CHAPTER SIXTEEN

Regional Variation in Nesting Success of Lesser Prairie-Chickens

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Abstract. Declines in Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) populations have been attributed to loss or fragmentation of habitat and conversion of native prairie to agricultural cropland, and have been exacerbated by improper grazing practices and drought. Loss of adequate vegetation for nesting and brooding of Lesser Prairie-Chickens have accelerated population declines observed in the Texas Panhandle. We monitored 114 female radio-marked Lesser Prairie-Chickens in the Texas Panhandle from 2001 to 2007 to determine if nest success differed in two regions (northeastern and southwestern) of the Texas Panhandle. We used an information-theoretic approach to test hypotheses explaining differences in nest success of Lesser Prairie-Chickens in each region. To evaluate differences between successful and unsuccessful nests, we measured vegetative height, plant species at nest, and visual obstruction readings (VOR) at each nest and at random points. Nest success was significantly (P = 0.040) lower in the southwestern region (38%) compared to the northeastern region (67%). Evaluating factors influencing nest success, we found that parameters examined did not explain differences in nesting success. However, we found nest locations had higher VOR then random sites in both the northeastern ($\bar{x}$ = 35 cm, SE = 2.3 vs. 21 cm, SE = 2.4) and southwestern ($\bar{x}$ = 18 cm, SE = 2.4 vs. 10 cm, SE = 1.1) regions. Height at nest locations ($\bar{x}$ = 44 cm, SE = 1.7) was greater than at random sites ($\bar{x}$ = 32 cm, SE = 1.8) for the southwestern region, but not the northeastern region ($\bar{x}$ = 52 cm, SE = 3.9; $\bar{x}$ = 60 cm, SE = 8.2, respectively). Height and VOR at both nest sites and random locations were higher in the northeastern region than in the southwestern region, indicating more cover and possibly explaining the greater nest success in the northeastern region. The effects of drought appeared to affect nesting attempts, nest success, and renesting in both regions during our study. To increase populations of Lesser Prairie-Chickens in Texas, we recommend managers focus on providing vegetation with adequate height and visual structure for successful nesting.

Key Words: Lesser Prairie-Chicken, nest success, radiotelemetry, reproduction, Texas, *Tympanuchus pallidicinctus*, vegetation type.

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Pinnated grouse (*Tympanuchus* spp.) populations have declined throughout their range, and many are considered species of concern (Storch 2007). Declines in distribution and abundance of Sharp-tailed Grouse (*T. phasianellus*), Greater Prairie-Chicken (*T. cupido*), and Lesser Prairie-Chicken (*T. pallidicinctus*) populations have been extensively documented (Taylor and Guthery 1980, Johnsgard 1983, Schroeder and Robb 1993, Connelly et al. 1998, Silvy et al. 2004). Given their historically small range, relatively small population sizes, and continued declines in abundance, Lesser Prairie-Chickens were listed as a candidate species in 1998 by the U.S. Fish and Wildlife Service (Federal Register 1998, Hagen and Giesen 2005) and placed on the International Union for Conservation of Nature and Natural Resources (IUCN) red list in 2004 (IUCN 2004, Storch 2007). Declines in Lesser Prairie-Chicken abundance have been attributed to habitat fragmentation, improper livestock grazing, and land conversion from rangelands to agricultural cropland (Crawford 1980, Taylor and Guthery 1980, Hagen et al. 2004).

Historically, Lesser Prairie-Chickens occupied rangelands throughout the Texas panhandle (Oberholser 1974, Litton et al. 1994). Changing land-use practices have left Lesser Prairie-Chickens in ranges dominated by woody species such as shinnery oak (*Quercus havardii*), resulting in small, isolated populations (McCleery et al. 2007). The extant range, in Texas, consists of two disjunct metapopulations in portions of ~11 counties (Taylor and Guthery 1980, Sullivan et al. 2000, Silvy et al. 2004). The majority of birds are located in the northeastern portion of the Texas Panhandle in native prairie dominated by bunchgrasses with small amounts of sand sagebrush (*Artemisia filifolia*), and a second smaller population inhabiting shinnery oak rangelands of the southwestern Panhandle.

Although the mechanisms responsible for declining Lesser Prairie-Chicken abundance are not completely understood, previous research on other prairie grouse has found nest success and brood survival to be significant factors influencing grouse numbers (Bergerud and Gratson 1988, Peterson and Silvy 1996). Numerous studies have documented nest success of Lesser Prairie-Chickens across their range in varying habitats (Sell 1979, Haukos 1988, Hagen et al. 2004, Hagen and Giesen 2005), but no recent studies have evaluated nest success in the two remaining Lesser Prairie-Chicken populations in Texas.

Because of uncertainty surrounding recovery efforts, we initiated field studies to determine whether Lesser Prairie-Chicken nest success differed between two populations in separate regions of the Texas Panhandle. The objectives of our study were to (1) investigate spatial variation in the nest success of Lesser Prairie-Chickens, and (2) determine what vegetation components may influence nest success in two Lesser Prairie-Chicken populations in different habitats.

STUDY AREAS

We conducted our study from April 2001 through August 2007 in two areas in the Texas Panhandle (Fig. 16.1). In 2001, trapping sites were located in

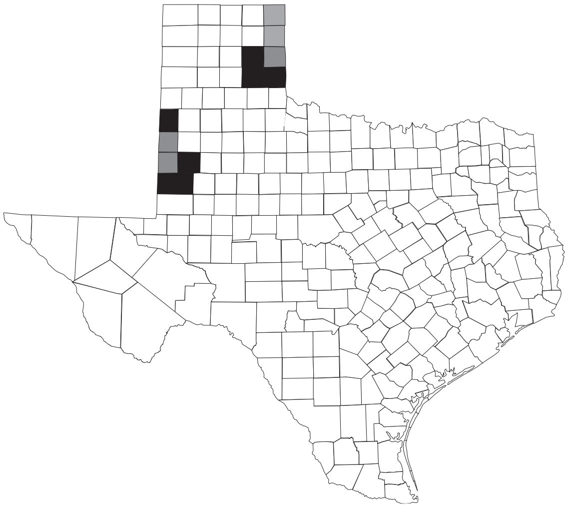

Figure 16.1. Current distribution (black) of Lesser Prairie-Chickens in 11 counties of Texas (after Silvy et al. 2004). Gray areas indicate counties where our study areas were located, 2001–2007.

portions of Hemphill (36°01′ N, 100°11′ W) and Wheeler (35°33′ N, 100°06′ W) counties (northeastern region). In 2002, we expanded trapping to include the southern portion of Lipscomb County (36°07′ N, 100°03′ W), Texas, and added Yoakum and southern Cochran counties (33°23′ N, 102° 50′ W) (southwestern region) in 2003.

The northeastern region was dominated by native prairie with sand sagebrush as the dominant woody species, with lesser amounts of Chickasaw plum (*Prunus angustifolia*) and fragrant sumac (*Rhus aromatica*). The southwestern region was dominated by shinnery oak with small amounts of sand sagebrush. Both regions contained similar grass and forb associations, as described by Jackson and DeArment (1963). However, the southwestern region had vegetative cover of 50% woody vegetation (83% shinnery oak and 17% sand sagebrush), 11% grass, 2% forbs, and 37% bare ground (Leonard 2008), whereas the northeastern region had 2% woody vegetation, 44% grass, 4% forbs, 35% bare ground, and 15% litter (Toole 2005). Common herbaceous species in both regions included little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), sand bluestem (*A. hallii*), sand lovegrass (*Eragrostis tichodes*), sand dropseed (*Sporobolus cryptandrus*), and three awn (*Aristida* spp.). Common forbs included camphorweed (*Heterotheca pilosa*), Texas croton (*Croton texensis*), western ragweed (*Ambrosia psilostachya*), and queensdelight (*Stillingia sylvatica*). Taxonomic nomenclature follows Gould (1962).

Our study areas ranged from 5,000 to 18,000 ha and were bordered by center-pivot irrigated cropland, Conservation Reserve Program lands (CRP), and grazed rangelands. Primary land uses were ranching and natural gas and oil extraction. Environmental conditions were similar across both study regions. Average precipitation across the regions was approximately 48 cm/year during our study (NOAA 2009). A severe drought occurred at both sites in 2003 (NOAA 2009).

METHODS

Data Collection

We captured female Lesser Prairie-Chickens using non-explosive Silvy drop nets (Silvy et al. 1990) on leks prior to and during the breeding season from late March to 1 June during 2001 through 2007. At capture, we identified birds as yearling or adult based on shape, wear, and coloration of the ninth and tenth primaries (Amman 1944, Copelin 1963). We equipped each female with a numbered leg band, and a 12–15-g battery-powered, mortality-sensitive radio transmitter. We used two models of necklace-style radio transmitters: non-adjustable collar-style radio transmitters with fixed-loop antennas (Telemetry Solutions, Walnut Creek, CA) and adjustable collar-style transmitters with whip antennas (Wildlife Materials Inc., Carbondale, IL).

We monitored Lesser Prairie-Chickens a minimum of three days per week throughout the study using vehicle-mounted five-element Yagi antennas. Observations were increased to ≥5 times per week during the spring and early summer to allow better monitoring of nesting activity. Nests were located on foot using three-element handheld Yagi antennas after hen locations remained unchanged for approximately three days. We recorded clutch size if the hen flushed off the nest, but did not intentionally flush hens to obtain these data. We marked each nest with a handheld global positioning system unit, and nest sites were not visited again until the hen left the nest or was depredated. At that time, we relocated nests and identified their fate as abandoned, destroyed, or hatched.

After nest fate was identified, we measured nest site characteristics to evaluate differences between vegetation characteristics at successful and unsuccessful nests. At each nest site, we recorded vegetative height (of tallest material) in centimeters and species of plant providing cover to the nest bowl. We also used a range pole (Robel et al. 1970), demarked at 10-cm (1-dm) intervals, to estimate visual obstruction readings (VOR) placed in the center of the nest bowl and viewed from a height of 1 m and a distance of 4 m in four cardinal directions. We also collected VOR measurements from random points by determining a random direction (1 of 8 cardinal directions) and random distance (200–800 m in 100-m increments) to evaluate differences in vegetation at the nest compared to random locations.

Statistical Analysis

We evaluated vegetation differences between successful (incubating females with ≥1 egg hatched) and unsuccessful nests for each region separately using logistic regression (PROC GENMOD, SAS version 9.1; SAS Institute, Inc., Cary, NC; dependent variable = nest success, independent variables = candidate models). We compared candidate models using an information-theoretic approach (Burnham and Anderson 2002). We used this approach to evaluate the influence of temporal factors (Year) as well as characteristics of the nest, including VOR, height of plants at nest bowl (Height), and the species of plant providing cover to the nest bowl (Species). These four variables were combined into eight candidate models: (1) Global (all four variables considered without interactions), (2) Null (intercept only model), (3) Year, (4) Height, (5) VOR, (6) Species covering the nest, (7) VOR + Height, and (8) Species covering the nest * Height (the interactive effects of these two variables). We evaluated the fit of each model using Akaike weights (w_i) and Akaike's Information Criterion corrected for small sample size (AIC_c; Simonoff 2003), and considered models with a $\Delta AIC_c < 2$ as equally parsimonious models (Burnham and Anderson 2002).

We calculated apparent nesting rate (hens for which we found nests divided by number of hens available to nest), apparent nest success (of nests found, percent hatching at least 1 egg), and daily nest survival using a maximum likelihood estimator of the survival rate (Bart and Robson 1982) using the software routines of Krebs (1999). We used the mean laying period (11 days, assuming mean clutch size of 11 eggs with 1 egg laid/day) and mean incubation period (25 days) to estimate nest survival across the laying–incubation period (36 days). Variances were approximated for daily nest survival (36-day period) using the delta method (Powell 2007). Additionally, we used a chi-square test to determine if differences existed in frequency of successful and unsuccessful nests between regions and t-tests to determine whether differences existed in the VOR and height of vegetation between nest bowls and random sites and between regions.

RESULTS

We trapped 114 female Lesser Prairie-Chickens over the course of the study; 52 hens produced 57 nests of which 27 (47%) were successful. Of 40 females trapped in the northeastern region (2001–2003), four lost their radio transmitters before nests were located, two were killed by predators before they nested, two radios stopped transmitting (may have been destroyed during predation) before nests were located, and 12 did not nest (7 during the 2003 drought) or had nests destroyed during laying. Twenty hens incubated 21 first nests and one renest, of which 14 hatched, 2 were abandoned, 5 were destroyed by predators, and one hen was killed near presumed hatch date but the nest could not be relocated to determine nest fate. Mean hatching date for first nests (n = 11) in the northeastern region was 24 May (95% CI = 18–30 May). Apparent nesting rate for the northeastern Texas Panhandle was 63% and apparent nest success was 67%. Maximum likelihood daily nest survival was 0.983 (SE = 0.006) and calculated laying–incubation period (36 days) survival was 54% (95% CI = 31–78%) for the northeastern region. Of the eight females that were unsuccessful, five were killed while nesting, and of the three available to renest (number starting second nest after first nest failed), two had first nests destroyed late in incubation and only one renested during the study. All nests in the northeastern Texas Panhandle were located in clumps of little bluestem.

In the southwestern Texas Panhandle, we trapped and radio-monitored 65 female Lesser Prairie-Chickens from 2003 through 2007. Of these 65 females, four lost radios before nests were located, five were killed by predators before they nested, four radios stopped transmitting (may have been destroyed during predation) before nests were located, and 20 did not nest or had nests destroyed during laying. A total of 32 incubated first nests and three renests (one hen was captured late in breeding season with brood patch; therefore, the nest was considered a renest), of which 13 hatched, 2 were abandoned, and 19 were destroyed by predators. Mean date of hatch for first nests in the southeastern region was 25 May (95% CI = 20–30 May). Two renests in the southwestern region hatched on 5 and 7 July. Overall nesting rate for the southwestern Texas Panhandle was 62% and nest success was 38%. Maximum likelihood daily nest survival was 0.965 (SE = 0.007) and calculated laying–incubation period (36 days) survival was 29% (95% CI = 16–46%) for the southwestern region. The majority of nests (31) were established under woody shrubs. Twenty-two hens used sand sagebrush for nest cover, while nine nests were established under shinnery oak plants. Five of the

TABLE 16.1

Means and 95% confidence limits (in parentheses) for height and visual obstruction readings (VOR) at nest bowl and random sites at successful and unsuccessful Lesser Prairie-Chicken nests by region, Texas Panhandle, 2001–2007.

Region/Fate	*n*	VOR at Nests	VOR at Random	Height at Nests	Height at Random
Northeastern	21	35 (31–39)	21 (16–26)	52 (44–60)	60 (44–76)
Successful	14	36 (31–41)	19 (14–25)	51 (43–59)	68 (53–84)
Unsuccessful	7	35 (24–45)	24 (23–25)	53 (34–72)	50 (38–61)
Southwestern	32	18 (13–23)	10 (8–12)	44 (41–47)	36 (32–40)
Successful	12	20 (14–26)	10 (7–13)	45 (42–48)	38 (27–48)
Unsuccessful	20	17 (10–24)	10 (7–13)	43 (38–49)	31 (26–36)

nests under woody shrubs also had bunchgrasses (little bluestem and threeawn) associated with the nest bowl. The remaining three nests were established in grass and other vegetation (one in weeping lovegrass, *Eragrostis curvula*, CRP; one in little bluestem; and one under a Buckley's yucca, *Yucca constricta*).

Apparent nest success in the northeastern region (67%, 95% CI = 43–85%) differed significantly ($\chi^2 = 4.199$, df = 1, $P = 0.040$) from that in the southwestern region (38%, 95% CI = 22–56%); however, maximum likelihood daily survival estimates (0.983 and 0.965, respectively, for northeastern and southwestern regions) did not differ ($\chi^2 = 3.288$, df = 1, $P = 0.070$) between regions. Evaluating factors influencing nest success for each region, we found the Null model had the lowest AIC value among the candidate models, indicating that it was the best fit for the data. Additionally, the 95% CIs of parameter estimates for all parameters in both regions contained zero. These combined findings indicated that parameters examined did not explain differences in nesting success. Models including the species of plant providing cover to the nest bowl were eliminated from the analysis of the northeastern region because all nests were covered by little bluestem.

In the northeastern region, VOR was significantly ($t = 5.49$, $P < 0.001$) higher at nest sites ($\bar{x} = 35$ cm) than at random sites ($\bar{x} = 21$ cm; Table 16.1). Similarly, VOR also was significantly ($t = 3.55$, $P = 0.001$) higher at nest sites ($\bar{x} = 18$ cm) than at random sites ($\bar{x} = 10$ cm) in the southwestern region. However, VOR at the nest bowl and at random points in the northeastern region was significantly higher than at the nest bowl and random sites in the southwestern region ($t = -5.19$, $P < 0.001$ and $t = -4.00$, $P < 0.001$, respectively).

Vegetation height ($\bar{x} = 44$ cm) at the nest bowl in the southwestern region (Table 16.1) was significantly ($t = 4.28$, $P < 0.001$) higher than at random sites ($\bar{x} = 36$ cm), whereas vegetation height ($\bar{x} = 52$ cm) at the nest bowl in the northeastern region was not significantly ($t = -0.93$, $P = 0.360$) different than at random sites ($\bar{x} = 60$ cm). Vegetation height at the nest bowl in the northeastern region was not significantly ($t = -1.77$, $P = 0.089$) different than in the southwestern region, but vegetation height at random points in the northeastern region was significantly ($t = 2.90$, $P = 0.009$) higher than at random points in the southwestern region (Table 16.1).

DISCUSSION

Nest success of Lesser Prairie-Chickens during our study was higher (47%) than some estimates from other portions of this species' range (27%, Merchant 1982; 28%, Riley et al. 1992; 26%, Pitman et al. 2006). Riley (1978), Patten et al. (2005), and Fields et al. (2006), however, documented quite similar apparent nest success (47%, 41%, and 48%, respectively), and Copelin (1963) and Davis (2009) reported higher values (67% and 76%, respectively). Merchant (1982) documented 54% nest success during a year of average precipitation, whereas no nests were successful during a severe drought year. Hagen and Giesen (2005) estimated nest success of Lesser Prairie-Chickens at 28% based on ten studies conducted throughout this species' range, although they cautioned that these results may have been negatively influenced by observer disturbance. We did not consider disturbance to be a factor in our study, as most birds were not flushed from their nests and nests were not visited a second time until nest fate was determined.

Our apparent low nest initiation rate combined with relatively high nest success may be biased as we did not locate nests for 20 hens in the southwestern region and 12 hens in the northeastern region. These hens may have initiated laying but had their nests destroyed before incubation began. With our maximum likelihood daily nest survival estimate being lower than the apparent nest survival estimate, this could be a partial explanation. However, we also determined through back-dating from hatch date the date when incubation began and found for both regions that we located nests during the first week of incubation for both regions. Thus, it also is likely that some hens did not nest or abandoned nests early in incubation because of the droughts of 2003 and 2006. Precipitation during the five months prior to the 2003 nesting season was 23% and 88% below the 30-year normal in the northeastern (7 hens not nesting) and southwestern regions, respectively. During 2006, precipitation during the five months prior to nesting was 84% below the 30-year normal in the southwestern region, and only 10 of 24 females were known to nest. Two of 10 nests were abandoned early in incubation, and for the first time during our study, both males and females left the study area. We located radio-tagged birds up to 8 km from the display grounds where they were trapped earlier in 2006. During 2007, only four females were observed on display grounds in the southwestern region, indicating females either died (7 deaths documented) during 2006 or did not return to the study area. Patten et al. (this volume, chapter 4) found that greater movements of Greater Prairie-Chickens led to higher mortality, especially among females. Drought appeared to play a major role in lack of nesting attempts, nest success, and renesting during our study. Similarly, Wolfe et al. (2007) maintained that low Lesser Prairie-Chicken nest success, smaller clutch sizes, and no documented renesting were due primarily to severe 2006 drought conditions on their study areas in Oklahoma. They also reported that effects of the drought carried into the 2007 nesting season, when only three nests were located and no renesting was observed.

At a regional scale, we found that Lesser Prairie-Chicken nests in the northeastern Texas Panhandle were more successful than those in the southeastern Panhandle. The southwestern region was dominated by woody vegetation (shinnery oak), whereas the northeastern region was dominated by grass (bunchgrasses). The southwestern region also had less grass groundcover (11%) than did the northeastern region (44%), where all nests were located in little bluestem clumps, even though woody plants (e.g., sand sagebrush, shinnery oak, and plum) as tall or taller than the little bluestem clumps were observed in 69% of 153 (m^2) vegetation plots (Toole 2005, Leonard 2008). It appears that in areas where sufficient bunchgrasses are present, Lesser Prairie-Chickens prefer to nest in bunchgrasses (Jones 2009). Cannon and Knopf (1981) found that Lesser Prairie-Chicken densities were positively correlated with percent grass cover and negatively correlated with brush frequency and density in shinnery oak grassland. Lesser Prairie-Chicken populations in Kansas are known to inhabit grass prairies generally devoid of brush (Fields et al. 2006, Pitman et al. 2006).

Although there were no differences in VOR at successful and unsuccessful nests within either the northeastern and southwestern regions, the mean VOR from random points in the southwestern region was 10 cm, whereas the mean in the northeastern region was 21 cm. It appears that females in both regions selected nest sites in areas where VOR was maximized. However, because mean VOR was higher at nest sites in the northeastern region (35 cm) than at nest sites in the southwestern region (18 cm), it is not surprising that nest success was higher in the northeastern region. Nests in the southwestern region placed under shinnery oak or sand sagebrush had little grass cover, whereas those in the northwestern region placed within little bluestem clumps, which provided greater VOR, apparently resulted in greater nest success. Vegetation height at nest sites did not appear to contribute to the difference in nest success between regions, as it did not differ by region. Nonetheless, height at nest sites in the southwestern region was greater than height at random sites, which may have helped predators find nests by searching taller vegetation areas.

Adequate vegetation structure for nesting is probably the most important factor determining nest success of Lesser Prairie-Chickens (Kirsch

1974). Lutz and Silvy (1980), for example, found that predation of Attwater's Prairie-Chicken (*T. c. attwateri*) nests was greater in areas with lower VOR. Our findings are similar to previous research documenting the importance of vegetative structure to the success of Lesser Prairie-Chicken nests (Haukos and Smith 1989, Fields et al. 2006, Pitman et al. 2006). Improvements in habitat quality and quantity are needed to provide sufficient cover to reduce nest predation for Lesser Prairie-Chickens in Texas.

Within the northeastern region, we found Lesser Prairie-Chickens nested exclusively in little bluestem clumps, even through woody vegetation was found in 69% of all m^2 quadrats, with mean height of 67 cm (Toole 2005). However, within the shinnery oak vegetation type (height <0.1–2 m), we found that Lesser Prairie-Chickens nested more often under sand sagebrush plants (22 nests) than under shinnery oak plants (9 nests), where shinnery oak and sand sagebrush comprised 83% and 17%, respectively, of woody plants (Leonard 2008). Sell (1979), working in Yoakum County, Texas (shinnery oak vegetation type), found Lesser Prairie-Chickens preferred sand sagebrush for nest concealment and recommended that nesting cover in the form of sand sagebrush and residual grass cover be provided. Conversely, Crawford and Bolen (1975) reported a mix of native shinnery oak–dominated rangeland and grain farming provided better habitat than 100% native rangeland. The authors suggested landscapes with <63% native rangeland were incapable of supporting Lesser Prairie-Chicken populations. More recently, Haukos and Smith (1989) reported that rangelands with <50% shinnery oak overhead cover were ideal for Lesser Prairie-Chickens. Shinnery oak also competes with food and cover plant species that are beneficial to Lesser Prairie-Chickens, and can comprise 90% of vegetation on heavily grazed rangelands (Pettit 1979).

Microhabitat use of shinnery oak rangelands by Lesser Prairie-Chickens is poorly understood; the presence of shinnery oak is cited as both beneficial (Sell 1979, Haukos and Smith 1989) and detrimental (Donaldson 1969, Martin 1990). Changes in shinnery oak age, composition, and structure may account for these conflicting results, and may also explain declining Lesser Prairie-Chicken abundance in the southwestern Texas Panhandle. When shinnery oak comprises <50% coverage of the area with a height shorter than that of the dominant grass (little bluestem), it is suitable habitat for Lesser Prairie-Chicken. However, as shinnery oak matures and concomitantly increases in density (>50% coverage) and height (>1.5 m), it often totally dominates an area. Mature oaks lead to the exclusion of important grasses and forbs through competition for space and limited moisture, especially during drought years that support invertebrates needed by Lesser Prairie-Chicken chicks.

To increase Lesser Prairie-Chicken numbers in Texas, we recommend that managers focus on providing conditions that maximize vegetative diversity and structure for successful nesting. To improve nesting success in nearby New Mexico habitats, Riley et al. (1992) recommended that managers increase grass cover at the expense of shinnery oak cover. A better understanding of how components of the maturation of shinnery oak including height, density, and structure influence dynamics of Lesser Prairie-Chicken populations is imperative to the recovery of the species.

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