Articles

Multiscale Habitat Selection of Lesser Prairie-Chickens in a Row-Crop and Conservation Reserve Program Land Matrix

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Abstract

The lesser prairie-chicken Tympanuchus pallidicinctus has received considerable attention in recent years, as a result of population decline and the uncertainty of its status under the 1973 U.S. Endangered Species Act. Substantial effort has been exerted studying the life history of the species and effects of some management practices on its ecology. However, information is lacking regarding lesser prairie-chicken use and selection of Conservation Reserve Program fields in the Southern High Plains of Texas. To fill in this knowledge gap, we assessed habitat selection by lesser prairie-chickens within Conservation Reserve Program fields, native grassland, and row-crop agriculture in Texas, 2015–2017. We assessed habitat selection using a Type II design at the second order of selection (home range placement within the landscape) and a Type III design at the third order (Global Positioning System locations within the home range). At the second order of selection, lesser prairie-chickens selected Conservation Reserve Program fields seeded in nonnative grasses ($w_i = 3.99$, 95% CI = 1.60–6.39) and native grasses and forbs ($w_i = 3.25$, 95% CI = 1.99–4.52) year-round. Row-crop agriculture ($w_i = 0.17$, 95% CI = 0.06–0.28) and native grassland ($w_i = 0.30$, 95% CI = 0.06–0.55) were avoided. Native grass Conservation Reserve Program fields were used in proportion to their availability ($w_i = 1.33$, 95% CI = 0.81–1.85) year-round. Only Conservation Reserve Program fields seeded in native grasses and forbs were selected at the third order of selection ($w_i = 1.32$, 95% CI = 1.16–1.47). Based on our results, Conservation Reserve Program fields provide habitat for lesser prairie-chickens, and as such, may be beneficial to persistence of the species on the High Plains of Texas.

Keywords: Conservation Reserve Program; habitat selection; lesser prairie-chicken; Texas; Tympanuchus pallidicinctus

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**Introduction**

The lesser prairie-chicken *Tympanuchus pallidicinctus* (hereafter, LEPC) occupies portions of Colorado, Kansas, New Mexico, Oklahoma, and Texas in the southwestern Great Plains of North America. The species’ occupied range has declined by an estimated 83% since the early 1900s, as a result of substantial habitat loss and degradation (Van Pelt et al. 2013). Factors contributing to habitat loss include conversion of native prairie to row-crop agriculture, energy development, invasive woody plant encroachment, and unmanaged grazing (Woodward et al. 2001; Hagen and Giesen 2005). Much of the habitat converted to row-crop agriculture was lost prior to the 1950s, but development of center-pivot irrigation in the 1960s allowed for the conversion of areas previously unsuitable for crop production (Spencer et al. 2017). Lesser prairie-chickens are now found in two geographically isolated populations in four habitat ecoregions. One population is located within the Sand Shinnery Oak *Quercus havardii* Prairie Ecoregion on the Southern High Plains of New Mexico and Texas. The other population is located in the Sand Sagebrush *Artemisia filifolia* Prairie Ecoregion in southeastern Colorado, southwestern Kansas, and the western Panhandle of Oklahoma; Mixed-Grass Prairie Ecoregion in south-central Kansas, southwestern Oklahoma, and northeastern Texas; and the Short-Grass Prairie Ecoregion in northwestern Kansas (Van Pelt et al. 2013). The CRP, administered by the U.S. Department of Agriculture (USDA) Farm Service Agency was initiated under the Federal Food Security Act (Farm Bill) of 1985, in an effort to reduce soil erosion and reduce production of commodity crops. Loss of habitat and recurrent drought have resulted in significant LEPC population declines (Hagen and Giesen 2005). Prominent droughts across the Southern Great Plains occurred during the 1930s, 1950s, and early 1990s, all contributing to LEPC declines (Sullivan et al. 2000). More recently, the drought of 2011–2013 had significant effects on LEPC populations, particularly in the Sand Shinnery Oak Prairie Ecoregion (McDonald et al. 2014). Aerial surveys flown in 2010 and 2011 indicated <2,000 LEPCs remained within both portions of the species’ range in Texas (Timmer et al. 2013). Range-wide, the estimated LEPC population was approximately 39,000 individuals in 2018, with the majority of individuals occurring in the Short-Grass Prairie and CRP Mosaic Ecoregion in Kansas (Nasman et al. 2018). As a result of significant range and population declines, the lesser prairie-chicken was listed as threatened under the 1973 U.S. Endangered Species Act (ESA 1973, as amended; U.S. Fish and Wildlife Service 2014) in May of 2014, but the listing ruling was vacated by judicial decision in September of 2015 (Van Pelt 2016).

Lesser prairie-chickens are found in prairies characterized by tall and midgrasses and small shrubs, which are often supported by sandy soils (Haukos and Zavaleta 2016). The traditional thought is LEPCs require large, unfragmented patches of prairie (4,900–20,236 ha) to sustain a population, mostly because of their seasonal habitat needs (Davis 2005; Haukos and Zavaleta 2016). Habitat requirements for LEPCs include open areas for male display, areas with a mixture of tall grasses and shrubs for nesting, grass and forb-dominated areas with overhead cover for brood-rearing, and grass- and shrub-dominated areas during autumn and winter (Taylor and Guthery 1980; Hagen et al. 2004). Grain fields are often utilized by LEPCs during the autumn and winter months (Haukos and Zavaleta 2016). Much of the current LEPC occupied range is fragmented and composed of intensive agriculture, native grasslands, and lands enrolled in CRP (Rodgers 2016). Lesser prairie-chickens have benefitted from the conversion of marginal croplands back to grasslands through CRP in portions of their range (Rodgers and Hoffman 2005). The LEPC range within Kansas expanded north of the Arkansas River as a result of the implementation of CRP (Rodgers and Hoffman 2005). Initial CRP fields in northwestern Kansas were seeded in native tall and midgrass species and provide nesting habitat in a matrix of short-grass prairie and cropland (Fields 2004). Conversely, much of the initial CRP enrollments in Texas and New Mexico were seeded in monocultures of nonnative grasses such as weeping lovegrass *Eragrostis curvula* (Rodgers and Hoffman 2005). The conventional thought has been these nonnative CRP fields offered minimal benefit for LEPCs in terms of food and cover (Sullivan et al. 2000; Rodgers and Hoffman 2005). However, the 1996 Farm Bill (Federal Agriculture Improvement and Reform Act 1996) required farmers reenrolling CRP contracts to reseed 51% of their CRP land with native grass mixes. As a result, wildlife conservation became another purpose of CRP, in addition to reducing soil erosion. The Texas Parks & Wildlife Department documented slight range expansions of LEPCs into northern Cochran and Bailey counties in the Sand Shinnery Oak Prairie Ecoregion in response to CRP, but populations continued to decline in the area throughout the 1990s (Sullivan et al. 2000). In 2008, CRP fields were further improved for wildlife with the implementation of the State Acres for Wildlife Enhancement (SAFE, USDA 2008). The purpose of SAFE was to restore habitat for high-priority wildlife species on a state and regional basis. The goal of SAFE in the Texas Panhandle was to provide 78,400 acres (31,727.35 ha) of native mixed-grass prairie to benefit LEPCs.
Lesser prairie-chickens are known to inhabit CRP fields in the Sand Shinnery Oak Prairie Ecoregion and are part of a larger metapopulation across the Southern High Plains of Texas and eastern New Mexico (Oyler-McCance et al. 2016). However, information is lacking regarding LEPC selection of CRP fields in context of their availability on the landscape in this ecoregion. The objective of our study was to examine LEPC selection among row-crop agriculture, native grassland, and different CRP enrollment types. We hypothesized LEPCs would select CRP fields seeded in native grasses and forbs over CRP fields seeded in nonnative grasses and row-crop agricultural fields (Fields 2004; Rodgers and Hoffman 2005).

Study Site

This study took place on private lands in Bailey and Cochran counties within the Southern High Plains of Texas (33°52’N, 102°58’W; Figure 1). The landscape within the study area was heterogeneous as a result of extensive conversion of native prairie to row-crop agriculture (Tables S1 and S2, Supplemental Material). Cotton and grain sorghum were the primary crops produced, using both center-pivot irrigation and dryland farming techniques. Beef cattle production was also present in the area but to a lesser extent than crop production. Native prairie within the study area was characterized by short-grass vegetation communities. Mesquite Prosopis glandulosa, buffalo grass Bouteloua dactyloides, blue grama B. gracilis, sideoats grama B. curtipendula, sand dropseed Sporobolus cryptandrus, narrow-leaf yucca glauca, western ragweed Ambrosia psilostachya, and broom snakeweed Gutierrezia sarothrae were common plant species within shortgrass prairie.

We focused our study efforts within CRP fields, which were interspersed across the landscape. The CRP fields consisted of four common contract types: 1) fields planted in nonnative grasses, particularly weeping lovegrass and old world bluestems Bothriochloa spp. (CP1), 2) fields planted in native grass species such as yellow indiangrass Sorghastrum nutans, little bluestem Schizachyrium scoparium, switchgrass Panicum virgatum, green sprangletop Leptochloa dubia, sideoats grama, and blue grama (CP2), 3) fields that were first seeded in nonnative grasses and then later seeded in natives (CP10), and 4) fields enrolled in SAFE. In addition to native grasses, forbs such as alfalfa Medicago spp., Maximillian sunflower Helianthus maximiliani, Illinois bundleflower Desmanthus illinoensis, and other natives were seeded in strips across fields enrolled in SAFE (M. Samaniego, USDA Farm Service Agency, personal communication).

The soils on the study area were primarily Amarillo and Arvada series (Girdner 1963). The soils within the Amarillo series are deep, medium- to coarse-textured, and have a reddish-brown subsoil. The Arvana series consists of shallow to moderately deep soils that are reddish-brown in color and moderately coarse textured. Arvada soils differ from Amarillo soils in having rock-like caliche (aggregated calcium carbonate) within 91.4 cm of the soil surface (Girdner 1963). The Southern High Plains is characterized by a very warm and dry climate. Annual rainfall averaged 42 cm (West Texas Mesonet 2019). Most precipitation events occurred during the summer months, with June being the wettest month on average. January was the coldest month with an average temperature of 2°C, and July was the warmest month with an average temperature of 25°C (West Texas Mesonet 2019).

Methods

Capture and relocation

We captured LEPCs on seven leks (i.e., communal breeding grounds) during the spring breeding season in 2015, 2016, and 2017. Leks were distinct areas where males congregated, defended territories, and displayed for females. We used walk-in funnel traps (Haukos et al. 1990), magnetic drop nets (Wildlife Capture Services, Flagstaff, AZ), tension drop nets (Silvy et al. 1990), and rocket nets (Haukos et al. 1990) for capture. We took standard morphological measurements on all individuals captured, including mass (g), tarsus length (mm), wing cord length (mm), and pinnae length (mm). We assessed sex by presence of eye comb and pinnae length, where males had a bright yellow eye comb and noticeably longer pinnae than females (Copelin 1963). We used plumage characteristics to assess age. Individuals with white spots within 2.54 cm of the tips of the outer two primary feathers were recorded as juveniles, and individuals lacking these spots were recorded as adults (Copelin 1963). We banded each bird with a Texas Parks and Wildlife aluminum leg band. The main goal of our research was to assess female reproductive ecology, so we equipped each female with a 22-g Satellite Platform Transmitting Terminal Global Positioning System (GPS) transmitter (PTT, Microwave Telemetry, Columbia, MD). We attached PTTs using the figure-8 rump method (Bedrosian and Craighead 2007). We deployed PTTs on males only after peak female attendance at leks during mid-April. Satellite PTT data consisted of 4 GPS locations/day, with fixes taking place at 0100, 0700, 1300, and 1700 hours Central Standard Time. We downloaded GPS data from the ARGOS website weekly. All methods were approved under Texas Tech University Animal Care and Use Protocol #14073-10.

Habitat selection

We developed a land-cover layer for our study area by using ArcGIS 10.2 (Environmental Systems Research Institute, Redlands, CA) to merge a Cropscape land-cover layer (National Agricultural Statistics Service, U.S. Department of Agriculture) with a 2014 CRP layer representing all properties enrolled in CRP across the LEC’s range. We clipped the resulting layer to Bailey and Cochran counties and grouped land-cover classes into five groups for the analysis. The final classes for the analysis were 1) Native Grass and Forb CRP, 2) Native Grass CRP, 3) Nonnative CRP, 4) Row-Crop Agriculture, and 5) Native Grassland. We characterized the native grassland category by native short-grass prairie.
Figure 1. Study area in the Sand Shinnery Oak Prairie Ecoregion of the lesser prairie-chicken *Tympanuchus pallidicinctus* range, Bailey and Cochran counties, Texas, 2015–2017.
Second order. We used selection ratios (Manly et al. 2002) to assess LEPC breeding season (March–August) habitat selection for 2015–2017 and nonbreeding season (September–February) habitat selection for 2015 and 2016. We evaluated male and female habitat selection separately for the breeding season and pooled sexes during the nonbreeding season. Sexes were separated during the breeding season as a result of different habitat needs between males and females (e.g., nesting and brood-rearing habitat for females vs. lekking habitat for males). We assessed habitat selection at the second order using a Type II design, where available habitat was evaluated at the population level and used habitat was evaluated at the individual level (Johnson 1980; Erickson et al. 2001). To quantify available habitat at the second order of selection, we generated a 4.8-km buffer around each lek and clipped the land-cover layer to each buffer using ArcGIS. We chose a 4.8-km buffer because LEPCs in general spend the majority of their lives within this distance from a lek (Haukos and Zavaleta 2016). We then calculated the proportion of the three CRP enrollments, row-crop agriculture, and native grassland within the buffer.

To quantify used habitat at the second order, we estimated breeding and nonbreeding season utilization distributions for each PTT-marked bird using the Brownian Bridge Movement Model (Horne et al. 2007). The Brownian Bridge Movement Model takes into account starting and ending locations and the time elapsed between them, as well as the speed or mobility of the animal (Horne et al. 2007). The model is well suited for situations in which there are large quantities of relocations that may be autocorrelated spatially and temporally but not independently (Walter et al. 2011). We calculated utilization distributions using the adehabitatHR package (Calenge 2006) in Program R (R Version 3.1.2, www.r-project.org, accessed December 2018). We generated the 95% isopleth for each Brownian Bridge Movement Model utilization distribution in Program R and imported it into ArcGIS as a shapefile for the habitat selection analysis. We then calculated the proportion of the five cover types within each 95% home range. We then compared habitat composition within the home range with habitat composition within the 4.8-km buffer for the second order analysis.

Third order. We assessed habitat selection at the third order using a Type III design, where both available habitat and used habitat were evaluated at the individual level (Johnson 1980; Erickson et al. 2001). Selection ratios were also used for the third order analysis. Similar to the second order analysis, sexes were separated during the breeding season and pooled during the nonbreeding season. We considered the proportion of the five cover classes within the 95% home range as available habitat in the third order analysis. To calculate used habitat at the third order of selection, we overlaid each individual's PTT locations over the land-cover layer and determined the proportion of locations within each class. We only used one lekking location for males and one nesting location for females. We then compared the proportion of points within each land-cover class with the habitat composition of the home range for the third order analysis.

We calculated a mean selection ratio, standard error, and 95% confidence interval for each land-cover class using the adehabitatHS package (Calenge 2006) in R. We also calculated a standardized selection ratio for each cover class by dividing the mean selection ratio by the sum of all mean selection ratios. If the confidence interval around a selection ratio overlapped one, then we considered the associated land-cover class to be used in proportion to its availability. If the upper value of the confidence interval was <1, then we considered the cover class to be avoided. If the lower value of the confidence interval was >1, then we considered the cover class to be selected by LEPCs. We acknowledge that not every land-cover type was used, even if it was considered available based on spatial scales and design within the study area. Within the guidelines of traditional habitat terminology, we did not consider land cover that was not used, regardless of availability, to be LEPC habitat (Hall et al. 1997). Therefore, we defined habitat as land-cover types that were selected for in proportion, or in greater proportion, to their availability for each spatial scale and design levels.

Results

Capture

We captured 35 LEPCs and deployed PTTs on 25 individuals from 2015 to 2017. We deployed 19 PTTs on males, and deployed 6 on females. Eleven of the PTT-marked males were adults, and eight were subadults. Five of the PTT-marked females were subadults, and one female was an adult. We estimated 22 home ranges for male LEPCs and 6 home ranges for female LEPCs during the breeding season, and 11 home ranges (9 males and 2 females) for the nonbreeding season.

Habitat selection

Second order. All but three LEPCs remained within 4.8 km of their lek of capture for the duration of the study. One female moved 55 km from her lek of capture into sand shinnery oak prairie in central Yoakum County, Texas, after brood loss (Figure S1, Supplemental Material). A second female captured in Cochran County moved 6 km to nest in sand shinnery oak prairie in eastern New Mexico. A third female moved 7 km from her lek of capture in Bailey County after brood loss. We evaluated habitat selection for these three individuals from the time of capture to dispersal.

There was evidence of selection for nonnative grass CRP and native grass and forb CRP by both sexes during the breeding season (Table 1). For males, the mean selection ratio for nonnative CRP was 3.99 (95% CI = 1.60–6.39), and the mean selection ratio for native grass
Table 1. Summary of design II, second-order habitat selection for lesser prairie-chickens *Tympanuchus pallidicinctus* during the breeding and nonbreeding seasons in Bailey and Cochran counties, Texas, 2015–2017.

<table>
<thead>
<tr>
<th>Season</th>
<th>Habitat</th>
<th>( \hat{w}_i )</th>
<th>Lower</th>
<th>Upper</th>
<th>( B_i )</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male breeding</td>
<td>Row-crops</td>
<td>0.17</td>
<td>0.06</td>
<td>0.28</td>
<td>0.02</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Native grassland</td>
<td>0.30</td>
<td>0.06</td>
<td>0.55</td>
<td>0.03</td>
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<td></td>
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<td></td>
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<td>1.85</td>
<td>0.15</td>
<td>o</td>
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<tr>
<td></td>
<td>Grass and forb CRP</td>
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<td>1.99</td>
<td>4.52</td>
<td>0.36</td>
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<tr>
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<td>0.00</td>
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<tr>
<td></td>
<td>Native grassland</td>
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<td>0.00</td>
<td>0.53</td>
<td>0.02</td>
<td>–</td>
</tr>
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<td>Nonnative CRP</td>
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<td>9.35</td>
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<td></td>
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<td>1.66</td>
<td>0.08</td>
<td>o</td>
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<td></td>
<td>Grass and forb CRP</td>
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<td>1.47</td>
<td>7.20</td>
<td>0.36</td>
<td>+</td>
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<td>0.03</td>
<td>0.47</td>
<td>0.02</td>
<td>–</td>
</tr>
<tr>
<td></td>
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<td>0.00</td>
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<td>1.87</td>
<td>3.83</td>
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</tr>
</tbody>
</table>

CRP = Conservation Reserve Program; ‘+’ = selection by prairie-chickens; ‘−’ = avoidance by prairie-chickens; ‘o’ = selection by prairie-chickens in proportion to availability.

* a Average selection ratio.

* b Weighted selection ratio.

Table 1. Summary of design II, second-order habitat selection for lesser prairie-chickens *Tympanuchus pallidicinctus* during the breeding and nonbreeding seasons in Bailey and Cochran counties, Texas, 2015–2017.

and forb CRP was 3.25 (95% CI = 1.99–4.52). For females, the mean selection ratio for nonnative CRP was 6.37 (95% CI = 3.39–9.35), and the mean selection ratio for native grass and forb CRP was 4.34 (95% CI = 1.47–7.20). During the nonbreeding season, the mean selection ratio for nonnative CRP was 5.58 (95% CI = 3.51–7.66), and the mean ratio for native grass and forb CRP was 2.86 (95% CI = 1.88–3.83). Row-crop agriculture and native grassland were avoided during the breeding and nonbreeding seasons, and native grass CRP was used in proportion to its availability (Table 1).

**Discussion**

The main goal of our study was to assess LEPC selection of CRP fields in Texas, given their availability on the landscape. Based on our findings, CRP fields were selected as habitat by LEPCs in the study area. This finding contradicts other recent research in the Sand Shinnery Oak Prairie Ecoregion. In eastern New Mexico, LEPCs used CRP fields in lower proportion than they were available on the landscape (second order selection, Meyers 2016). However, LEPCs in that study area had native shinnery oak prairie available, and the vast majority of the CRP fields were CP1 fields seeded in weeping lovegrass (Meyers 2016). Native prairie in our study area was shortgrass prairie, and many of the CRP fields had been improved by planting native grass and forb species.

The selection for nonnative CRP in the study area at the second order of selection is contradictory to our hypothesis that LEPCs would not select nonnative grass CRP. Monocultures of nonnative grasses constituted the main type of CRP planted during the first 10 y of the program (1986–1995) in Texas. There was no documentation of significant range expansion or population increases for LEPCs in Texas after the seeding of these initial CRP fields (Sullivan et al. 2000). The one nonnative CRP field where our study efforts took place was 532 ha and bordered by large expanses of cotton and sorghum fields to the north and south. We hypothesize that LEPCs showed selection for the field because it constituted only 11% of the landscape (Tables S1 and S2, Supplementary Material) and was the only available, large tract of grassland within a landscape consisting mainly of cultivated crops and smaller CRP fields. Our results suggest nonnative CRP was selected by LEPCs year-round, but interestingly, the probability of adult survival decreased as the proportion of nonnative CRP within the home range increased (Harryman 2017). Also, only one of two LEPC nests found within nonnative CRP was successful, and the brood was lost within 3 d posthatch (Harryman 2017). Combined, these results indicate nonnative CRP fields may constitute an ecological trap for LEPCs because they offer perceived value for daily activities of LEPCs, but ultimately lack the necessary
vegetative structure and cover to protect LEPCs from predators and the elements (see Hagen et al. 2013).

Lesser prairie-chickens in our study area selected native grass and forb CRP fields at two scales of selection during the breeding and nonbreeding seasons, which is consistent with our hypothesis. We observed selection by both sexes, and the probable driver for the selection of this CRP type was structural heterogeneity and abundant food resources, both resulting from diverse seeding mixes (Hagen et al. 2004, 2013). In addition, breeding season survival increased as the proportion of native grass and forb CRP within the home range increased (Harryman 2017). Although native grass and forb CRP fields were selected over native grass fields throughout the course of a year, native grass CRP fields still have benefits for LEPCs. We found five leks on a tract of property that had both native grass and forb and native grass CRP fields present, and three of the leks were located within the native grass field. In addition, three of four nests monitored on the property were located within the native grass field. Fields (2004) recommended seeding CRP fields in alternating strips of native grasses and native forbs, thereby providing habitat for nesting and brood-rearing. Planting CRP fields in this manner, and implementing midcontract management practices within the native forb strips, may provide a mosaic of habitat at finer spatial scales.

Lesser prairie-chickens in our study area used agricultural fields and short-grass prairie in proportion to their availability at the third order of selection. We acknowledge that LEPCs used these cover types for the duration of the study. Lesser prairie-chickens used row-crop agriculture and short-grass prairie in proportion to its availability only on an individual basis (Type III design). Our location data suggest that most relocations within crop fields were foraging events; there were generally only 1–2 locations/d within cropland, with the rest located within CRP fields. At the second order of selection (i.e., Type II design, population level), LEPCs avoided row-crop agriculture and short-grass prairie and selected CRP. Evidence suggests that CRP fields increase LEPC occupancy on a relatively small scale (Hagen et al. 2016). In northwestern Kansas, LEPC occupancy increased when the percentage of CRP land within 7.5 × 7.5-km grids (56 km²) exceeded 20%. On a larger scale (15 × 15-km grids, 225 km²), LEPC occupancy was more a function of native grassland patch size and the percentage of land enrolled in prescribed grazing (Hagen et al. 2016). As such, retaining and enhancing native shinnery oak prairie may have the most benefit for LEPCs at the ecoregion scale, while CRP fields provide additional habitat at local scales (Hagen et al. 2016; Meyers 2016).

Lesser prairie-chickens typically spend the majority of their lives within 4.8 km of a single lek or lek complex (Borsdorf 2013; Haukos and Zavaleta 2016). However, long-distance movements outside this 4.8 km threshold are recently discovered, via use of PTTs, to be a component of the species’ ecology. Dispersal movements up to 71 km in length have been recorded by LEPCs in Kansas (Earl et al. 2016). Habitat loss and fragmentation are a major concern for the species, due to subsequent population declines and reduced gene flow. However, long-range movements suggest the potential for greater connectivity between populations than previously thought (Earl et al. 2016). The long-distance movements we recorded suggest connectivity exists for LEPCs in our study area and individuals in sand shinnery oak prairie in southern Cochran and Yoakum counties, Texas, and eastern New Mexico. Movement of LEPCs out of CRP into sand shinnery oak prairie, and genetic evidence presented in Oyler-McCance et al. (2016), indicate the two groups constitute one population of LEPCs across the Southern High Plains of Texas.
and eastern New Mexico. Therefore, CRP fields may provide additional habitat for LEPCs throughout the Sand Shinnery Oak Prairie Ecoregion and not just on the study area in Bailey and Cochran counties.

We realize the limitation of a small sample size in this study. However, LEPC abundance within the Sand Shinnery Oak Prairie Ecoregion is lower compared with the Mixed-Grass Prairie and Short-Grass Prairie and CRP Mosaic ecoregions in the northern portion of the species’ range. The estimated 2018 population was 5,812 individuals in sand shinnery oak prairie, compared with 7,028 individuals in the Mixed-Grass Prairie Ecoregion and 22,714 individuals in the Short-Grass Prairie and CRP Mosaic Ecoregion (Nasman et al. 2018). Also, we hypothesize that LEPCs in our study area constitute a small portion of the sand shinnery oak population because of the limited space available within CRP fields. Despite a small sample size, our results show CRP fields provide habitat for LEPCs year-round in the Sand Shinnery Oak Prairie Ecoregion in Texas.

Management Implications

The Conservation Reserve Program can be used strategically to complement LEPC management and conservation efforts in the Sand Shinnery Oak Prairie Ecoregion in Texas. Conservation Reserve Program fields in the study area provide habitat for LEPCs throughout the year. The CRP fields in the study area are interspersed throughout a row-crop-dominated landscape, and strategically placing new CRP tracts adjacent to fields already occupied by LEPCs will increase grassland patch size. New CRP tracts may also reduce landscape fragmentation and serve to connect LEPCs in the study area to individuals within surrounding sand shinnery oak prairie. Finally, our results suggest re-enrolling or keeping CRP fields in grasses after contract expiration will help to ensure long-term conservation benefits for LEPCs.

Supplemental Material

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Figure S1. Female lesser prairie-chicken *Tympanuchus pallidicinctus* movements from the Cochran County, Texas study area south into Yoakum County, Texas. The long-distance movement was undertaken by a single female on 31 May 2016 after total brood loss.

Table S1. Use data for individual lesser prairie-chickens *Tympanuchus pallidicinctus* in Bailey and Cochran counties, Texas during the breeding season (1 March–31 August, 2015–2017). We defined percent landscape as the five land cover classes used within a 4.8 km buffer around the individual’s lek of capture. We defined percent home range as the five cover classes used within the individual’s 95% home range. We defined percent points as the percent of the relocation points within each cover class.

Table S2. Use data for individual lesser prairie-chickens *Tympanuchus pallidicinctus* in Bailey and Cochran counties, Texas during the non-breeding season (1 September–28 February, 2015–2016). We defined percent landscape as the five land cover classes used within a 4.8 km buffer around the individual’s lek of capture. We defined percent home range as the five cover classes used within the individual’s 95% home range. We defined percent points as the percent of the relocation points within each cover class.


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