CHAPTER FOURTEEN

Grasslands of Western Kansas, North of the Arkansas River*

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Abstract. Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) occur in short-grass and mixed-grass prairies and associated grasslands restored through the Conservation Reserve Program (CRP) north of the Arkansas River in Kansas. The Short-Grass Prairie/CRP Mosaic Ecoregion currently supports ~65% of the range-wide population of Lesser Prairie-Chickens. CRP lands provide important grassland habitats, especially nesting and brood-rearing areas for breeding Lesser Prairie-Chickens. A combination of implementation of CRP grasslands at a landscape scale and favorable environmental conditions is thought to have led to a significant increase in the occupied range and population density of Lesser Prairie-Chickens in the ecoregion. Spring lek surveys since 1999 have documented the northern expansion of the observed distribution of Lesser Prairie-Chickens in 2008, 2011, and 2012. An expanding distribution has led to the development of a contact zone of sympatry between Lesser Prairie-Chickens and Greater Prairie-Chickens (*T. cupido*). Hybridization between the two congeneric species has been documented and is currently estimated to occur at a rate of ~5%. The potential effects of hybridization on the genetic structure of Lesser Prairie-Chickens are poorly understood. Conservation of Lesser Prairie-Chickens in the region will be best accomplished by maintaining current habitat and provide management tools, guidelines, etc. and implement, recommend management practices, such as grazing, prescribed fire, herbicide application, and prairie restoration, to improve habitat quality at smaller spatial scales. The ecoregion has been only recently occupied by substantial numbers of Lesser Prairie-Chickens, and new data are needed to develop conservation and management plans. Current knowledge gaps include information on population demographics, limiting factors, habitat use and seasonal movements at various scales, habitat management techniques, energy development impacts, and climate change. Additionally, improved land use policies are needed for long-term protection of habitat within the region, beyond the typical duration of 10–15 years for CRP contracts. If conservation goals are met, the ecoregion north of the Arkansas River in Kansas could continue to remain a stronghold for the Lesser Prairie-Chicken in the future.

Key Words: Conservation Reserve Program, habitat management, hybrid, Kansas, Short-Grass Prairie/CRP Mosaic Ecoregion, sympatric range, *Tympanuchus pallidicinctus*.

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The Short-Grass Prairie/Conservation Reserve Program (CRP) Mosaic Ecoregion lies on the eastern extent of the short-grass prairie and the transition to mixed-grass prairie in western Kansas, north of the Arkansas River (Figure 14.1). The short-grass prairie is unique to the western edge of the Great Plains abutting the eastern front range of the Rocky Mountains (Samson and Knopf 1996). Short-grass prairie extends into the western quarter of Kansas, and the area is often referred to as the northern High Plains (Shiflet 1994). Mixed-grass prairie also occurs in the region, especially along the eastern edge of the distribution of Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) in Kansas, but also as inclusions further west (Kansas Native Plant Society 2014). McDonald et al. (2014) and Van Pelt et al. (2013) have described the area as the Short-Grass Prairie/CRP Mosaic Ecoregion for Lesser Prairie-Chickens, and the name describes the gradient of grassland types found in the ecoregion.

Before European settlement, the ecoregion was a landscape of generally flat short-grass prairie interspersed with mixed-grass prairie and small tracts of sand sagebrush (*Artemisia filifolia*) prairie along some drainages and unique soil types. Playas or small ephemeral wetlands were historically a common feature across this area, especially within the large expanse of flat "table" lands (Haukos and Smith 1994). Following European settlement, much of the extant prairies were cultivated and playas were incorporated into larger crop fields. Center-pivot irrigation systems became widespread in the 1960s and 1970s, allowing farmers to tap into the Ogallala Aquifer to provide season-long water supply for increased crop production. The use of groundwater revolutionized agriculture in the area, even during periods of drought. During the 1960s to the 1980s, large areas of prairies were again broken and plowed as a result of this advancement in agricultural technology (Waddell and Hanzlick 1978, Sexson 1980).

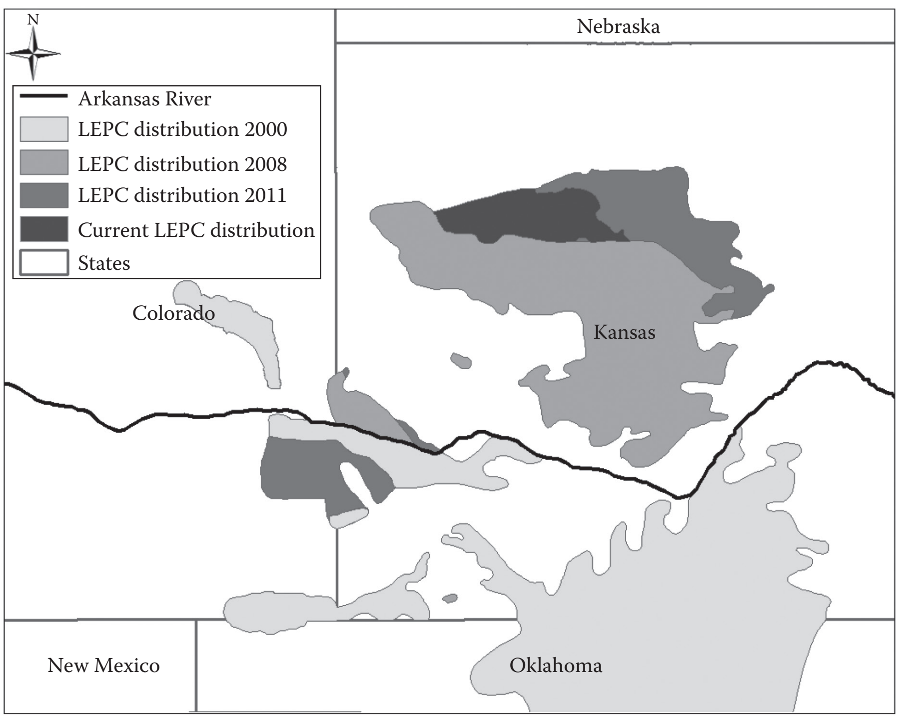

Figure 14.1. Changes in the distribution of Lesser Prairie-Chickens (LEPC) in Kansas and Colorado since the early 2000s. Spring lek surveys were conducted by the Colorado Parks and Wildlife, Kansas Department of Wildlife, Parks, and Tourism, and partners and resulted in multiple northward changes in distribution boundaries during the past decade (also see Figure 14.3). Distributional limits and dates represent where and when biologists officially moved the known boundaries for the species distribution, but not necessarily how Lesser Prairie-Chicken were using the landscape in real time.

Plant cover and vegetative structure of native short-grass prairie are not generally considered suitable habitat for the life cycle of Lesser Prairie-Chickens (Hagen et al. 2004). For example, Lesser Prairie-Chickens tend to select plant heights and visual obstruction for nesting cover much greater than the habitats provided by typical short-grass communities (Hagen et al. 2004). In other parts of their range, Lesser Prairie-Chickens often use shrub-dominated landscapes that provide needed vegetation structure in semiarid environments (Chapters 15 and 17, this volume). Historically, the sand sagebrush and mixed-grass prairies along the larger drainages in this region may have provided habitat for Lesser Prairie-Chickens. It is unknown what proportion of the eastern short-grass and western mixed-grass regions in Kansas were historically occupied by Lesser Prairie-Chickens or how densities varied among vegetation types (Hagen 2003). However, voluntary conversion of cropland into perennial grass cover through the Conservation Reserve Program of the U.S. Department of Agriculture has improved habitat conditions. The state of Kansas differed from other states by requiring seed mixes to resemble native mixed-grass and tall-grass communities, which increased potential habitat, reduced landscape fragmentation, and resulted in increased population abundance and occupancy of Lesser Prairie-Chickens (Rodgers 1999, Fields 2004, Rodgers and Hoffman 2005, Fields et al. 2006; Figure 14.2).

The objectives of our chapter are to (1) provide a synthesis of known ecological information regarding Lesser Prairie-Chickens and their habitat requirements in the short-grass, mixed-grass, and CRP prairie complex of the ecoregion; (2) consider distribution changes and northern expansion in the ecoregion since the early 2000s; (3) provide insights regarding the sympatric distributions of Lesser and Greater Prairie-Chickens (*Tympanuchus cupido*) and evidence for hybridization; (4) provide management recommendations specific to the ecoregion; and (5) describe the most important research and information needs that are still needed for Lesser Prairie-Chickens within the Short-Grass Prairie/CRP Mosaic Ecoregion.

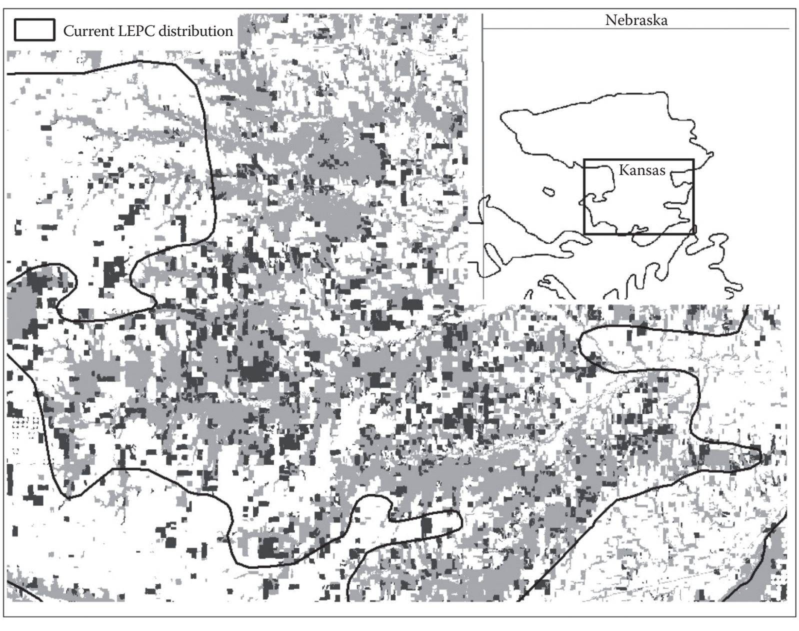

Figure 14.2. Vegetative land cover at the northern extent of the range of Lesser Prairie-Chickens (LEPC) in Kansas. Light gray represents grasslands, black represents Conservation Reserve Program (CRP) cover in 2005, and white represents cropland. The interspersion of CRP and grassland seems to be important to prairie chickens in this ecoregion. The area includes a contact zone where Lesser and Greater Prairie-Chickens are sympatric (see Figure 14.3).

CHARACTERISTICS OF THE GRASSLAND–CRP MOSAIC

The Short-Grass Prairie/CRP Mosaic Ecoregion is in a rain shadow of the Rocky Mountains and far removed from the moist influence of the Gulf of Mexico. The environment is typically semiarid with most precipitation falling as rain during the warm growing season. The average annual precipitation ranges from 28 to 51 cm, with amounts increasing west to east. Short-grass prairie is dominated by grasses such as buffalograss (*Buchloë dactyloides*) and blue grama (*Bouteloua gracilis*). Midgrasses usually present in mixed-grass prairies include sideoats grama (*B. curtipendula*), little bluestem (*Schizachyrium scoparium*), sand dropseed (*Sporobolus cryptandrus*), and western wheatgrass (*Pascopyrum smithii*). Woody species are generally not abundant, although some small inclusions of sand sagebrush occur along a few drainage corridors (Küchler 1974).

Estimates can vary but ~60% of short-grass and mixed-grass prairies remain in North America (Bragg and Steuter 1996, Samson and Knopf 1996, Weaver et al. 1996). However, within the Short-Grass Prairie/CRP Mosaic Ecoregion, at least 73% of the landscape has been converted to cropland, with ~7% of the area currently in CRP (M. Houts, Kansas Biological Survey, unpubl. data). Areas with less productive soils, steeper slopes, or insufficient precipitation or groundwater resources have remained grasslands. Livestock grazing is the predominant land use for the remaining grasslands. Much of the High Plains that is not dominated by large expanses of cropland is currently a complex of grazed short- and mixed-grass prairies, seeded native grasses in CRP fields, and intermixed cropland (Figure 14.2).

The Conservation Reserve Program is currently administered by the Farm Service Agency (FSA) of the U.S. Department of Agriculture (USDA). The program was created in 1986 and provided funds for the conversion of marginal croplands to perennial grasslands (Figure 14.2). In this particular region, nearly all of the seed mixes for establishing CRP consisted of native grasses. However, the species of grass seeded were rarely the historically dominant grass species for a given ecological site. In Kansas, the USDA, in cooperation with the state wildlife agency, provided technical guidance for grass seed mixes in CRP plantings primarily consisting of native tall- and midgrass species, including the following: big bluestem (*Andropogon gerardii*), little bluestem, Indian grass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and sideoats grama, with occasional additions of western wheatgrass, blue grama, and buffalograss. Forbs were included in CRP seeding mixes for new contracts beginning with the 1996 Federal Agriculture Improvement and Reform Act (Farm Bill), and most mixes commonly included a variety of native forbs: Maximillian sunflower (*Helianthus maximiliani*), purple prairie clover (*Petalostemon pupureum*), prairie coneflower (*Ratibida columnifera*), and Illinois bundleflower (*Desmanthus illinoensis*). Introduced forbs such as alfalfa (*Medicago sativa*), white sweet clover (*Melilotus alba*), and yellow sweet clover (*M. officinalis*) were also permitted in the ecoregion (Fields 2004).

The CRP seed mixes produced grasslands, which provided similar structure to mixed- and tall-grass prairies. The resultant stands were interspersed among native prairies and cropland, providing nesting cover for Lesser Prairie-Chickens that was adjacent to shorter, more open grassland habitats preferred for brood rearing (Fields 2004, Hagen et al. 2004; Figure 14.2). Both nest success and chick survival are critical factors in the population growth of Lesser Prairie-Chickens (Hagen et al. 2009). Existing evidence suggests the interactive effects of "newly" available habitat in CRP cover and favorable environmental conditions likely contributed to significant expansion and growth of Lesser Prairie-Chicken populations in the ecoregion in the 1990s and early 2000s (Channell 2010).

CHANGES IN THE DISTRIBUTION OF LESSER PRAIRIE-CHICKENS

As recently as 2000, published distributions generally delineated the Arkansas River as the northern extent for the contemporary range of Lesser Prairie-Chickens, and associated with sand sagebrush vegetation in Colorado and Kansas (Bailey and Niedrach 1965, Andrews and Righter 1992, Jensen et al. 2000; Figure 14.1). However, there were numerous reports of Lesser Prairie-Chicken occurring in areas north of the Arkansas River prior to 2000 (Jensen et al. 2000, Hagen 2003). Lek surveys for Lesser Prairie-Chickens in the ecoregion began in earnest from 1999 to 2004

(R. Rodgers, unpubl. data). The estimated distribution of Lesser Prairie-Chickens was expanded to incorporate more northern locations in 2008 (Figure 14.1). Some detected leks were only attended by Lesser Prairie-Chickens, but mixed leks of Lesser Prairie-Chickens and Greater Prairie-Chickens were also located in an area of sympatric distribution (Figure 14.3). From 2010 to 2013, intensive lek searches along the northern Lesser Prairie-Chicken distribution boundary were completed (M. Bain and D. Dahlgren, unpubl. data). Based on information gathered, the known boundary of Lesser Prairie-Chicken distribution was again moved north in 2011 and 2012 (Figures 14.1 and 14.3).

In recent years, the highest densities of Lesser Prairie-Chickens within Kansas and range-wide were in the Short-Grass Prairie/CRP Mosaic Ecoregion north of the Arkansas River in Kansas (Pitman 2013, McDonald et al. 2014). In fact, during the recent range-wide survey and subsequent population analysis for Lesser Prairie-Chickens, an estimated 65% of the remaining range-wide populations occurred in the ecoregion (McDonald et al. 2014). Based on the best available data, it appears that populations of Lesser Prairie-Chickens have grown substantially in the grasslands north of the Arkansas River since the mid-1980s and were associated with introduction of CRP plantings (Rodgers 1999, Rodgers and Hoffman 2005).

SYMPATRIC RANGE AND HYBRIDIZATION

The grasslands north of the Arkansas River represent the only portion of the range of Lesser Prairie-Chickens where the species is sympatric with Greater Prairie-Chickens (Figure 14.3). Most of the known leks in the ecoregion are either Lesser Prairie-Chickens only or mixed-species leks (Figure 14.3). Hybridization has been documented between Lesser Prairie-Chickens and Greater Prairie-Chickens, and hybrid vocalizations have been found to be intermediate between the two species (Bain and Farley 2002). Further, some vocalizations in the area of sympatry are

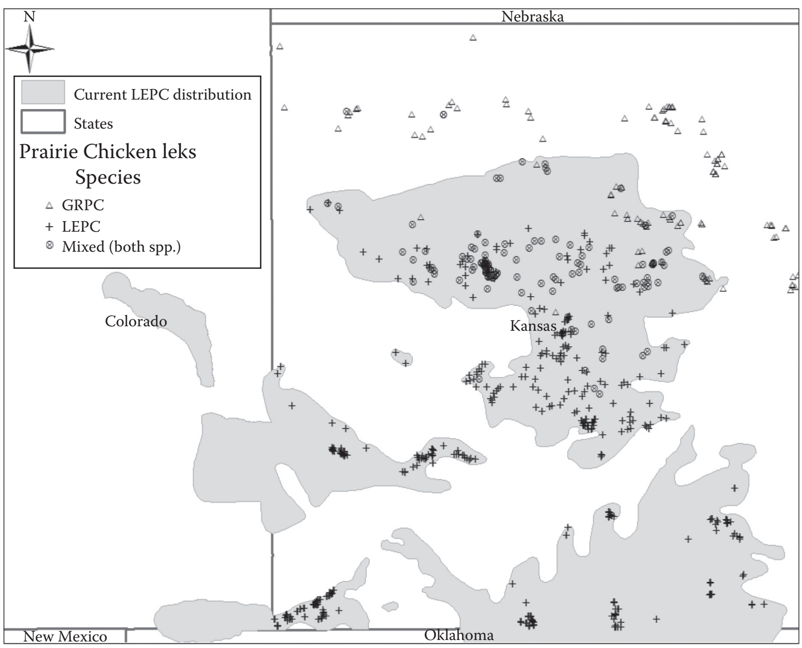

Figure 14.3. Lek locations of Greater Prairie-Chickens (GRPC), Lesser Prairie-Chickens (LEPC), and mixed-species leks in a contact zone where both species are sympatric in west-central and northwest Kansas. Data on lek locations were provided by the Kansas Department of Wildlife, Parks, and Tourism. The map includes all historic lek locations, but some leks may not be currently active. These data represent only known locations, but do not account for variation in abundance or areas without surveys. Two mixed-species leks located north of the current range of Lesser Prairie-Chicken were occasional occurrences of a single Lesser Prairie-Chicken at leks of Greater Prairie-Chicken and were omitted from delineation of the current distributions.

intermediate between hybrid and parental forms, suggesting possible backcrossing (i.e., F2 or F3 offspring, M. Bain and D. Dahlgren, pers. obs.). Intermediate vocalizations suggest that hybrids can produce viable offspring, but this observation has not been confirmed with molecular methods and the extent of genetic introgression remains unknown. Distinguishing a first-generation hybrid (F1) or hybrid offspring (F2, F3) from either parent species due to morphology or plumage characteristic is difficult. However, like vocalizations, some plumage characteristics seem to be intermediate between the two species (Figure 14.4).

If hybridization reduces fitness, isolating mechanisms are likely to evolve. However, postzygotic isolation evolves slowly and low levels of hybridization may occur with no loss of fitness (Grant and Grant 1996). Reproductive isolation between Lesser Prairie-Chicken and Greater Prairie-Chicken appears to be weak in this region, particularly gametic and postzygotic isolating mechanisms. However, prezygotic behavioral isolating mechanisms could include female choice, male competition, lek segregation and other lek attendance attributes, or display behaviors that could minimize the occurrence of hybridization. The effects of genetic introgression on recruitment of Lesser Prairie-Chickens are unknown, as are the possible negative effects of deleterious alleles, or the positive consequences of hybrid vigor and adaptation to a dynamic landscape.

Evidence at different spatial scales suggests that some degree of lek segregation occurs and the hybridization rate is <5%, which has not changed along lek survey routes in this ecoregion during the last decade (Bain 2002, Pitman 2013). Bain (2002) found that hybrid males had high attendance rates, agonistic behavioral traits, and lek territories similar to males of the parent species. However, copulation by hybrid males was never detected despite a large number of observation periods. Female choice might prevent further genetic introgression by avoiding hybrid males as mates. Therefore, it is likely that hybrid genetics would introgress at a greater rate through hybrid females. Characteristics involved in attracting females are likely the first to diverge (Ellsworth et al. 1994). Acoustic masking of display vocalizations might discourage

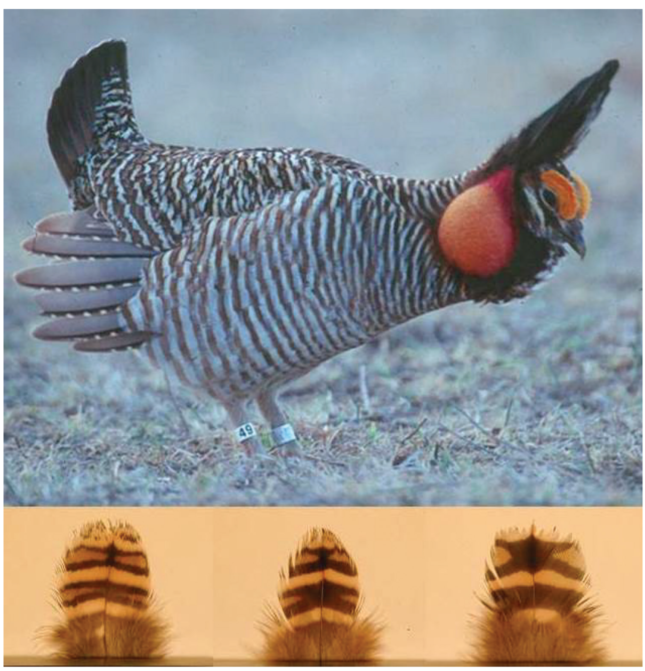

Figure 14.4. Hybrid Lesser-Greater Prairie-Chicken on a lek in western Kansas. The eye combs are characteristic of Lesser Prairie-Chicken and the air sacs are intermediate in color between the two parental species. Lower pictures are rump feathers of Lesser, hybrid, and Greater Prairie-Chickens (left to right). Note the contrast in the amount of dark and light brown for both upper and lower barring, with the hybrid intermediate between the two parental species.

mixed-species leks (Gibson et al. 1991), because optimization of sound windows might have contributed to the divergence of *Tympanuchus* (Sparling 1983). Relatively, minor differences in display behaviors such as boom duration can affect antiphonal booming, other display characteristics, and lek segregation (Bain 2002). Therefore, it is likely that even the most different traits, such as behaviors associated with breeding displays, could have diverged very recently.

The issues of hybridization and the possibility of viable offspring and potential backcrossing to parent species warrant consideration, as does the degree of speciation between *Tympanuchus* species. The Lesser Prairie-Chicken was initially classified as a unique species in 1885 (Ridgway 1885). Due to the fact that genetic information was not available at the time, the distinction was clearly based on morphological, behavioral, and distributional differentiation. Moreover, there are differing species definitions in the scientific literature for the two species of prairie chickens. Jones (1964) and Crawford (1978) considered Lesser and Greater Prairie-Chickens to be separate species, but suggested that reproductive isolation and species distinction could be tested in a zone of sympatry. Aldrich and Duvall (1955) and Johnsgard (1983) considered Lesser Prairie-Chicken to be a subspecies of Greater Prairie-Chicken, and the American Ornithologists' Union (1998) considered them to be a single superspecies. More recent analysis using modern genetic methodology amplifies the lack of evidence for definitive genetic speciation (Chapter 5, this volume). Luchinni et al. (2001) considered the Lesser Prairie-Chicken and Greater Prairie-Chicken "nominal" species; meaning phenotypically, but not necessarily genetically different. The authors have stated that "Nominal species of *Tympanuchus* hybridize extensively where they are in contact…; their mtDNA haplotypes are not fixed among species… and show shallow genetic distances, suggesting that speciation has been recent and perhaps incomplete" (Luchinni et al. 2001:159). Additionally, Oyler-McCance et al. (2010) provide little evidence for genetic divergence among *Tympanuchus* spp. If molecular data indicate that the Lesser Prairie-Chicken and Greater Prairie-Chicken are not yet fully genetically divergent, current distribution boundaries might be considered less taxonomically important. For practical purposes, it is likely that the application of conservation practices will benefit both species in their sympatric range. Because the ecoregion currently supports the highest densities of birds reported for Lesser Prairie-Chickens, >65% of the extant range-wide population may be exposed to potential hybridization with Greater Prairie-Chickens (McDonald et al. 2014). Hybridization has critical implications associated with systematics, and the potential impacts of genetic introgression or "dilution" of the genes of Lesser Prairie-Chickens. However, little is known about the consequences of hybridization between these two species or implications for management or conservation measures in the future. Understanding hybridization between the two species remains a future research need.

The systematics literature suggests that Lesser Prairie-Chickens and Greater Prairie-Chickens are genetically similar and are species that have only recently diverged. However, we are not suggesting that Lesser Prairie-Chickens are not unique or on significantly divergent evolutionary trajectories, nor that any area that supports *Tympanuchus* spp. is not critical to their conservation. Rather, we argue that clear articulation is needed regarding genetic and functional population goals for both Lesser Prairie-Chickens and Greater Prairie-Chickens. We also suggest that sympatric zones, distributional shifts, and patterns of speciation and introgression need to be better understood and considered as conservation efforts move forward and objectives for recovery must be clearly stated (Chapter 5, this volume).

ECOLOGICAL DRIVERS

Drought

The northern High Plains is subject to periodic drought (Samson and Knopf 1996). In fact, it may be more appropriate to describe climate patterns in the region as regularly in drought conditions, but periodically interrupted by wetter periods. Similar to most of the Great Plains, climatic conditions are highly variable. Timing, frequency, and amount of precipitation, in relation to soil type, growing season, and temperature, are major drivers of plant species composition, annual growth, and production (Holecheck et al. 2000), as well as associated invertebrate and vertebrate animal communities. Most precipitation comes during the growing season, generally favoring warm-season grasses in both short-grass and mixed-grass communities (Samson and Knopf 1996). Recent drought years of 2010–2013 have been moderate to severe in the ecoregion. Residual grass and shrub cover associated with CRP and lightly stocked grasslands are of particular importance for Lesser Prairie-Chickens during drought, as annual biomass production is minimal and grazing pressure removes much of the cover outside of CRP fields.

Grazing

Short-grass and mixed-grass prairies coevolved with periodic seasonal grazing by large ungulates such as American bison (*Bison bison*), pronghorn (*Antilocapra americana*), elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*). Other important herbivores have included smaller organisms such as insects, songbirds, and black-tailed prairie dogs (*Cynomys ludovicianus*). Prairie dogs, in particular, played key roles in soil disturbance, affecting the distribution of large ungulates (Coppock et al. 1983, Krueger 1986, Whicker and Detling 1988). Short-grass prairie can be particularly resilient to grazing pressure (Shiflet 1994). Current grazing practices in the ecoregion are primarily cow-calf and stocker cattle operations. High grazing intensity has generally reduced or completely removed midgrass species such as little bluestem and sideoats grama from many ecological sites where these plants were once common. However, in recent years, some producers are utilizing more moderate stocking rates and intensities. Changes in grazing management are especially true for landowners involved in contracts with the Lesser Prairie-Chicken Initiative (LPCI) administered by the Natural Resources Conservation Service (USDA NRCS 2013). Data are currently lacking on the potential responses of Lesser Prairie-Chickens to different grazing practices in the ecoregion.

The CRP fields, based on policy of the FSA, are generally not subject to grazing during the contract period. However, FSA can permit haying and grazing of CRP stands during emergency drought conditions within a county during a given growing season, which allows producers to hay or graze their own CRP contracted fields. According to Kansas FSA policy, if landowners choose to hay, they must leave at least 50% of the field in standing cover and a stubble height on average of 25.4 cm (10 in.) within the distribution of Lesser Prairie-Chickens (Shaughnessy 2014). If landowners choose to graze CRP fields with domestic livestock, they are required to have a stocking rate of no greater than 75% of NRCS established rates. Again, landowners must retain a stubble height that averages 25.4 cm (10 in.) within the known distribution of Lesser Prairie-Chickens (Shaughnessy 2014). In recent drought years, most counties in the ecoregion have authorized emergency haying and grazing in multiple consecutive years (Shaughnessy 2014). In 2013, the Kansas FSA required that any portion of CRP fields within the range of Lesser Prairie-Chickens can only be emergency hayed or grazed in 1 of 3 consecutive years. In 2014, the policy was adopted as part of the biological opinion in the federal listing of the Lesser Prairie-Chicken under the Endangered Species Act (Shaughnessy 2014).

Fire

Fire is an important ecological process influencing grassland systems in the Great Plains. Prior to European settlement, Native Americans used fire to influence grassland and animal communities (Moore 1972, Frost 1998). Fire-return intervals have been largely determined by climate, physiographic, edaphic, and vegetation conditions and resiliency (Daubenmire 1968, Wright and Bailey 1982). Since European settlement, natural fire has largely been suppressed across most of the Great Plains, including the Short-Grass Prairie/CRP Mosaic Ecoregion. Both short-grass and mixed-grass prairies respond well to fire if moisture is available following a burning event (Frost 1998, Brockway et al. 2002). In many native grasslands in this ecoregion, sideoats grama may be the only species capable of producing adequate structure for nesting. If fire is followed by intensive grazing or drought, sideoats grama can take on a lower growing, sod-forming structure and competition appears to favor buffalograss and blue grama; thus, fire can diminish nesting habitat in some cases (M. Bain, pers. obs.; Archer and Smeins 1991, McPherson 1995). However, in stands of grass that have not received disturbance, such as some CRP fields, or where woody plant invasion has occurred, fire can be a cost-efficient tool for improving nesting and brood-rearing habitats for Lesser Prairie-Chickens. When grasslands in the ecoregion were less fragmented, intact, contiguous, and comprised of a greater proportion of midgrass species, fire likely played an important role in maintaining habitat for Lesser Prairie-Chickens. In recent years, there has been an increased effort by multiple agencies and nongovernmental organizations to implement fire for grassland and CRP management in this area. However, landowners in the ecoregion are often reluctant to use fire as a management tool due to fear of losing control of a prescribed fire, lack of training, lack of equipment, and social or cultural constraints (Elmore et al. 2009).

HABITAT REQUIREMENTS

Few scientific studies specifically addressing the ecology and habitat use of Lesser Prairie-Chickens have been conducted in this ecoregion. The knowledge gaps are largely due to the recent recognition of expanded distribution boundaries for the species in the ecoregion (Figure 14.1), as well as the recent realization of the large populations of Lesser Prairie-Chickens in the ecoregion (McDonald et al. 2014). Many research needs exist for this area, with relatively little scientific information to date. Fields (2004) was the first wildlife ecologist to radio-mark individual Lesser Prairie-Chickens (along with Greater Prairie-Chickens) and monitor habitat use and survival in the Short-Grass Prairie/CRP Mosaic Ecoregion (see also Fields et al. 2006). Researchers from Kansas State University began a field study in 2013 with the objectives of collecting new data on patterns of habitat use, space use and movements, and survival (R. Plumb and D. Haukos, unpubl. data).

Diet

No diet studies of Lesser Prairie-Chickens have been conducted in the ecoregion. Grasslands are highly fragmented by cropland throughout the ecoregion (Figure 14.2), and Lesser Prairie-Chicken use has been documented in croplands, especially during late fall and winter months (Fields 2004). Ingested contents in the digestive tract of harvested birds have shown significant use of croplands for food sources during this seasonal period (Dahlgren et al., pers. obs.). The use of grains as a food source, especially during the potential resource bottleneck of winter, may be an important diet consideration, but relative contributions to the diet of Lesser Prairie-Chickens are unknown. It has been suggested that when cropland first became part of the landscape on the plains, prairie chickens may have benefited from waste grain as a novel food source (Chapter 2, this volume). Fields (2004) demonstrated that the use of forb-rich areas across vegetation types by broods suggests that forbs and associated invertebrates were important food items for chicks as reported in the literature from other regions (Taylor et al. 1980, Hagen et al. 2005).

Lekking

Lek sites in the region are predominantly in grasslands, but sometimes in croplands such as winter wheat or fallow fields. Few leks are found within CRP fields due to habitat conditions with taller vegetation height and greater stem density. However, when the vegetation is removed, such as after an emergency haying event, leks have been documented in these areas (R. Plumb, Kansas State University, pers. obs.). The region has Greater Prairie-Chicken, Lesser Prairie-Chicken, and mixed-species leks, with a species dominance gradient ranging from Greater Prairie-Chickens in the north to Lesser Prairie-Chickens in the south (Figure 14.3). Additionally, hybrid prairie chickens have been detected at multiple lek sites (Bain and Farely 2002). Jarnevich and Laubhan (2011) used maximum entropy modeling and known lek locations to produce a probability map for lekking habitat of Lesser Prairie-Chickens that included the Short-Grass Prairie/CRP Mosaic Ecoregion. Lek and prairie chicken densities can be relatively high in some areas, with as many as 12 leks along a 16.1 km route (10-mile) in an area of 51.8 km^2 (20 $mile^2$), and up to 6.18 birds per km^2 (16 birds per $mile^2$, see Gove Route, Pitman 2011). The Kansas Department of Wildlife, Parks, and Tourism (KDWPT) conducts lek surveys each spring across Kansas, and currently has four lek routes within the ecoregion (Pitman 2013).

A recent study was conducted in the northeastern portion of the Lesser Prairie-Chicken range in a four-county area of Kansas, including Graham, Rooks, Trego, and Ellis counties. V. Cikanek (unpubl. data) investigated lek sites of both prairie chicken species in relation to surrounding landscape characteristics at three spatial scales: close to the lek, a 1.5 km radius from leks, and a 3 km radius from leks. At the smallest scale, lek sites were further from paved roads and higher in elevation than random locations. At the larger scales of 1.5–3 km, leks were associated with larger and more contiguous patches of grasslands (including CRP), less oil structure development, and more CRP compared to random locations.

Nesting Ecology

Nests of prairie chickens in the region have been found in CRP (70%; $n = 42$ of 60), grassland (27%; $n = 16$ of 60), and only rarely in cropland (3%; $n = 2$ of 60, nest sites of Lesser and Greater Prairie-Chickens combined, Fields 2004). In the vegetation types, nest sites were found in western wheatgrass, little bluestem, big bluestem, and switchgrass (Fields 2004). CRP fields that were interseeded with forbs after grass establishment or not treated were used for nest sites in greater proportion than their relative availability (Fields 2004). Fields et al. (2006) reported apparent nest success of 48.3% for nests where ≥1 egg hatched ($n = 29$ of 59). In this study, vegetation cover in CRP, grassland, or cropland did not influence daily nest survival (Fields et al. 2006). Age of the nest and seasonal timing had the greatest influence on daily nest survival. There was a progressive decline in nest survival among early-, mid-, and late-season nests (Fields et al. 2006). Fields et al. (2006) also found that increasing temperature led to decreased nest survival. About 50% of complete nest losses were attributed to depredation by mammals (Fields 2004).

Lek searches and monitoring were not initiated until after CRP plantings were established across much of the ecoregion. However, anecdotal evidence suggests that Lesser Prairie-Chickens may have been present in the ecoregion, but abundance and occupancy expanded following the initiation of CRP (Pitman 2013, McDonald et al. 2014). Many biologists have concluded that the population increase was largely due to the increase in available nesting habitat in the form of CRP plantings that were conducted at a large landscape scale within the region (Figure 14.2). Nest survival has been shown to be the most important vital rate impacting population dynamics of Lesser Prairie-Chickens (Hagen et al. 2009). However, in their 2-year study with a relatively small sample of nests, Fields et al. (2006) did not find a difference in nest survival rates between vegetation types. The result suggests that the increase in the quantity of nesting habitat in the region may have been most influential in increasing population abundance and range.

Brood-Rearing Ecology

Habitats used by broods of prairie chickens have mainly been native grasslands, followed by CRP, and then rarely in cropland (Fields et al. 2006). Previous research demonstrated that grassland sites have relatively high forb cover and open areas for the movement of small chicks (Fields 2004). While CRP provides nesting habitat, the vegetative structure can be too dense to provide good brood-rearing habitat in the absence of ecological disturbances from grazing, haying, or fire. CRP that contains significant forb cover has been shown to provide important brooding habitat (Fields 2004). From field observations, it appears that the transitional edge between CRP and grasslands can be an important interface for prairie chicken broods (R. Rodgers, pers. obs.).

In their 2-year study, Fields et al. (2006) reported that only 7 of 25 (28%) monitored broods had ≥1 chick survive more than 60 days after hatch. Brood success from hatch to 60 days was much greater for broods attended by adult females (0.49, SE = 0.19) compared to broods attended by subadult females (0.05, SE = 0.03, Fields et al. 2006). The 2-year study was conducted in years with above-average temperatures and one of the years was extremely dry during the nesting and brood-rearing period.

Water

Lesser Prairie-Chickens have been documented using free water sources in other ecoregions (Boal et al. 2014, Grisham et al. 2014). However, it is unknown whether they benefit from free water, or if they simply use these water sources when available. There are multiple natural and artificial water sources in the ecoregion. Livestock grazing and associated water facilities have increased the availability of surface water sources and distribution across the landscape well beyond historic conditions. Additionally, water facilities for wildlife or "wildlife guzzlers" have been constructed within CRP fields as part of the USDA contracts. Kansas NRCS guidelines specifically state that guzzlers within CRP fields are intended for upland game birds. However, the impact of guzzlers on game birds and other wildlife is poorly understood (Boal et al. 2014).

In a study during the summers of 2011 and 2012, cameras associated with guzzlers were used to obtain data for occupancy modeling of

Figure 14.5. Female Lesser Prairie-Chickens at a CRP guzzler site in Gove County, Kansas. The guzzler was monitored from late March to early May 2012 with a motion-sensing camera (DLC Covert). All photos during this pilot study indicated attendance by females only. The open ground-level water tank allowed access to prairie-chickens without entry under the guzzler roof. The design was unique compared to other monitored 23 guzzlers that had 50 gal (189.3 L) drums situated under the guzzler roof, where only one visit was recorded for a Lesser Prairie-Chicken. Each 50 gal drum had a small opening cut out with a wildlife ramp leading down into the water source.

upland game birds, mesopredators, and other wildlife (B. Calderon, unpubl. data). The study area had multiple guzzler and paired nonguzzler sites in CRP fields in a five-county area of Kansas in Logan, Gove, Trego, Ellis, and Russell counties. Sites spanned an east-to-west precipitation gradient across the northern extent of the range of Lesser Prairie-Chicken. During the study, no detections of Lesser or Greater Prairie-Chickens were recorded at any guzzler sites. However, preliminary data indicated that raccoons (*Procyon lotor*) and other mesopredators had higher detection and occupancy rates at guzzler compared to nonguzzler sites.

In a pilot study conducted during the spring of 2012, motion-sensing cameras were placed at guzzlers in CRP fields in Gove County in an area of relatively high lek densities of both species of prairie chickens and in the same focal study area used by Fields (2004; D. Dahlgren, unpubl. data). Twenty-four cameras and guzzler locations were used. Monitoring occurred from late March to mid-May during nest initiation and start of the incubation period. Prairie chickens were detected at only 2 of 24 guzzler sites during this period (8%) and only once at 1 of the 2 sites. The remaining site had multiple and regular detections of female Lesser Prairie-Chickens until water levels in the tank dropped below accessibility (Figure 14.5). Notably, the guzzler with the most prairie chicken use had a different design than others monitored with a ground-level open water tank compared to all other guzzlers, which had 50 gal (189.3 L) drums with small access openings and wildlife escape ramps (Figure 14.5). The use of specifically designed water sources has been similarly documented in other ecoregion (Boal et al. 2014). Mesopredators were also detected at guzzler sites during the pilot study.

POPULATION DYNAMICS

Little information is available regarding population dynamics of Lesser Prairie-Chickens within the Short-Grass Prairie/CRP Mosaic Ecoregion. The KDWPT currently conducts spring lek surveys for both species of prairie chickens in March–April along four 16.1 km routes (10-mile). Routes in the region occur in Hodgeman, Ness, Gove, and Logan counties (Pitman 2013; Chapter 4, this volume). Each spring, biologists conduct two samples with 11 stops that are 1.6 km apart (1 mile) along the route listening and looking for leks of prairie chicken. All detected leks within 1.6 km (1 mile) on either side of the route are located and flushed at least once, and preferably twice during the survey period. Lek survey data provide both regional and statewide trends for populations of prairie chickens. For the Short-Grass Prairie/CRP Mosaic Ecoregion, Lesser and Greater Prairie-Chickens are combined for trend information. The Logan route was tested in 2012 and established in 2013, but not used here because of a lack of trend information. Based on three of the four current routes, lek densities and numbers of birds per lek have been relatively stable since the inception of these routes in the early 2000s (Figure 14.6). However, the trend has been slightly down in recent years, likely due to implications of region-wide drought conditions on recruitment (Figure 14.6).

CONSERVATION AND MANAGEMENT OF LESSER PRAIRIE-CHICKENS IN GRASSLANDS NORTH OF THE ARKANSAS RIVER

Large blocks of native grasslands provide the most valuable habitat in other three ecoregions in the range of the Lesser Prairie-Chicken. Populations of the species in the Short-Grass Prairie/CRP Mosaic Ecoregion, by necessity, depend more on the interspersion of native grassland and CRP tracts (Figure 14.2). CRP grasslands provide suitable nesting cover while native grasslands can often

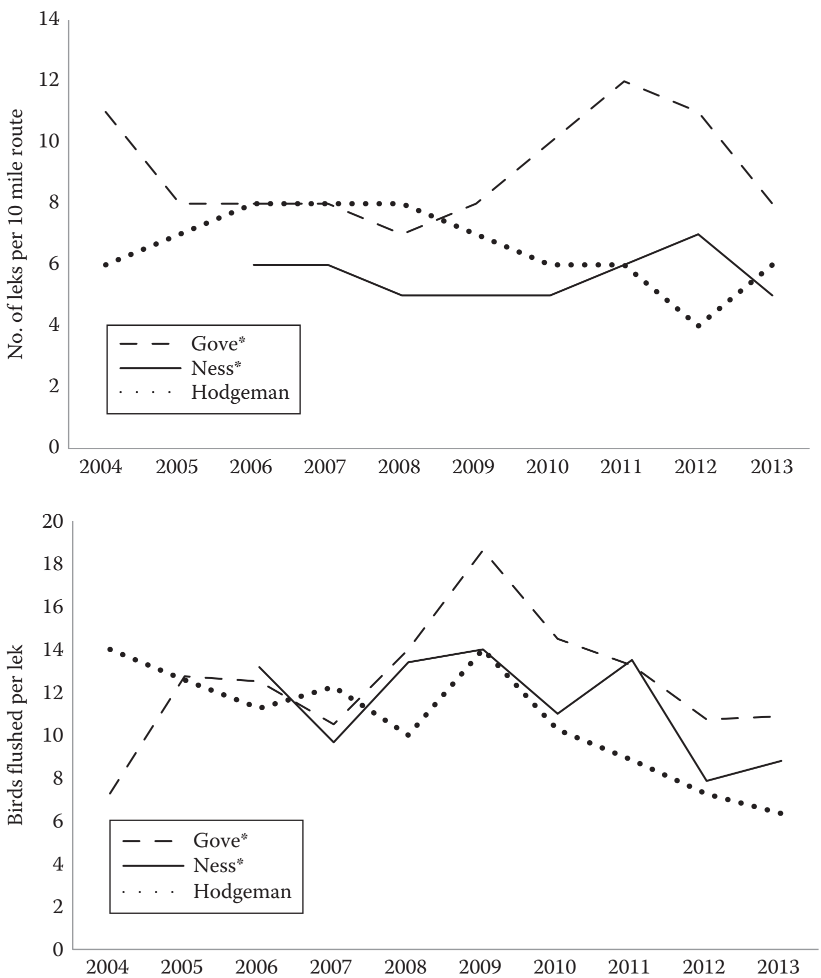

Figure 14.6. Lek survey trends for Lesser and Greater Prairie-Chickens with both species combined for routes in the Short-Grass Prairie/CRP Mosaic Ecoregion. Logan County route was not included due to establishment in 2013 and lack of trend information. Gove and Ness routes have an * to indicate that both Lesser and Greater Prairie-Chickens are observed during annual surveys along each route. Data were provided by the Kansas Department of Wildlife, Parks, and Tourism, and the most recent reports for lek surveys of prairie chickens are available at the agency website. (From Kansas Department of Wildlife, Parks, and Tourism 2014.)

offer better brood-rearing habitat (Fields 2004), allowing females to exploit the edges where these two vegetation types occur adjacent to each other. The addition of CRP grasslands has also been sufficient in many areas to shift the overall grassland–cropland ratio from a landscape of mostly cropland to one that is mostly grassland, likely benefiting Lesser Prairie-Chickens throughout their annual cycle.

Management priorities have been created within the Conservation Reserve Program that provides greater opportunity and incentives for the establishment of CRP grasslands adjacent to or near extant native grasslands. Targeted recruitment has been accomplished through the establishment of carefully targeted Conservation Priority Areas, which provide additional Environmental Benefit Index points for appropriate lands enrolled through the competitive General Signup process of the CRP. The State Acres for Wildlife practice (CP38E) of the Continuous Signup process has also provided opportunity and incentives to target CRP grasslands toward key focal areas where enrollments are most likely to benefit Lesser Prairie-Chickens. The Lesser Prairie-Chicken Range-wide Conservation Plan developed by the Western Association of Fish and Wildlife Agencies (WAFWA) has also delineated critical focal areas in the region and established an avoidance, minimization, and mitigation process whereby greater habitat protections, better habitat management, and new habitat establishment can best be targeted (Van Pelt et al. 2013).

Based on a broad assessment of where CRP grasslands had apparently benefited prairie grouse populations in the western United States, Rodgers and Hoffman (2005) recommended desired CRP stand heights of 30–75 cm (12–30 in.) or roughly shin-to-thigh high. The authors also recommended that CRP stands be established using species that would produce a diverse, clumpy stand structure. Such grasslands will provide three critical habitat structural requirements for prairie chickens to be able to easily (1) hide and be concealed, (2) move without obstruction, and (3) see approaching danger (G. Horak, pers. comm.). Fields (2004) found that vegetation at the nest is generally much taller, and often twice as tall as the surrounding habitat conditions (e.g., 45.7 cm versus 22.9 cm), and that vegetation at successful nests was often taller than unsuccessful nests. The results suggest that habitat patchiness at small scales may be important for successful nesting. Small-scale patchiness might be more easily achieved in endemic grasslands than in CRP, under current CRP management policy. In summary, it is evident that Lesser Prairie-Chickens need adequate concealment in a grassland stand that is neither too dense nor too tall. In the Short-Grass Prairie/CRP Mosaic Ecoregion, bunchgrasses, such as little bluestem and sideoats grama, can best provide such grassland structure, particularly when complimented with forbs.

Rodgers and Hoffman (2005) strongly discouraged the use of invasive exotic grasses such as smooth brome (*Bromus inermis*) and Caucasian or yellow bluestem (*Bothriochloa ischaemum*) in the establishment of new stands of CRP fields. Without a program policy that allows for grazing of CRP stands during the established nesting season of birds (April 15–July 15), cool-season grasses such as western wheatgrass and smooth brome have shown a capacity to outcompete native warm-season species in CRP stands in this semiarid region, resulting in monocultures with little heterogeneous structure. If native warm-season grasses have been heavily invaded by smooth brome or western wheatgrass, the recommended treatment is a November application of glyphosate (plus surfactant) active ingredient at 0.42–0.83 kg per ha (6–12 oz per acre) followed by 1–2 hard freezes at <-4°C when the temperature has warmed at least 12°C. The treatment has been shown to be effective at killing smooth brome and would likely be effective on western wheatgrass while not harming the already-dormant warm-season species (M. Bain, pers. obs.).

Prescribed fire is another useful tool in managing CRP stands for prairie chickens by providing for grassland succession across the landscape, reducing litter accumulation, and controlling undesirable plant species. In this semiarid region, new CRP stands with warm-season grasses generally do not reach maturity until at least the fourth growing season after seeding (R. Rodgers and M. Bain, pers. obs.). Excessive litter accumulation typically will not occur until at least 2 years after maturity is reached. Consequently, initial prescribed burns of new CRP stands typically are not needed until at least six years after the stand was seeded, perhaps longer, depending on stand density. Following the first burn, we suggest that prescribed fire repeated at 4–6 year intervals, depending on precipitation, would likely maintain suitable vegetation vigor and structure to satisfy the habitat needs of Lesser Prairie-Chickens.

The use of prescribed fire during the late summer months of mid-July to August has the potential to benefit Lesser Prairie-Chickens as well. Summer burns can reduce excessive height that occurs in some CRP stands and have been shown to favor forb production in subsequent growing seasons (Howe 1994), particularly if only portions of a landscape are burned resulting in heterogeneity of vegetation structure and composition (Fuhlendorf and Engle 2004). The use of summer burns also extends the potential days available in the year for conducting prescribed fire and can provide an enhanced margin of safety if surrounding vegetation is still green and less flammable.

Prescribed grazing can be an important CRP management tool. In addition to cool-season management, high-intensity grazing for short duration during the dormant season may increase forb production and the vigor of warm-season grasses, but this management tool needs more testing. Typical CRP grazing in July–November generally occurs too late in the growing season to effectively control cool-season species of grasses. Dormant or early season high-intensity, short-term grazing may reduce current year nesting cover, but would at least improve nesting habitat in subsequent years if given adequate rest during the growing season.

The habitat provided by much of the intact native grassland in this ecoregion has been reduced in quality and quantity by high grazing intensity with little or no grazing rest for more than a century. However, little bluestem, sideoats grama, and other grass species selected by Lesser Prairie-Chickens are sometimes still present in such pastures but in a suppressed condition. Reducing grazing pressure by using lighter stocking rates and periodic rest over time can improve the quantity and quality of habitat available to Lesser Prairie-Chickens.

Grassland grazing plans that address the most common limiting factor of quality nesting habitat are especially important in areas lacking CRP. The USDA programs such as Lesser Prairie-Chicken Initiative (LPCI) and the Lesser Prairie-Chicken Range-wide Conservation Plan under the Western Association of Fish and Wildlife Agencies (WAFWA) have provided landowners with incentive payments for prescribed grazing (Van Pelt et al. 2013). The 3–5-year plans of the LPCI and the 5–10-year plans of WAFWA are relatively short term, with the frequency of long-term adoption by landowners after contract expiration unknown. In the arid region with common, prolonged drought, changes in species composition as a vegetative response to management changes generally require decades rather than years. Only long-term management programs over 15–30 years or in perpetuity can ensure habitat improvements. Moderate stocking rates and rest rotations can be used to achieve at least a minimum amount and appropriate distribution of quality nesting habitat. To efficiently target nesting habitat, management units that include grass species capable of producing structure for nesting must first be identified. The most common species capable of producing suitable structure are sideoats grama, little bluestem, sand dropseed, and western wheatgrass, but some ecological sites simply do not support these plant species. The most effective grazing plans begin with identifying sites to target the development of nesting structure and then provide the stocking rate or rest that best expedite the development of that structure. Grazing plans should complement producers' long-term goals for their operations, ensuring benefits to both the producer and wildlife habitat. Depending upon environmental conditions and existing species composition and structure, deferment, rest, or light to moderate stocking rates with 25%–40% total utilization should be used in these areas. Research is needed to confirm and increase the efficacy of grazing recommendations.

Haying CRP fields may also produce some benefits to habitat similar to fire or grazing. However, the negative impact of long-term loss of cover, especially if haying is followed by drought, may outweigh any benefits. Habitat loss may especially be true if haying occurs at large scales. Generally, we do not recommend haying to benefit Lesser Prairie-Chickens.

More information is needed concerning the impacts of energy development on Lesser Prairie-Chicken, but based on the negative impacts to other species of prairie grouse (Hovick et al. 2014), anthropogenic development should probably be minimized in priority Lesser Prairie-Chicken habitat such as the WAFWA Lesser Prairie-Chicken focal areas (Van Pelt et al. 2013). Approaches for discouraging energy development are highly controversial, but the WAFWA Lesser Prairie-Chicken Range-wide Conservation Plan currently offers a mechanism for accomplishing this goal. Recent evidence suggests that the established design of guzzlers designed to provide open water sources for Lesser Prairie-Chickens is not effective and could be benefiting mesopredators that are detrimental to grassland birds (B. Calderon, unpubl. data). Guzzlers are no longer incentivized by USDA CRP signup programs.

INFORMATION NEEDS AND GAPS

As with the three other ecoregions for Lesser Prairie-Chickens, the most urgent research needs are related to identifying limiting factors of populations and associated habitats at multiple spatial scales and how known threats influence these factors (U.S. Fish and Wildlife Service 2012). To our knowledge, the only published population and habitat related research for Lesser Prairie-Chickens specifically within the Short-Grass Prairie/CRP Mosaic Ecoregion are presented in Fields (2004) and Fields et al. (2006). An example of needed information for our area of interest is given in Hagen et al. (2009), where population modeling was conducted to identify vital rates that may be drivers of population growth. Once population and habitat information becomes readily available, the development of meaningful population, habitat recovery, and long-term conservation objectives will become possible. Economic incentives necessary to obtain these objectives need to be determined, as well as the most appropriate mechanisms to implement these incentives. For a wide-ranging species that occurs primarily on private lands, the effectiveness of the strategy using voluntary conservation is of primary concern.

Perhaps the most urgent information needs in this region are associated with understanding the effects of CRP and adjacent grasslands on population persistence, occupancy, and growth. Anecdotal observations indicate that areas within the region with the highest Lesser Prairie-Chicken densities are comprised of ~60% grassland, 20% CRP, and 20% cropland. Quantification of these land use attributes at landscape scales and their functional influence on demographic rates are urgently needed. To efficiently target and implement conservation, the minimum amount of nesting structure that is required in a given area must be identified for local property management and at a landscape scale. At a landscape scale, information on habitat requirements is critical for efficient and targeted implementation of programs such as CRP. Conversely, with the reduction of the CRP acreage cap and competitive commodity prices, knowing how much grassland (including CRP) is needed in a given area to support populations of Lesser Prairie-Chickens and the optimal size and configuration of available patches will be critically important.

If Lesser Prairie-Chickens truly depend on CRP to persist in the Short-Grass Prairie/CRP Mosaic Ecoregion, the current habitat availability is in a precarious situation where >50% of the range-wide population depends upon the existence of a relatively short-term (10–15-year) program subject to political support and a dynamic financial market driven by commodity prices. If a process to develop long-term solutions for maintaining or increasing CRP and the subsequent mosaic of vegetative structure in this landscape is not found, we could eventually lose the ecoregion as a remaining stronghold for the species. Identifying the process and creating long-term solutions based on market-based or conservation programs will require knowledge of financial drivers that influence land use decisions, such as annual payments that are competitive with current market values. In addition, policy development and subsequent communication must focus on maintaining or increasing landowner participation in CRP. The potential threatened status of Lesser Prairie-Chickens has created landowner fear of participation in CRP. If policy is not developed to alleviate this fear and that policy is not clearly communicated to landowners, a threatened status could have a net negative effect on populations of Lesser Prairie-Chickens in the region. The effort must ultimately identify the level of incentives required to guarantee at least a minimum area of CRP and other grasslands in the landscape for longer periods than current programs, and up to 30 or 50 years to perpetuity. Conservation planning could include identifying an incentive-based path for landowners to transition current CRP into permanent grazing lands. For example, provisions in the "Farm Bill" and other conservation programs, such as Agricultural Land Easements and the WAFWA Lesser Prairie-Chicken Range-wide Conservation Plan (Van Pelt et al. 2013), could be used to secure long-term easements, which then could be modified and targeted to focus conservation measures for Lesser Prairie-Chickens. If such solutions are not found, the owners of CRP and native grassland that currently provide Lesser Prairie-Chicken habitat may ultimately succumb to economic pressures to convert to alternative types of land use.

Further investigation into the trade-off between spatial extent and duration of conservation practices is needed to develop sound strategies for conservation, particularly related to adaptive management. In our ecoregion, long-term trends suggest range expansion and increasing densities remain possible for Lesser Prairie-Chickens. In such areas, conservation priorities that focus on securing long-term maintenance of intact, quality habitat, such as perpetual easements on CRP-grassland complexes, may be more critical than producing additional habitat. Once a certain threshold of habitat is protected over the long term, or participation and demand for long-term conservation has been met, a shift toward restoring potential habitat may be warranted. In areas where little habitat is available to conserve, conservation priorities should focus on restoring as much habitat as possible, as quickly as possible. Once a certain threshold of habitat is restored, it may be more efficient to shift strategies and begin long-term conservation easements for some of the most functional habitat. The greatest information needs associated with these issues are related to the appropriate proportions of short- and long-term habitat at landscape scales and triggers that might be useful in optimizing cost-efficiency and effectiveness over time.

Energy development is increasing in the Short-Grass Prairie/CRP Mosaic Ecoregion. Specifically, oil and natural gas development is creating new roads and associated infrastructure throughout prairie chicken habitat. Additionally, pressure to develop wind energy resources is likely to increase in the region. Similar to other ecoregions within Lesser Prairie-Chicken range, we currently lack a full understanding of the potential impacts that energy developments could have on populations of Lesser Prairie-Chickens.

Management prescriptions currently in place for Lesser Prairie-Chickens within our ecoregion need more experiential and research information to help guide and improve the methods in the future. Policy and resulting management practices must be flexible enough to prescribe management needs for individual fields or habitat patches and provide suitable options for landowners. First, research must be conducted that identifies the most cost-efficient management practices that adequately address needs for nesting habitat, survival, or other limiting factors within the management unit. For example, research and subsequent policy could be developed related to the following list of management information questions: Is flash grazing with high-intensity stocking for a short duration during the dormant season an effective means of reducing grass biomass and improving vegetative structure and plant density? What are the optimal stocking rates to maximize the quality of nesting and brood-rearing habitat? Is summer burning the most effective management tool for mature stands of warm-season grasses with few forbs that do not provide adequate brood rearing? In more arid portions of the region, when is the initial burn appropriate for restored CRP grasslands in terms of stand age or plant structure? For the range of existing stand types, what is the optimal time to burn? Would short-term, intensive grazing or disking have a greater disturbance response and subsequently be preferable to burning? Under what environmental conditions does burning reduce nesting habitat and for how long? If cool-season grass dominance is the primary threat to the stand, are spring burning, glyphosate application in autumn, or other management practices effective at control? At what level of dominance by smooth brome, western wheatgrass, or other cool-season grasses is a prescribed burn during nesting period worth the benefit of habitat restoration versus potential loss of production by Lesser Prairie-Chickens? Is potential nest loss by spring burning offset by renesting or long-term benefits in increased production? For the range of existing stand types, what is the most effective means of seedbed preparation for interseeding with forbs—disking, burning, spraying, or mowing? For established stands, are there any scenarios where seedbed preparation is not necessary? What is the optimum seed mixture and rate or seeding for interseeding of legumes or other priority forb species? We recognize that waiting for consideration of a laundry list of applied research needs is not an option, and managers must move forward based on the best available science and their own knowledge base from personal experience.

However, a need for an urgent response does not preclude the need for research-based information concerning management practices, especially if certain practices become popularized in management prescriptions.

Currently, livestock grazing is considered a compatible use with habitat requirements (USFWS 2012). However, different grazing systems and stocking rates will have variable impacts. Identifying the most appropriate stocking rates and grazing systems, including species of grazer, timing, and duration, that are most compatible with requirements of Lesser Prairie-Chickens will be important to future conservation in this ecoregion. A focus on grazing would be especially important if the management of CRP fields could include livestock grazing as a future management practice. Although not specific to Lesser Prairie-Chickens, much guidance can be garnered from the existing literature on grazing impacts to vegetation.

In addition to grazing, fire is another ecological driver that can be managed. Prescribed fire has rarely been applied to arid grasslands in the region due to ongoing fire suppression and concerns of landowners, and consequently, effects of fire on habitats of Lesser Prairie-Chickens are largely unknown. Prescribed fire on CRP lands is more common, and where undisturbed vegetation likely limits brood rearing, it is likely the most appropriate management tool. Additionally, where tree encroachment is an issue, prescribed fire is often the most cost-effective method to maintain open grasslands. Information is needed to determine the optimum timing and environmental conditions, and appropriate role of prescribed fire in existing grassland fragments and CRP for the purpose of Lesser Prairie-Chicken conservation.

Habitat requirements of prairie chickens within their sympatric range are likely to be similar to allopatric populations, and habitat selection by Lesser Prairie-Chickens and Greater Prairie-Chickens is similar in the contact zone. However, if differences were detected, those findings would likely shed light on important, limiting factors related to habitat for each species. Research that detects similar habitat use for both species would be just as insightful. Currently, little is known about the potential role of hybridization between Lesser and Greater Prairie-Chickens or implications for future conservation measures for either species. Research should be designed to assist in the determination of whether genetic distinctness between Lesser Prairie-Chickens and Greater Prairie-Chickens should be a recovery goal. Therefore, understanding hybridization rates between these two species is an important research need. Vocalizations that are intermediate to the parental species suggest that hybrids produce viable offspring; however, these observations have not been confirmed genetically. Reproductive isolation between Lesser and Greater Prairie-Chickens appears to be weak in this region, but behavioral isolating mechanisms could include female choice, male competition, lek segregation, and other lek attendance attributes and display behaviors. In fact, within the 96 leks described by Bain and Farley (2002), segregation by species was greater than would be predicted by chance alone. The effects of hybridization on production by Lesser Prairie-Chickens, extent, and direction of genetic introgression, and other negative or positive effects are unknown and require more research attention.

Shifts in distribution and occupied range for both Lesser and Greater Prairie-Chickens and a subsequent increase in area of the sympatric zone will likely continue until new range limits are reached or changes in land use, especially conversion of native grasslands or CRP to cropland, occur at larger scales in this region. The dynamic nature of the distribution of Lesser Prairie-Chickens in relation to environmental conditions, particularly in this region, clearly has been influenced by humans and suggests that historic distribution distinctions may offer little toward recovery planning. Rather, research needs to be developed that identify current and projected functional populations and the limiting effects of land use, climate change, or other factors in those areas. Therefore, understanding climate change and its potential impact on this species is warranted (Channell 2010; Chapter 12, this volume). Specifically, how will predicted increases in temperature and evapotranspiration influence life history traits or demographic parameters? To help managers, climate models could be incorporated into recovery efforts for the Lesser Prairie-Chicken to help direct resources to areas with a higher probability of persistence. Information on climate change and distribution shifts that includes potential hybridization with Greater Prairie-Chickens in northern reaches might help identify important recovery areas, perhaps beyond the recognized current distribution.

CONCLUSION

The Short-Grass Prairie/CRP Mosaic Ecoregion north of the Arkansas River in Kansas represents a unique portion of the current distribution for Lesser Prairie-Chickens in their five-state occupied range. Based on current evidence, Lesser Prairie-Chickens in this area use CRP and associated grasslands to meet their seasonal life cycle needs (Fields 2004, Fields et al. 2006; Figure 14.2). The introduction of CRP grasslands at landscape scales is believed to be the cause of population increases in this area over the past three decades, but particularly in the late 1990s and early 2000s. However, it has been documented that Lesser Prairie-Chickens occurred in this region, but presumably at much lower population levels before the Conservation Reserve Program was started (Jensen et al. 2000, Hagen 2003). The CRP provides a short-term contract for grasslands on a field-by-field basis and does not currently address long-term landscape-scale certainty for persistence of the species in this area. Long-term security is a significant need for the species, especially considering increasing commodity prices and other competing issues for CRP contract renewal and expansion in the region. The recognized distribution of Lesser Prairie-Chickens has been moving northward in recent years with new data from spring lek searches conducted by biologists since 1999. Much of this portion of the range of Lesser Prairie-Chickens is sympatric with Greater Prairie-Chickens (Figure 14.3). Hybridization between Lesser and Greater Prairie-Chickens has been documented, but the potential effects on the Lesser Prairie-Chicken are poorly understood (Bain and Farley 2002). More research and information are needed on population genetics, habitat use at various scales, management prescriptions, human dimensions, energy development, climate change, and population dynamics for Lesser Prairie-Chicken in this region, where ~65% of the remaining range-wide population is found (McDonald et al. 2014). If conservation goals can be met, the Short-Grass Prairie/CRP Mosaic Ecoregion may remain one of the last strongholds for Lesser Prairie-Chicken as a species.

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