis, lands in long-term resource conserving cover increase the carrying capacity of the landscape for the lesser prairie-chicken by as much as 30 percent in the shortgrass prairie portion of its current range (Bird Conservation Region [BCR] 18—McLachlan and Carter 2009) and by nearly 10 percent in the central mixed-grass region portion of its range (BCR 19—McLachlan and Rustay 2007), illustrating the high value of resource conserving cover as an effective conservation tool for the lesser prairie-chicken.

However, these previous analyses were based on assessing the current landscape without regard for potential vegetation changes due to climate change. Climate change scenarios predict that average temperatures will increase while precipitation will decrease in the southern portions of the Southern Great Plains and increase in the northern portions. Changes in temperature and precipita-

NRCS Photo: Gary Kramer

tion are predicted to affect vegetation composition. Changes in vegetation could have significant effects on grassland birds, including the lesser prairie-chicken, which may have to relocate to areas with suitable habitat to survive.

This assessment seeks to answer the following questions:

- How might grassland habitat in the PLJV region change under projected future climate conditions?
- What effects may these projected habitat changes have on the lesser prairie-chicken?
- To what extent can USDA conservation programs mitigate any negative effects of climate change through establishment of grassland vegetation?

Partnership for evaluation

In 2007, a partnership was formed among the PLJV, Natural Resources Conservation Service (NRCS), and Farm Service Agency (FSA) to conduct an evaluation of the effects of lands enrolled in the Conservation Reserve Program (CRP) on priority grassland birds. Land enrolled in the CRP serves as a proxy for any land in long-term conserving cover. In 2007 and 2009, PLJV completed two assessments—evaluations of the effects of the CRP on priority birds in the mixed-grass prairie and on priority birds in the shortgrass prairie. (Final reports and CEAP Conservation Insights for those assessments are available on the CEAP Web site (http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap).

In 2009, PLJV, in collaboration with The Nature Conservancy, designed a third CEAP assessment to evaluate the ability of established grass in CRP to offset potential negative impacts of climate change on the lesser prairie-chicken, a bird species of high conservation concern. This Conservation Insight provides a brief synopsis of the climate change assessment. Full details including modeling assumptions and relevant references are available from the full PLJV final project report available at http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1041603.pdf.

Assessment approach

PLJV used climate change and dynamic vegetation models to assess potential impacts of climate change on grassland habitat in the lesser prairie-chicken range. They then evaluated the ability of long-term conserving cover established through USDA conservation programs to offset any potential negative impacts. The PLJV region is congruent with the shortgrass and mixed-grass prairie (BCRs 18 and 19) and encompasses the current range of the lesser prairie-chicken (fig. 1). The PLJV region spans over 160 million acres of gently sloping terrain made up of prairie, wetlands, croplands, woodlands, urban areas, reservoirs, and streams in portions of six Great Plains States. Shortgrass prairie is dominated by blue grama and buffalo grass interspersed with small amounts of tallgrass species in the east (e.g., little bluestem, Indian grass). Mixed-grass prairie vegetation is a mix of shortgrass prairie species and tallgrass prairie species. Common shrub species occurring across the PLJV region are sand sagebrush and sand shinnery oak. Historically, this region was dominated by native prairie but now is dominated by cropland, which makes up over 40 percent of its total land cover.

Data analysis consisted of four major steps:

1. Use climate models to assess changes in temperature and precipitation from 2000 to 2060—The first step was to assess historical (2000) and future (2060) climate conditions in the PLJV region, including the current lesser prairie-chicken range. PLJV obtained Atmosphere-Ocean General Circulation Model (AOGCM) projections of historical and future climate from the World Climate Research Programme. PLJV evaluated the historical runs from each AOGCM projection and selected the Hadley Model because it simulated the major influences on the Southern Great Plains (BCRs 18 & 19) better than the other available models. Climate change data were derived using the high-emissions scenario (A2) because current reports indicate that Earth's emissions trajectory is more consistent with the higher CO_2 emissions scenario than with lower emissions scenarios.

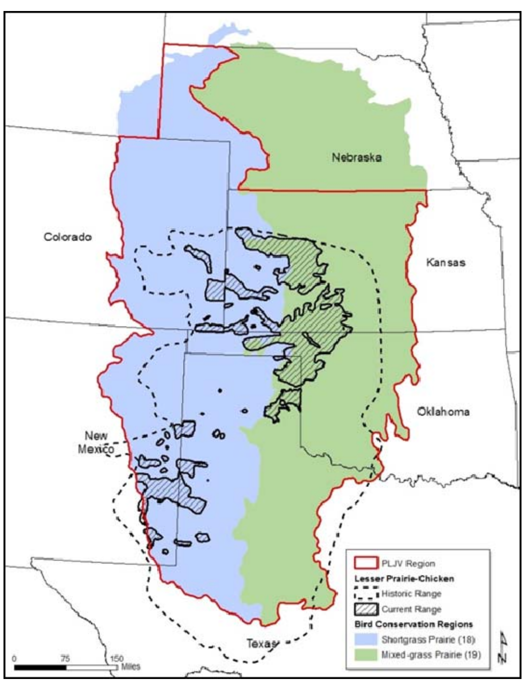


Figure 1. Boundaries of the Playa Lakes Joint Venture, Shortgrass Prairie and Central Mixed-Grass Prairie Bird Conservation Regions (BCRs 18 and 19), and the historic and current range of the lesser prairie-chicken.

2. Use dynamic vegetation models to assess historical (2000) and future (2060) above-ground vegetation carbon levels and relate them to grassland condition—The second step was to use the derived climate data to estimate historical (2000) and project future (2060) grassland conditions using the MC1 dynamic vegetation model. The MC1 dynamic vegetation model (Bachelet et al. 2001) projects the amount of above-ground carbon in a plant community given a certain set of processes (e.g., disturbance, such as fire; variation in precipitation; temperature extremes). By changing the magnitude of a process—more extreme temperatures, for example, or more extreme precipitation events—differences in above-ground carbon values can be projected. Changes in above-ground carbon values can be related to changes in plant community structure (e.g., community dominated by grasses or shrubs) and productivity (e.g., height of grass). Changes in plant community or productivity can have beneficial or detrimental impacts on bird species that have historically used the area as breeding, brood rearing, migrating and wintering habitat.

3. Estimate lesser prairie-chicken carrying capacity and potential declines resulting from predicted climate-induced vegetation changes—The third step was to estimate the current lesser prairie-chicken carrying capacity (the ability of land to support lesser prairie-chickens expressed in number of birds) and project changes in this capacity related to climate change. To do this, PLJV used its spatial landcover layer in concert with the HABS database (see box at right). Carrying capacity estimates were calculated separately for each State portion of each BCR because bird-to-habitat densities as well as bird population goals are most appropriately related at this spatial scale. For example, the Kansas portions of BCRs 18 and 19 were analyzed individually.

4. Assess the potential of USDA programs to offset declines in lesser prairie-chicken carrying capacity based on possible future enrollment scenarios—The fourth and final step was to assess the ability of land enrolled in long-term conservation cover to offset the potential declines in lesser prairie-chicken carrying capacity associated with climate change. To do this, PLJV examined a range of future USDA program enrollment scenarios, assuming that some portion of future enrollments would be 'targeted' for lesser prairie-chicken conservation—meaning that the long-term conserving cover would occur in large block configuration (near large patches of native habitat) and plantings would be appropriate for the lesser prairie-chicken (a mix of native grasses, forbs, and possibly shrubs).

To gauge how much program enrollment could feasibly be targeted for the lesser prairie-chicken, PLJV used the current CRP enrollment rates (the portion of cropland currently enrolled in the CRP) as a surrogate, assuming that current participation would reflect future participation in USDA conservation cover activities. For each BCR-state area, PLJV calculated the "local CRP" enrollment rate within the lesser prairie-chicken range portion of that BCR-state area.

PLJV then used the BCR state-specific lesser prairie-chicken density data for CRP land planted to native species (contained in the HABS database) to calculate how much lesser prairie-chicken carrying capacity could be provided by targeting 10, 20, 30, 40, 50, and 75 percent of local CRP acres. These future carrying capacities were considered offsets of potential declines caused by climate change.

Use of the Hierarchical All Bird System (HABS)

The 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 manner 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 during the breeding season on CRP lands planted to native grass in the Kansas portion of BCR 18.

Results

Projected temperature and precipitation changes—Annual average temperatures are predicted to increase in the PLJV region and within the current lesser prairie-chicken range. Projected temperature increases range geographically in the PLJV region from approximately 2.6° to 3.1° C above historical (2000) average temperatures by 2060. The greatest increase is projected in the northern portion of the lesser prairie-chicken range (in Colorado, Kansas, Oklahoma, and the northeast Panhandle of Texas; fig. 2). This area of the lesser prairie-chicken range contains the majority of the current population.

Precipitation in the PLJV region is predicted to decrease by approximately 32 mm/yr (1.3 in/yr) compared to historical (2000) precipitation. The greatest decrease is expected in the northern portion of the lesser prairie-chicken range (fig. 3).

Projected vegetation change under future climate conditions—The MC1 vegetation model projected that above-ground carbon will decline throughout much of the PLJV region and the lesser prairie-chicken range over the 60-year projection, indicating a decrease in vegetation biomass in grassland habitat. Reductions of 13 percent (3 g/m^2) throughout the PLJV region and of 18 percent (5g/m^2) in the current lesser prairie-chicken range are projected. Overall, 84 percent of the PLJV region and 99 percent of the lesser prairie-chicken range are projected to have reduced above-ground carbon by 2060.

The maps in figure 4 illustrate the spatial distribution of historical and future estimated above-ground carbon levels, showing projected geographic shifts over 60 years. The MC1 model predicted an eastward shift in vegetation carbon levels such that carbon levels historically occurring in the shortgrass prairie BCR shift east into the mixed-grass prairie BCR in 60 years. Likewise, new lower carbon levels are projected for much of eastern Colorado, including the western reach of the current lesser prairie-chicken range.

Potential for USDA programs to buffer effects of climate change—Participation in USDA programs that establish long-term conserving cover vary by Sate and BCR within the study area, ranging from 16 percent of cropland in BCR19-KS to 33 percent in BCR18-TX. Across the study area, about 22 percent (3.9 million acres) of cropland was enrolled in one USDA program (CRP) prior to 2009 contract expirations.

The HABS-estimated current lesser prairie-chicken carrying capacity of the study area is about 49,600 birds. In each of the States within the study area, most (>96 percent) of the carrying capacity for the species is provided by native habitats in large block formation except for the BCR18 and BCR19 portions of Kansas, where CRP provides 47 percent and 20 percent of the carrying capacities, respectively. This disparity occurs because CRP grass plantings in Kansas (where native grasses were planted) provide suitable habitat, unlike in all other States in the lesser prairie-chicken range.

Redistributing the acreage enrolled in CRP, and retaining high-priority expiring CRP contracts in grass cover through other USDA conservation programs (e.g., NRCS Lesser Prairie-Chicken Initiative conservation activities), to focus on creating and maintaining large blocks of grassland habitat has the potential to offset lesser prairie-chicken population declines associated with projected climate change. For every 10-percent increase in targeted long-term conserving cover, a 1- to 2-percent decline in lesser prairie-chicken carrying capacity due to climate change (about 1,000 birds) could be offset (table 1). Likewise, targeting 20 percent of lands enrolled in programs generating long-term conservation cover could offset a 3- to 4-percent climate change-induced decline in lesser prairie-chicken carrying capacity (about 1,800 birds). This scenario would require about 500,000 acres of long-term con-

Figure 2. Projected change in average annual temperature (degrees Celsius and Fahrenheit) from 2000 to 2060 in the Playa Lakes Joint Venture region and current lesser prairie-chicken range.

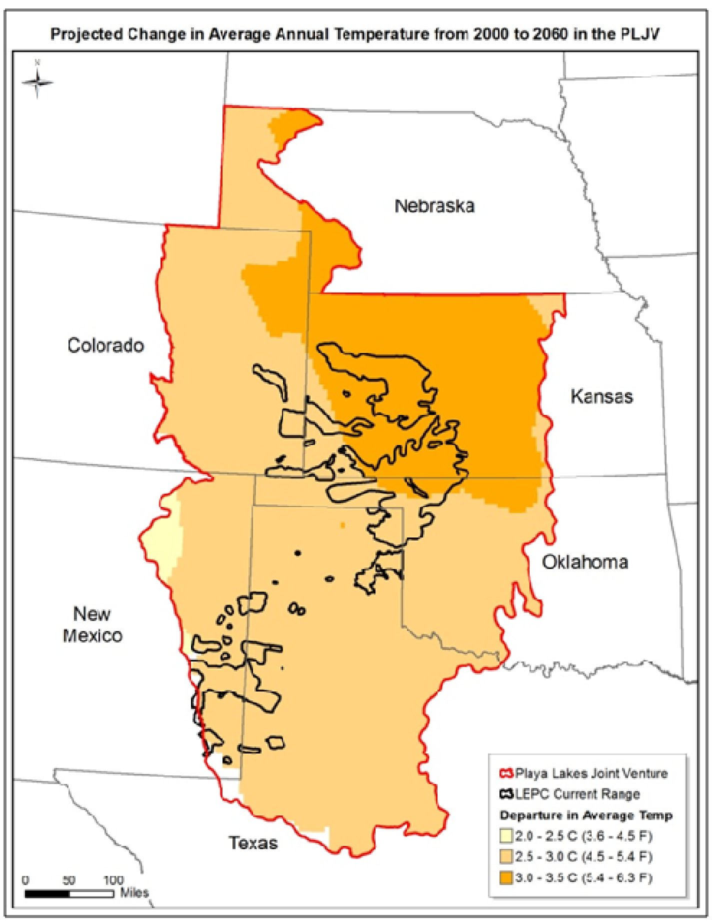
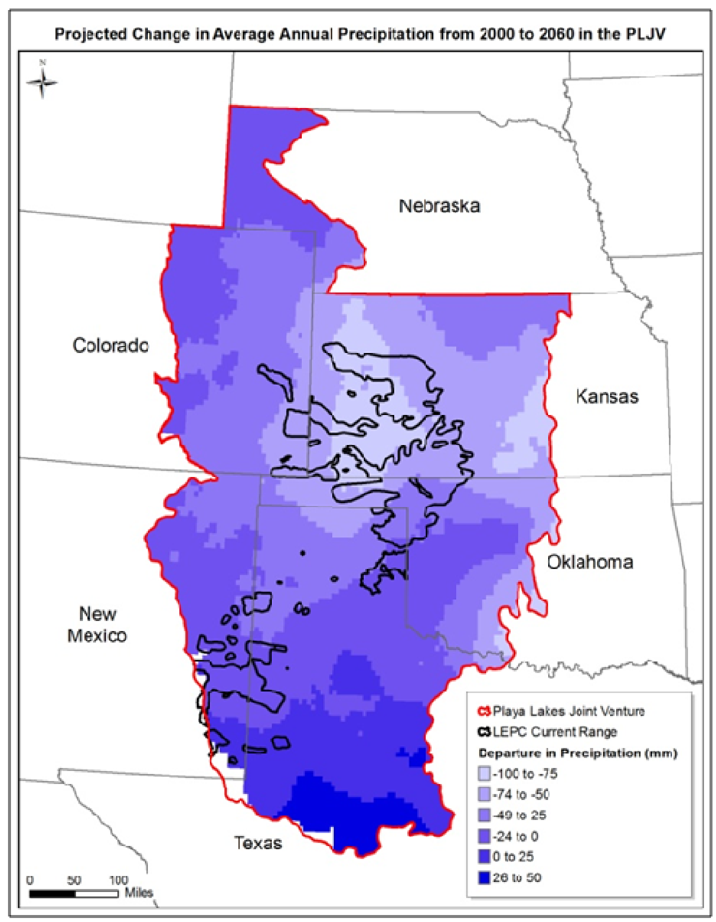


Figure 3. Projected change in annual precipitation (mm) from 2000 to 2060 in the Playa Lakes Joint Venture region and current lesser prairie-chicken range.



serving cover to be targeted throughout all States in the lesser prairie-chicken range except Kansas (where nearly 786,000 acres are currently targeted)—a total of 1,286,000 acres of targeted grass cover establishment.

PLJV's estimates of potential offsets in decline of lesser prairie-chicken carrying capacity caused by targeted land in long-term conserving cover include only the direct impact of the land retirement as 'new' habitat; it does not incorporate any increases in lesser prairie-chicken carrying capacity that occur as newly retired acres turn previously fragmented native habitat patches into large blocks. In such cases, the landscape's lesser prairie-chicken carrying capacity would increase further because the once-fragmented native habitat patches would now become suitable lesser prairie-chicken habitat. Therefore, potential offsets in decline could be greater in some areas depending on the opportunity to create new large grassland blocks on existing grass habitat adjacent to the targeted acres.

Population goals and carrying capacities presented in this report are estimates. They do not reflect a true census of lesser prairie-chickens 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 land cover 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.

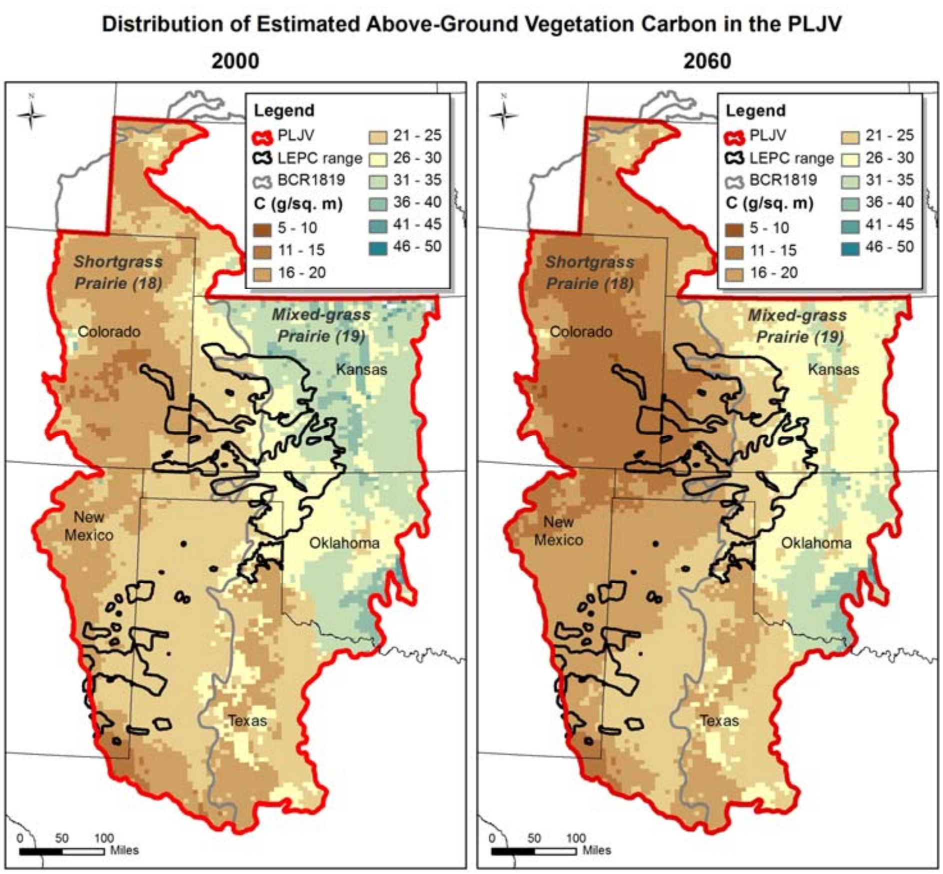
Putting findings into practice

Conservation managers are tasked with delivering and conserving habitat in an ever-changing environment. Decisions must be made not only with regard to today's needs but also with an eye toward the future.

This assessment estimates declines in grassland vegetation biomass in the Southern Great Plains over the 60-year projection, caused by projected changes in the region's climate. Overall, the region is projected to have less productive grasslands (i.e., lower-stature and/or sparser) compared with grassland conditions in 2000 (fig. 4). By mapping these projected shifts in grassland condition, areas where habitat changes may be most substantial and, thus, where impacts may be greatest on grassland-associated wildlife such as the lesser prairie-chicken, can be identified.

Shifts in vegetation condition will likely result in range shifts for many grassland bird species and other wildlife. Species will react differently to changing habitat conditions. For example, species associated with taller, denser grasses in the shortgrass prairie, such as grasshopper sparrows, may decline in the western portions of their range (where grass condition is predicted to become shorter and sparser) and increase or maintain populations in eastern portions of their range (where habitat conditions are predicted to remain more stable). Conversely, species that prefer relatively short and sparse grassland structure, such as mountain plovers, may expand their range to incorporate the projected shorter stature grasses in eastern Colorado and western Kansas. Species' range information, such as Breeding Bird Survey range maps, can be used in combination with projected vegetation maps to identify areas of relatively low and high risk for individual species. Resource managers can use these tools to identify low-risk, high-reward areas (e.g. regions where projected shifts in vegetation condition are low and species' density is high) for delivering effective and efficient habitat conservation. Alternatively, they can identify high-risk areas where

Figure 4. Spatial distribution of estimated above-ground vegetation carbon in 2000 versus 2060, based on the MC1 dynamic vegetation model. The chart shows the percent area of the PLJV by estimated carbon levels for both years (fit is a fifth-order polynomial trend line).



habitat conservation may be most vital, such as areas providing connectivity among populations.

Spatially explicit information on future landscape conditions, such as that provided through this assessment, can assist natural resource managers in making informed decisions regarding strategic conservation delivery such as where to target habitat management activities, Farm Bill program enrollment and incentives, and even land acquisition. This information is also useful for targeting new land retirements in other USDA programs (e.g., Environmental Quality Incentives Program and Wildlife Habitat Incentive Program special initiatives) to keep important existing habitat in grass cover. Two previous CEAP assessments by the PLJV have demonstrated the benefit of land in long-term conserving cover to a number of grassland species (McLachlan and Rustay 2007, McLachlan and Carter 2009). In this analysis, PLJV demonstrates how spatial targeting of program enrollments could offset potential population declines of the lesser prairie-chicken caused by projected climate change without increasing the total acres enrolled. This assessment can also inform conservation efforts of others working to maximize habitat conditions for lesser prairie-chickens and other priority grassland species in the future.

Decision support tools (DSTs) that evaluate grassland blocks, crop fields, and the habitat requirements of bird species (including spatial parameters) within the landscape context through a geographic information system are particularly useful. For example, PLJV developed and used a DST for this assessment to identify suitable habitat for lesser prairie-chickens. The DST evaluated CRP locations, acres, and conservation practices within the context of surrounding habitat. Other species requirements and priorities can be layered to maximize benefits for a suite of target species.

Figure 5 shows how this DST can rank crop fields into tiers of potential benefit to lesser prairie-chicken if converted to grass, considering adjacency to large blocks of native habitat, existing CRP fields, and major roads. Ranking CRP enrollments and crop fields according to potential benefit to birds allows strategic enrollment and re-enrollment of fields in CRP or other programs, creating more and higher quality habitat. Various incentives and outreach measures can be employed to encourage enrollment or re-enrollment of high-priority habitats in long-term resource-conserving cover through conservation programs.

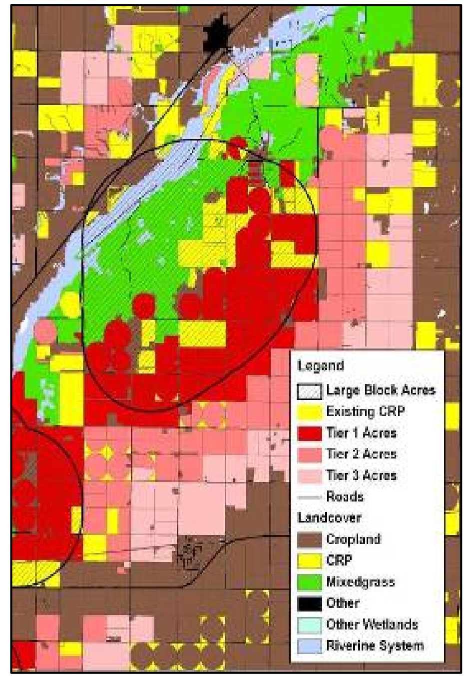


Figure 5. Map produced by a Decision Support Tool showing the rank (Tier 1 = highest priority [red], Tier 2 = medium priority [dark pink], Tier 3 = low priority [light pink]) of crop fields near existing large blocks of suitable lesser prairie-chicken habitat.

Table 1. Potential declines in lesser prairie-chicken carrying capacity due to climate change, potential offset in decline provided by varying levels of targeted CRP acres, and number of targeted CRP acres required for offsets. Targeted CRP acres are assumed to occur in Large Block configuration (near large tracts of native habitat) and planted to species appropriate to provide suitable lesser prairie-chicken habitat (native grasses, forbs, shrubs).

Potential climate change-induced decline in lesser prairie-chicken carrying capacity	Minimum targeted CRP acres required to offset decline	Potential offset in carrying capacity	Currently targeted CRP[c]	Additional targeted CRP required for offset	Total targeted CRP required for offset
Percent	*Percent of local CRP acres[a,b]*	*No. of birds*	*Acres*	*Acres*	*Acres*
1–2%	**10%**	811	785,890	249,440	1,035,330
3–4%	**20%**	1,803	785,890	498,880	1,284,770
5–6%	**30%**	2,795	785,890	748,320	1,534,211
7–8%	**40%**	3,787	785,890	997,760	1,783,651
9–10%	**50%**	4,779	785,890	1,247,201	2,033,091
20%	**75%**	11,338	785,890	2,197,181	2,983,071

[a] 'Local' refers to the amount of CRP that currently exists in the lesser prairie-chicken range.
[b] Future CRP acres assumed to be targeted (in Large Block formation and planted with native plant species).
[c] Current CRP acres in Large Block formation in Kansas are assumed to be currently targeted. Other States contain no targeted CRP acres because of dominance of non-native plantings.

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NRCS Photo: Gary Kramer

The Conservation Effects Assessment Project: Translating Science into Practice
The Conservation Effects Assessment Project (CEAP) is a multi-agency effort to build the science base for conservation. Project findings will help to guide USDA conservation policy and program development and help farmers and ranchers make informed conservation choices.

One of CEAP's objectives is to quantify the environmental benefits of conservation practices for reporting at the national and regional levels. Because fish and wildlife are affected by conservation actions taken on a variety of landscapes, the wildlife national assessment draws on and complements the national assessments for cropland, wetlands, and grazing lands. The wildlife national assessment works through numerous partnerships to support relevant studies and focuses on regional scientific priorities.

Primary investigators on this project were Megan McLachlan and Anne Bartuszevige of the Playa Lakes Joint Venture and Duane Pool of The Nature Conservancy. 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. It provides science-based guidance and decision-support tools for all-bird conservation throughout the region, as well as outreach, coordination, and financial support to its partners and local groups to conduct on-the-ground habitat conservation and restoration. The Nature Conservancy, founded in 1951, is the leading conservation organization working around the world to protect ecologically important lands and waters for nature and people. The Conservancy is working to address threats to conservation involving climate change, fire, fresh water, forests, invasive species, and marine ecosystems.

For more information: www.nrcs.usda.gov/technical/NRI/ceap/

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