

**SEASONAL SURVIVAL, REPRODUCTION, AND USE OF WILDFIRE AREAS
BY LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS
PANHANDLE**

A Thesis

by

RYAN STERLING JONES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2009

Major Subject: Wildlife and Fisheries Sciences

**SEASONAL SURVIVAL, REPRODUCTION, AND USE OF WILDFIRE AREAS
BY LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS
PANHANDLE**

A Thesis

by

RYAN STERLING JONES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Approved by:

Chair of Committee,	Nova J. Silvy
Committee Members,	Markus J. Peterson
	Fred E. Smeins
Head of Department,	Thomas E. Lacher

May 2009

Major Subject: Wildlife and Fisheries Sciences

ABSTRACT

Seasonal Survival, Reproduction, and Use of Wildfire Areas by Lesser Prairie Chickens
in the Northeastern Texas Panhandle. (May 2009)

Ryan Sterling Jones, B.S., Kansas State University

Chair of Advisory Committee: Dr. Nova J. Silvy

Lesser prairie chicken (*Tympanuchus pallidicinctus*) numbers have declined considerably in Texas since the early 1900s. Conversion of native prairie to cropland has been the major cause of the decline. I trapped and monitored 115 (66 males, 49 females) lesser prairie chickens in the Rolling Plains of the Texas Panhandle from 2001 through 2003.

I used an information-theoretic approach to model selection as implemented in program MARK to evaluate factors contributing to variation in survival and differences in nest success. I found breeding season survival of both males and females was lower compared to non-breeding season survival. Annual survival was 0.52 (95% CI: 0.32–0.71). Model selection indicated higher nest success (70%) in the sand sagebrush (*Artemisia filifolia*) vegetation type as compared to the shinnery oak (*Quercus harvardii*) type (40%).

I also evaluated post-burn habitat alterations and plant succession (1 year and 2 years after burning) as potential lesser prairie chicken habitat. After spring rainfalls stimulated re-growth of herbaceous plants, male lesser prairie chickens moved to the site, feeding on new-emerging forbs throughout the summer. A female lesser prairie chicken

with a brood used the burned site during the first summer after the burn. A year later, males established a lek on the burned site. Two female lesser prairie chickens with broods used the burned site during the second summer. Burned sites had more forbs than non-burned sites and probably had more insects available which are an important food source for chicks during their first 4–5 weeks of age.

DEDICATION

Mom and Dad

ACKNOWLEDGEMENTS

I thank my parents for instilling strong values and for their unwavering encouragement and support. I also thank them for supporting a love for the outdoors at an early age. I would also like to thank my committee Dr. Nova Silvy, Dr. Markus Peterson, and Dr. Fred Smeins for their guidance and patience. I especially thank Dr. Silvy. Dr. Silvy's office door was always open to me. He provided wonderful guidance regarding my graduate research as well as life in general. He is a great mentor and friend.

I appreciate the help of Ben Toole for all of those hours in the field. I am grateful to the landowners and land managers who allowed access to their properties over the course of this study. I also am grateful to John Hughes (U.S. Fish and Wildlife Service) for logistical support. This project was funded by Texas Parks and Wildlife Department, and Texas A&M University. Additional funding provided by the Western Governors Association enabled field activities to be conducted to evaluate habitat differences in burn versus non-burn areas within the lesser prairie chicken study site.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
DEDICATION	v
ACKNOWLEDGEMENTS	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	ix
LIST OF FIGURES.....	x
 CHAPTER	
I INTRODUCTION.....	1
Background	1
Study Area.....	2
Objectives.....	6
II BREEDING AND NONBREEDING SURVIVAL OF LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE	7
Synopsis	7
Introduction	7
Methods.....	10
Study Areas	10
Data Collection.....	11
Statistical Analyses	11
Results	14
Discussion	16
III REPRODUCTIVE SUCCESS OF LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE	20
Synopsis	20
Introduction	20
Methods.....	22
Study Areas	22

CHAPTER	Page
Data Collection.....	23
Statistical Analyses	24
Results	24
Discussion	26
IV USE OF WILDFIRE AREAS BY LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE	29
Synopsis	29
Introduction	29
Methods	31
Study Areas	31
Procedures	31
Results	32
Radio Telemetry	32
Use of Burn Areas	32
Vegetation Comparisons	33
Discussion	35
V SUMMARY AND CONCLUSIONS.....	38
LITERATURE CITED	40
VITA	49

LIST OF TABLES

TABLE	Page
2.1 Notation and description of models used to estimate survival of lesser prairie chickens in Texas, 2001–2003	13
2.2 Number of lesser prairie chickens (by sex) captured and radio-marked in the Texas Panhandle, 2001–2003	14
2.3 Plausible candidate models ^a used to estimate survival of radio-tagged lesser prairie chickens in the Texas panhandle from 2001–2003	15
3.1 Year, site (1 = sand sagebrush, 2 = shinnery oak), nest fate (1 = successful, 0 = unsuccessful), age of hen, dominant plant species at nest, mean obstruction of vision at nest, and plant height at nest	25
4.1 Ground coverage (%) of woody species, forbs, grass, litter, and bare ground and visual obstruction readings in lesser prairie chicken habitat, 1 and 2 years post burn (2002 and 2003)	33

LIST OF FIGURES

FIGURE	Page
1.1 Counties in the Rolling Plains of Texas where study areas were located, 2001–2003	3
2.1 Current and unoccupied former range of lesser prairie chicken in North America	9

CHAPTER I

INTRODUCTION

BACKGROUND

Since the late 1800s, distribution and numbers of lesser prairie chicken (*Tympanuchus pallidicinctus*) has decreased in historically occupied regions of eastern New Mexico, southeastern Colorado, southwestern Kansas, western Oklahoma, and the Texas Panhandle (Crawford 1980, Taylor and Guthery 1980). Rangewide declines in numbers (>97%) were believed to have resulted primarily from habitat loss (Crawford 1980, Taylor and Guthery 1980, Pitman 2003).

By the mid-20th century, prairie chicken researchers such as Lehman (1941), Hamerstrom et al. (1957), and Jackson and DeArment (1963) already were observing declining prairie chicken abundance. These declines have continued to the present.

Litton (1978) estimated up to 2 million lesser prairie chickens in Texas prior to 1900. By 1974, estimated numbers had declined to about 17,000. Concerns about the extinction of lesser prairie chickens in Texas initially arose in the 1930s when this species was restricted to portions of 12 counties (Sullivan et al 2000). During this time, lesser prairie chickens reached record lows, thus a ban on hunting was enforced from 1937 until 1967 (Litton 1978). In 1940, lesser prairie chickens inhabited portions of 20 counties (1,366,578 ha), in the Texas Panhandle, but by 1989 occupied range had decreased by 58% (573,230 ha). Though numbers of lesser prairie chickens in Texas increased to huntable levels in the 1960s, abundance again declined in the 1990s due to

This thesis follows the format and style the Journal of Wildlife Management.

drought and continued habitat loss (Sullivan et al. 2000). In 1995, the U.S. Fish and Wildlife Service was petitioned to list the lesser prairie chicken as threatened under the Endangered Species Act, and in 1998 a “warranted but precluded” listing was given (Federal Register 1998).

Previous research on lesser prairie chickens in Texas has occurred primarily in the shinnery oak (*Quercus harvardii*; plant names follow Correll and Johnston 1970) rangelands of the southwestern Texas Panhandle (e.g., Crawford and Bolen 1976, Haukos and Smith 1989, Haukos et al. 1990, Olawsky and Smith 1991). No telemetry-based studies have been conducted in the Rolling Plains region of the Texas Panhandle. However, from 1940 through the 1960s, Jackson and DeArment (1963) evaluated ranges, movements, and breeding success in Hemphill and Wheeler counties through general observation.

STUDY AREAS

Field research was conducted in the northeastern portion of the Rolling Plains ecoregion (Gould 1962) of the Texas Panhandle (Fig. 1.1) in portions of Hemphill, Lipscomb, and Wheeler counties. The Rolling Plains has an elevation ranging from 242–909 m (Gould 1962). The average annual temperature was 16.9 C, and the average annual rainfall was 55.7 cm.

In 2001, study areas were located in portions of Hemphill (Study Area I) and Wheeler (Study Area II) counties. In 2002, Study Area I was expanded to include the southern portion of Lipscomb County, Texas. Primary land uses at both study areas were ranching and natural gas extraction. Both study areas were located in native

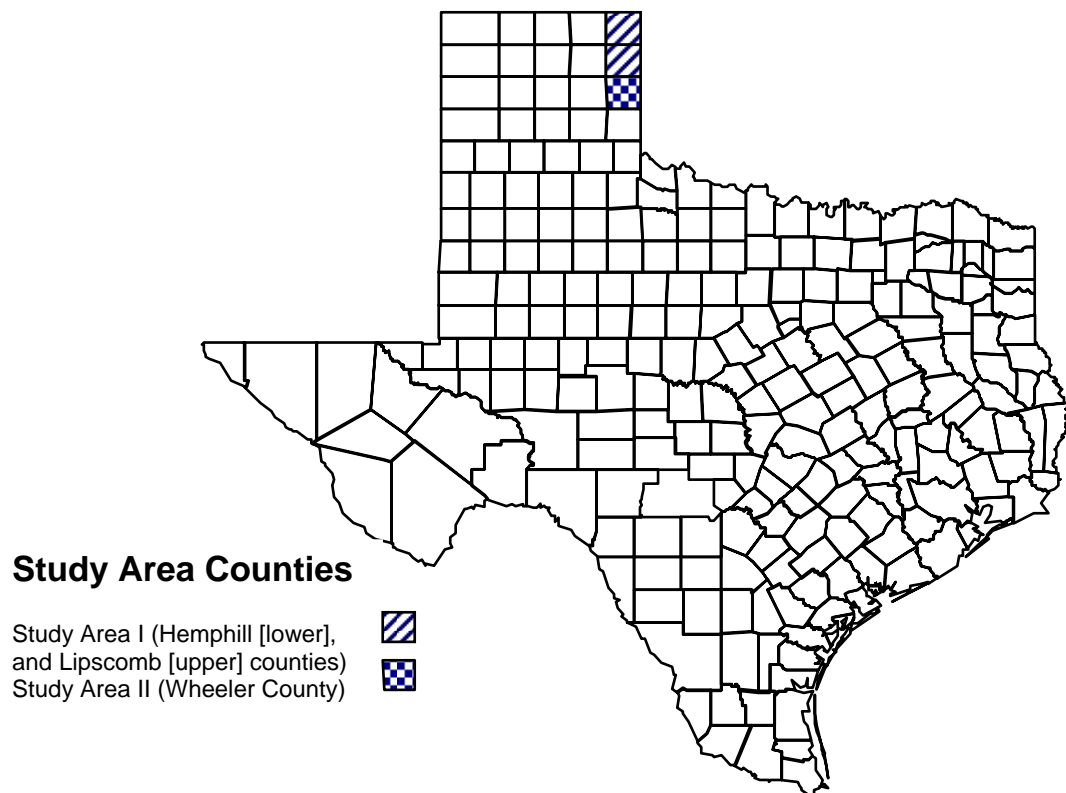


Figure 1.1. Counties in the Rolling Plains of Texas where study areas were located, 2001–2003.

rangelands with different woody species, but contained similar grass and forb associations as described by Jackson and DeArment (1963). Topography of the 2 study areas varied from flat to gently rolling with some upland dunes and stabilized hummocks. Study Area I consisted of 2 soil associations: Tivoli-Springer and Dalhart-Dumas-Springer. The Tivoli-Springer association, the most prevalent, contained deep, loose, sandy soils on upland dunes and hummocks (Jackson and DeArment 1963). The Dalhart-Dumas-Springer association contained deep, loamy level-sloping soils on

uplands. Study Area II consisted of 4 soil associations: Pratt-Delwin, Grandfield-Devol, Devol-Tivoli, and Grandfield-Hardeman (Jackson and DeArment 1963). The Pratt-Delwin association was the most prevalent and contained deep to shallow, gently sloping, and rolling silt loams. The Grandfield-Devol association contained deep, nearly level-gently sloping loamy fine sands. The Devol-Tivoli association contained deep, gently sloping-steep loamy fine sands. The Grandfield-Hardeman association contained deep, nearly level-sloping fine sandy loams.

Study Area I was dominated by grass species including little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), switchgrass (*Panicum virgatum*), Indian grass (*Sorghastrum nutans*), sand lovegrass (*Eragrostis tichodes*), sand dropseed (*Sporobolus cryptandrus*), fringeleaf paspalum (*Paspalum ciliatifolium*). Areas with more clay soils supported buffalograss (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*). Common forbs included camphorweed (*Heterotheca pilosa*), Texas croton (*Croton texensis*), western ragweed (*Ambrosia psilostachya*), and queensdelight (*Stillingia sylvatica*). Dominate woody plants on Study Area I were sand sage (*Artemisia filifolia*), with lesser amounts of Chickasaw plum (*Prunus angustifolia*) and fragrant sumac (*Rhus aromatica*), whereas Study Area II was dominated by shinnery oak with lesser amounts of the grasses named above.

Study Area I consisted of 3 ranches totaling 13,553 ha in portion of Hemphill and Lipscomb counties, Texas. Native grass pasture ranching was the dominant agricultural land use in this study area. All properties in Study Area I consisted of little-bluestem, sand sage-dominated rangelands, with lesser amounts of fragrant sumac and

Chickasaw plum. The largest property (8,491 ha), constituted the southern portion of Study Area I and was located in Hemphill County on a private ranch 14 km northeast of Canadian, Texas. Grazing pressure was moderate, though grazing pressure on adjacent properties varied from light to heavy. A steer-stocker operation was used on-site. Adjacent properties used both cow-calf, and steer-stocker operations. A residential structure was located on the property. Extensive natural gas development and infrastructure, in the form of roads, occurred on the study area and surrounding properties. No crop production occurred on the property or on adjacent properties.

In 2002, Study Area I was expanded by 5,061 ha to include 2 additional ranches located in Lipscomb County, Texas. One ranch (northern) was 2,308 ha in size and located 2.4 km west of Higgins, Texas. This location received moderate to heavy grazing pressure from a rotational cow-calf grazing regime. Minimal natural gas infrastructure occurred on-site and on adjoining properties. No crop production occurred on the property, but center-pivot wheat production was located on adjoining properties to the southwest and west. The second property was 2,752 ha in size and located along the boundary of Hemphill and Lipscomb counties approximately 7.9 km west of Higgins, Texas. On-site grazing pressure during 2002 and 2003 was moderate to moderately heavy and adjacent properties were moderately grazed. A continuous cow-calf operation was used on-site and on most adjoining properties. Minimal natural gas infrastructure and road development occurred on-site and on adjoining properties.

Study area II (8,129 ha) consisted of a single ranch in Wheeler County, Texas, approximately 5 km south of Allison. Since 1900, the ranch has been used for cattle

production, and since the 1970s for natural gas extraction. Surrounding land use included ranching and farming operations, though farming was historically more prominent up to the 1970s. Several nearby fields were enrolled in the conservation reservation program (CRP) contracts primarily planted in monoculture stands of weeping lovegrass (*Eragrostis curvula*). On-site grazing pressure was heavy, while grazing pressure on adjacent properties varied from light-heavy. A cow-calf operation was used on-site and on adjacent properties. Three active residential structures were located on the Study Area II. Extensive gas infrastructure, including roads and gas-petroleum storage tanks, occurred on the study area. Natural gas extraction was minimal on surrounding properties. No active crop production occurred on the study area or on surrounding properties. Historically, dry-land farming was prominent on most surrounding properties.

OBJECTIVES

In 2001, Texas A&M University (Toole 2005), in association with Texas Parks and Wildlife Department (TPWD), initiated a 3-year study of lesser prairie chickens in the northeastern Texas Panhandle in portions of Lipscomb, Hemphill, and Wheeler counties. Field activities began during April 2001 and concluded August 2003. The Objectives of my portion of the study were to determine lesser prairie chicken (1), seasonal survival, (2) reproduction, and (3) use of areas following wildfires.

CHAPTER II

BREEDING AND NONBREEDING SURVIVAL OF LESSER PRAIRIE

CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE

SYNOPSIS

Lesser prairie chickens (*Tympanuchus pallidicinctus*) abundance has declined throughout their range because of loss or fragmentation of habitat due primarily to conversion of native prairie to agricultural cropland and exacerbated by overgrazing and drought. I used radio-marked lesser prairie chickens to determine whether differences in survival existed between populations occurring in 2 areas dominated by different vegetation types (sand sagebrush [*Artemisia filifolia*] versus shinnery oak [*Quercus havardii*]) in the Texas Panhandle from 2001 through 2003. I used a model-selection approach to evaluate potential generalities in lesser prairie chicken survival. My results indicated survival of lesser prairie chickens differed between breeding and non-breeding periods, but not study sites. I estimated annual survival of lesser prairie chickens at 0.52 (95% CI: 0.32–0.71). Based on my results, higher mortality of birds during the breeding season illustrates the need to manage for vegetation components such as sand sagebrush and residual bunchgrasses so that potential breeding season mortality may be lessened.

INTRODUCTION

Continued declines, extirpation, and extinction of pinnated grouse (*Tympanuchus* spp.) across their historic ranges in North America have been extensively documented (e.g., Johnsgard 1983, Silvy et al. 2004, Storch 2007). Although lesser prairie chickens (*T. pallidicinctus*) inhabit rangelands in all 5 states within their historic range, they now

occupy the most restricted range (Fig. 2.1) of any North American grouse other than Gunnison's sage-grouse (*Centrocercus minimus*) (Giesen and Hagen 2005). Habitat loss in the form of range-wide land conversion from native short- and mid-grass prairies to agricultural cropland, and urban and energy development have been hypothesized as

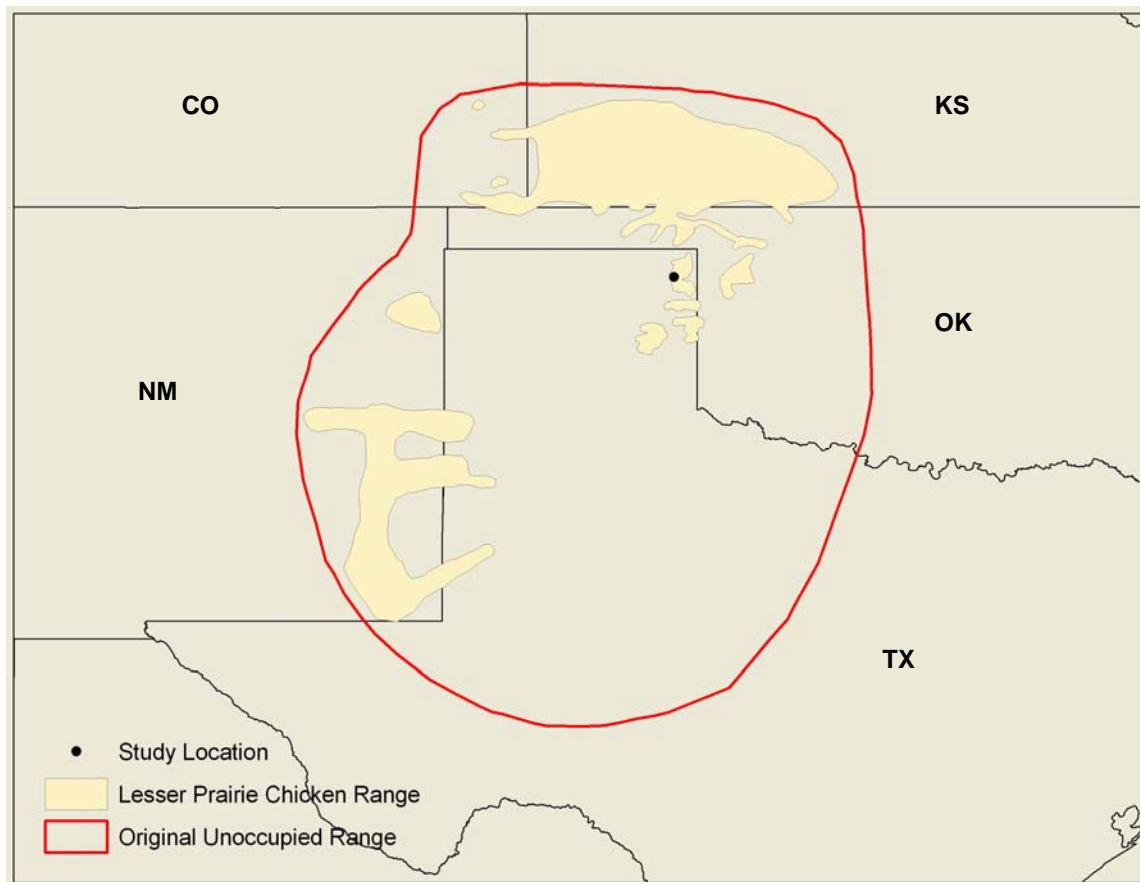


Figure 2.1. Current and unoccupied former range of lesser prairie chicken in North America.

causes of declines in lesser prairie chicken abundance (Taylor and Guthery 1980). Compounding the effects of habitat loss is fragmentation and degradation of remaining habitat by drought and overgrazing (Crawford 1980, Taylor and Guthery 1980). Many grouse populations have experienced declines and are considered at risk (14 of 18 species are red-listed in at least 1 nation; Storch 2007). Lesser prairie chickens have been classified as vulnerable by the International Union for Conservation of Nature and Natural Resources (IUCN) since 2004 (IUCN 2007) and “warranted but precluded” by the United States Fish and Wildlife Service (United States Department of the Interior, Fish and Wildlife Service 2007).

Survival estimates are important components to avian demography and are essential for grouse management (Caizergues and Ellison 1997, Hagen et al. 2007). Parental input between male and female grouse differ in promiscuous mating systems and the 2 sexes should have different survival, which may be exacerbated during the breeding compared to the non-breeding season (Bergerud and Gratson 1988). Factors contributed to declining abundance are not known with certainty, but increased mortality during the breeding season has been observed in several grouse species including lesser prairie chickens (Hannon et al. 2003, Patten et al. 2005, Hagen et al. 2007). Studies (Sell 1979, Haukos 1988, Patten et al. 2005, Pitman et al. 2006, Hagen et al. 2005, 2007) have quantified differing aspects of lesser prairie chicken survival, yet information on annual or seasonal survival of lesser prairie chickens is incomplete, as no recent studies have evaluated survival of remaining Texas populations. Because of the uncertainty surrounding lesser prairie chicken recovery, I studied survival of lesser prairie chickens

in 2 populations in the northeast Panhandle of Texas. I used radio-telemetry to (1) estimate survival of lesser prairie chicken in an area dominated by grass and in an area dominated by shinnery oak, and (2) determine whether generalizations about factors contributing to variation in lesser prairie chicken survival can be made to these 2 populations.

METHODS

Study Areas

I conducted my study from April 2001 through August 2003 in 2 areas in the northeast Texas Panhandle (Fig. 1.1). In 2001, trapping sites were located in portions of Hemphill (36°01'N, 100°11'W) and Wheeler (35°33'N, 100°06'W) counties. The Hemphill County areas had sand sagebrush (*Artemisia filifolia*), with lesser amounts of Chickasaw plum (*Prunus angustifolia*) and fragrant sumac (*Rhus aromatica*) as dominant woody plants. The Wheeler County site was dominated by shinnery oak (*Quercus havardii*). In 2002, trapping sites were expanded to include the southern portion of Lipscomb County (36°07'N, 100°03'W), Texas. Vegetation in Lipscomb County was the same as that in Hemphill County.

Environmental conditions were similar across both study regions and a severe drought occurred on both sites in 2003 (NOAA 2005). Study areas ranged from 5,000–18,000 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. Average precipitation across the regions was approximately 48 cm/year during my study (NOAA 2005).

Data Collection

I trapped lesser prairie chickens using non-explosive Silvy drop nets (Silvy et al. 1990) on leks. Birds were trapped during the breeding season from late March to 1 June from 2001 through 2003. At capture, birds were sexed and aged as juvenile or adult based on shape, wear, and coloration of the ninth and tenth primaries (Amman 1944, Copelin 1963). All birds were equipped with a numbered leg band, and fitted with a 12–15 g battery-powered, mortality-sensitive radio transmitter. Two models of necklace-style radio transmitters were used during the study; non-adjustable collar-style radio transmitters with fixed-loop antennas (Telemetry Solutions, Walnut Creek, California USA) and adjustable collar-style transmitters with whip antennas (Wildlife Materials Inc., Carbondale, Illinois USA or AVM Instrument Company, Ltd., Livermore, California, USA).

I monitored radio-marked lesser prairie chickens 3 days per week year round throughout the study using triangulation (White and Garrott 1990) or homing during random tracking periods using a vehicle mounted 5-element Yagi antenna or 3-element handheld Yagi antenna. Observations were increased to 5 times a week during the spring and early summer to estimate nest and brood success and breeding season mortality.

Statistical Analyses

I estimated survival of adult lesser prairie chickens using a staggered entry (Pollock et al. 1989), known fate design in program MARK 5.1 (White and Burnham 1999). I defined encounter occasions monthly, and based survival estimates on the best

fitting model. I estimated period survival (monthly) for radio-marked individuals beginning 20 April 2001. I used 20 April as the initial date individuals entered the survival dataset and I allowed at least 2 weeks after capture before entering individuals for analysis to ensure transmitter effects had declined (Hagen et al. 2006).

I used an information-theoretic approach to model selection (Burnham and Anderson 2002) as implemented in program MARK to evaluate factors contributing to variation in survival. When I found evidence of model selection uncertainty, I used multi-model inference and provided model-averaged estimates of survival (Burnham and Anderson 2002). I used the delta method to calculate standard errors and confidence intervals for the model-averaged annual survival estimates (Seber 1982). For each area (Hemphill/Lipscomb and Wheeler), I independently analyzed survival data using a standardized candidate model set in an effort to determine if generalities in factors contributing to variation in survival were assumable for lesser prairie chickens in different populations during different time frames.

In order to evaluate temporal variation, I divided the breeding season into segments based on reproductive phenology. I developed candidate models (Table 2.1) which evaluated variation in survival between the initial nesting and renesting periods, models that hypothesized a linear decline in survival over the breeding period, and evaluated these temporal trends both within and between years. I applied my standardized candidate set to the data collected on both sites and focused primarily on inter-annual variation. Because of my expectation of sex and site variation, I incorporated both into the best fitting model after analyzing my initial model set, in an

Table 2.1. Notation and description of models used to estimate survival of lesser prairie chickens in Texas, 2001–2003.

Model	Model notation	Model description
1	S_{SEX}	Survival differs by sex
2	S_{SITE}	Survival differs by site
3	$S_{BREED} (AMJJ; ASOCNJFM)$	Survival differs between breeding and non-breeding season, constant within each season
4	$S_{BREED} (AMJ; JASOCNJFM)$	Survival differs between early to mid-breeding season and non-breeding season, constant within each season
5	$S_{BREED} (T-AMJJ; ASOCNJFM)$	Survival varies according to linear trend during breeding season and is constant during non-breeding season
6	$S_{BREED} (AM; JJ; ASOCNJFM)$	Survival differs between early breeding, mid to late breeding, and non-breeding season, constant within each season
7	$S_{YEAR: BREED} (AMJJ; ASOCNJFM)$	Survival differs between years, between breeding and non-breeding season, constant within each year-season combination
8	$S_{YEAR: BREED} (AMJ; JASOCNJFM)$	Survival differs between years, between early to mid-breeding season and non-breeding season, constant within each year-season combination
9	$S_{YEAR: BREED} (AM; JJ; ASOCNJFM)$	Survival differs between years, between early breeding, mid to late breeding, and non-breeding season, constant within each year-season combination
10	$S_{YEAR: BREED} (AM; JJASOCNJFM)$	Survival differs between years, between early breeding, and non-breeding season, constant within each year-season combination
11	S_{YEAR}	Survival differs between years, constant within a year

attempt to optimize model selection procedures (Norman et al. 2004). However, if addition of these variables did not change $\Delta AICc \geq 2$ units, I considered that model non-competitive and focused interpretation on the best fitting model without inclusion of sex or site variation (Burnham and Anderson 2002:131).

RESULTS

I trapped and monitored 115 (66 males, 49 females) lesser prairie chickens from 2001 through 2003 (Table 2.2). I censored individuals from my analysis ($n = 18$) lost due to mortality, transmitter failure, or slipped radios (radios during 2001 with fixed loop antennas were too large and many were lost) within 2 weeks of capture.

I found evidence of model selection uncertainty, as several models in each set were viable models based on $\Delta AICc < 2$ (Table 2.3). Models which included year effects

Table 2.2. Number of lesser prairie chickens (by sex) captured and radio-marked in the Texas Panhandle, 2001–2003.

Year	Site	County	Male	Female	Total
2001	1	Hemphill	15	12	27
	2	Wheeler	12	7	19
2002	1	Hemphill, Lipscomb	19	7	26
	2	Wheeler	5	6	11
2003	1	Hemphill, Lipscomb	9	8	17
	2	Wheeler	6	9	15

had little support in my candidate model sets, which indicated that within-year variation is less relevant than between-year variation to lesser prairie chicken survival. Models that included site effects also had little support in my candidate model sets. For both study sites the best approximating models consisted of those which outlined differences between breeding and non-breeding season survival. The pattern of lower breeding

Table 2.3. Plausible candidate models^a used to estimate survival of radio-tagged lesser prairie chickens in the Texas panhandle from 2001–2003.

Model notation	-2 log likelihood	No. of parameters	ΔAIC_c	w_i
$S_{BREED} (AMJJ; ASOCNJFM)$	244.90	2	0.00	0.287
$S_{BREED} (AM; JJ; ASOCNJFM)$	244.13	3	1.25	0.154
$S_{BREED} (T-AMJJ; ASOCNJFM)$	240.19	5	1.39	0.144
$S_{BREED} (AMJ; JASOCNJFM)$	246.36	2	1.45	0.139
$S_{YEAR: BREED} (AMJJ; ASOCNJFM)$	241.12	5	2.31	0.090
S_{SEX}	248.22	2	3.31	0.055
S_{SITE}	248.43	2	3.53	0.049
S_{YEAR}	247.31	3	4.43	0.031
$S_{YEAR: BREED} (AM; JJ; ASOCNJFM)$	237.19	8	4.56	0.029
$S_{YEAR: BREED} (AM; JJASOCNJFM)$	242.65	6	5.89	0.015
$S_{YEAR: BREED} (AMJ; JASOCNJFM)$	244.29	6	7.53	0.006

^aThe lowest AIC_c value for the best fitting model was 248.929.

season survival was supported by the data collected on both sites (Table 2.3). The best fitting model was one where survival differed between breeding and non-breeding season, but was constant within each season (SBREED (AMJJ; ASOCNJFM)) with the aforementioned model (SBREED (AM; JJ; ASOCNJFM)) also being plausible (Table 2.3).

Because model (SBREED (AM; JJ; ASOCNJFM)) was one of the best 2 models for each model set, I estimated survival and associated variance measures by model averaging over parameters in this candidate model. Model averaged monthly survival was lower for both the first nest period (0.92, [$SE = 0.02$] and the renesting period 0.93 [$SE = 0.02$] than for the non-breeding period (0.96 [$SE = 0.01$]). Based on my monthly survival estimates, model averaged estimate of annual survival was 0.52 (95% CI: 0.32–0.71). Period (monthly) survival estimates indicated survival was ~4% lower during breeding than non-breeding seasons for both study sites. A period estimate of 0.92 (for the breeding season) indicated that breeding season survival for 4 months was 0.71, while a period estimate of 0.96 (for the non-breeding season) indicated that non-breeding season survival for 8 months was 0.72.

DISCUSSION

Breeding season survival of both males and females was lower compared to the non-breeding season on both study sites as an equal proportion were likely to die during the 4 month breeding season compared to the 8-month non-breeding season. Similar results were found for populations of lesser prairie chickens in New Mexico and Oklahoma as mortality of both male and females peaked during the breeding season

(Patten et al. 2005, Wolfe et al. 2007). Hagen et al. (2007) also reported higher mortality during the reproductive season (0.69 , $SE = 0.04$) compared to the non-breeding season (0.77 , $SE = 0.06$) in Kansas, and estimated that approximately 30% of all female mortalities were directly related to breeding season activities.

Other grouse species show similar trends in survival during breeding and non-breeding seasons. Populations of sharp-tailed grouse (*Tympanuchus phasianellus*), black grouse (*Tetrao tetrix*), willow ptarmigan, (*Lagopus lagopus*), sage grouse (*Centrocercus urophasianus*) and spruce grouse (*Falcapennis canadensis*) exhibited increased mortality associated with breeding season activities (Marks and Marks 1988, Boag and Schroeder 1992, Caizergues and Ellison 1997, Schroeder and Baydack 2001, Hannon et al. 2003, Leupin 2003).

Understanding the mechanisms driving survival during the breeding and non-breeding seasons is critical for lesser prairie chickens and other grouse species given the conservation status of grouse around the world (Storch 2007). The most critical component for female survival during the breeding season may be nest placement, and survival of females may be lower during the breeding season because of the costs incurred during reproduction (Bergerud and Gratson 1988, Hagen et al. 2007). The relationship between cover at nest sites and hen survival may be of importance to grouse demographics (Wiebe and Martin 1998). For males, survival may be lower during the breeding season than the non-breeding season because of increased vulnerability and conspicuousness on the display grounds (Bergerud and Gratson 1988, Hagen et al. 2005).

Hagen et al. (2007) found survival of females during the breeding season was associated with nest sites with greater shrub cover, but less vertical vegetation structure. Hagen et al. (2004) suggested that although lesser prairie chicken declines have slowed in Kansas, their continuation is probably a result of poor habitat quality and quantity. Lesser prairie chicken habitat use is selective in regard to microclimate (Patten et al. 2005), and may be detrimental to lesser prairie chicken survival if arthropod density and residual cover in the form of bunchgrasses are decreased. Restoration of current habitat or creation of patchy habitats may be essential for providing adequate habitat for lesser prairie chickens throughout the Texas Panhandle.

Annual survival estimates from my study were similar to studies in Kansas (Jamison 2000, Hagen et al. 2005, 2007), where lesser prairie chicken populations continue to occupy the majority of their historic range (Taylor and Guthery 1980, Hagen 2003). However, caution should be taken when making direct comparisons of annual survival estimates because of the variety of methods used to calculate survival estimates (Hagen et al. 2005). Increasing breeding season survival of lesser prairie chickens is important, if not imperative, to the short-term conservation and long-term recovery of lesser prairie chickens in Texas. Although nest and brood success are vital stages critical for grouse recovery (Bergerud and Gratson 1988, Peterson and Silvy 1996, Wisdom and Mills 1997), Patten et al. (2005) suggested even small declines in adult survivorship can affect nest production and ultimately population persistence. Since the majority of mortalities occurred during the breeding season, this also is likely the case in Texas. Based on my estimates of survival and given the mounting evidence of continued

population declines (Storch 2007), it is likely that current populations are not sustainable. Thus, without immediate management attention focused on large-scale habitat restoration, the future of lesser prairie chickens in Texas is bleak. Without changes in policies and attitudes towards recovery of the species by scientists and agencies (McCleery et al. 2007), the lesser prairie chicken will continue towards extinction in Texas.

CHAPTER III

REPRODUCTIVE SUCCESS OF LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE

SYNOPSIS

Declines in lesser prairie chicken (*Tympanuchus pallidicinctus*) abundance have been attributed primarily to overgrazing and loss or fragmentation of habitat from conversion of native prairie to agricultural cropland. Loss of adequate vegetation for nesting and brooding of lesser prairie chickens may exacerbate population declines observed in the northeastern Texas Panhandle. Radio-marked lesser prairie chickens were monitored in the northeastern Texas Panhandle from 2001 through 2003 to determine if nest success of lesser prairie chicken populations differed in areas dominated by sand sagebrush (*Artemisia filifolia*) versus shinnery oak (*Quercus havardii*). I used a model-selection approach in to evaluate hypotheses explaining differences in nest success of lesser prairie chickens. Nest success was lower in the shinnery oak study site (41%, 95% *CI* = 25–56%) compared to the sand sagebrush study site (75%, 95% *CI* = 54–96%). Results suggest that vegetation types affect nest success of lesser prairie chickens in Texas and further research is needed to determine which micro-habitat variables within these vegetation types reflect these differences.

INTRODUCTION

Pinnated grouse (*Tympanuchus* ssp.) abundance has 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

chickens (*T. cupido*), and lesser prairie chickens 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 limited range, relatively small population size, and continued declines, the lesser prairie chicken was listed as a candidate species (Federal Register 1998, 50 CFR 17) in 1998 by the United States Fish and Wildlife Service, and placed on the International Union for Conservation of Nature and Natural Resources (IUCN) red list in 2004 (IUCN 2004). Declines in lesser prairie chicken abundance have been attributed to habitat loss or fragmentation, overgrazing, and land conversion from rangelands to agricultural cropland (Crawford 1980, Taylor and Guthery 1980).

Historically, lesser prairie chickens occupied rangelands throughout the Texas panhandle (Oberholser 1974, Litton et al. 1994). Changing land use practices forced lesser prairie chickens into marginal range conditions dominated by woody species such as shinnery oak resulting in small isolated populations (McCleery et al. 2007). They now exist as 2 disjunct populations in portions of ~11 counties with the majority of birds located in the northeastern portion of the Texas panhandle in rangelands dominated by sand sagebrush and bunchgrasses, and a smaller population inhabiting shinnery oak rangelands of the southwestern panhandle (Taylor and Guthery 1980, Sullivan et al. 2000, Silvy et al. 2004).

Numerous studies have documented nest success of lesser prairie chickens across their range and in varying habitats (Riley et al. 1992 [New Mexico], Giesen 1994 [Colorado], Patten et al. 2005 [New Mexico and Oklahoma], Pitman et al. 2006

[Kansas]); however, no recent studies have evaluated nest success of lesser prairie chickens in the 2 remaining populations in Texas. Because of uncertainty surrounding lesser prairie chicken recovery, studies were initiated to determine if nest success differed between populations in sand sagebrush versus shinnery oak vegetation types. The goals of this study were to (1) estimate nest success in different regions of the Texas Panhandle, and (2) determine what vegetation components may influence nest success in lesser prairie chicken populations.

METHODS

Study Area

Field research was conducted from 2001 through 2003 in the northeastern portion of the Rolling Plains ecoregion (Gould 1962) of the Texas Panhandle in portions of Lipscomb, Hemphill, and Wheeler counties. The northeastern region consisted of 2 study areas. Study area I was dominated by sand sagebrush with lesser amounts of Chickasaw plum (*Prunus angustifolia*) and fragrant sumac (*Rhus aromatica*), whereas study area II was dominated by shinnery oak.

All sites contained similar grass and forb associations as described by Jackson and DeArment (1963). Common herbaceous species included little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), sand bluestem (*Andropogon hallii*), sand lovegrass (*Eragrostis tichodes*), sand dropseed (*Sporobolus cryptandrus*), and three-awn (*Aristida* sp.). Common forbs included camphorweed (*Heterotheca pilosa*), Texas croton (*Croton texensis*), western ragweed (*Ambrosia psilostachya*), and queensdelight (*Stillingia sylvatica*).

Data Collection

Lesser prairie chickens were captured 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 from 2001 through 2007. At capture, I aged birds as yearling or adult based on shape, wear, and coloration of the ninth and tenth primaries (Amman 1944, Copelin 1963). I equipped each hen with a numbered leg band, and a 12–15 g battery-powered, mortality-sensitive radio transmitter. Two models of necklace-style radio transmitters were used during the study; non-adjustable collar-style radio transmitters with fixed-loop antennas (Telemetry Solutions, Walnut Creek, California USA) and adjustable collar-style transmitters with whip antennas (Wildlife Materials Inc., Carbondale, Illinois USA).

Lesser prairie chickens were monitored 3 days per week throughout the study using a vehicle mounted 5-element Yagi antenna. Observations were increased to 5 times a week during the spring and early summer to estimate nest success. Nests were located by “walk-ins” using a 3-element handheld Yagi antenna after hen locations remained unchanged for approximately 3 days. I determined clutch size if the hen flushed off the nest. Hens were not unnecessarily flushed to obtain data on clutch size. I marked each nest by geo-referencing (GPS), and nest sites were not visited again until movements indicated that a hen left a nest. I relocated nests and determined fate as abandoned, destroyed, or hatched. At each nest, I determined plant species and vegetation height. I used a range pole (Robel et al. 1970), demarked at 10-cm (1-dm) intervals, to estimate obstruction of vision (OV) at each nest site. I recorded 4 OV measurements at cardinal directions (0^0 , 90^0 , 180^0 , and 270^0) at each nest (Robel et al.

1970) and calculated a mean OV for each nest. I also selected a random point for each nest site using a random direction (0^0 , 45^0 , 90^0 , 135^0 , 180^0 , 225^0 , 270^0 , or 315^0) and a random distance (100, 200, 300, 400, or 500m) and repeated OV measurements as run at nest sites.

Statistical Analysis

I used a 2 sample *t*-test to determine if significance ($P \leq 0.05$) difference existed between mean vegetation heights or mean OV measurements at successful and unsuccessful nests and between sites. I used a Chi-square test to determine if there was significance ($P \leq 0.05$) relationship between age of hen and nest success.

RESULTS

I trapped 49 females (27 in sand sagebrush and 22 in shinnery oak vegetation types) over the course of the study. I located 21 nests of which 14 (67%) nests were successful (Table 3.1). Only 2 of 5 (40%) nests located in the shinnery oak vegetation type were successful, whereas 12 of 16 (75%) nests that were located in sand sagebrush vegetation type were successful. Nests located in sand sagebrush ($\bar{x} = 3.8$, $SE = 0.3$) had significantly ($t = 3.17$, $P = 0.008$) more cover (OV) than did nests located in shinnery oak ($\bar{x} = 2.7$, $SE = 0.3$). However, there was no difference ($t = 0.63$, $P = 0.549$) in cover at random points in the sand sagebrush ($\bar{x} = 2.2$, $SE = 0.3$) or shinnery oak ($\bar{x} = 1.8$, $SE = 0.5$) vegetation types. Plant height was similar ($t = 1.73$, $P = 0.110$) for nests located in sand sagebrush ($\bar{x} = 54.4$, $SE = 4.8$) and shinnery oak ($\bar{x} = 42.8$, $SE = 4.7$).

In both the sand sagebrush and shinnery oak vegetation types, all successful and unsuccessful nests were located in little bluestem clumps (Table 3.1). Also, nest sites (\bar{x}

= 3.5, $SE = 0.23$) had significantly ($t = 5.49$, $P < 0.001$) more cover (OV) than did paired random sites ($\bar{x} = 2.1$, $SE = 0.24$). Only 1 of 5 adult hens was a successful nester, whereas 13 of 16 juvenile hens were successful nesters. There was no difference ($t = -1.50$, $P = 0.161$) in mean OV at successful ($\bar{x} = 3.8$, $SE = 2.9$) and unsuccessful ($\bar{x} = 3.1$,

Table 3.1. Year, site (1 = sand sagebrush, 2 = shinnery oak), nest fate (1 = successful, 0 = unsuccessful), age of hen, dominant plant species at nest, mean obstruction of vision at nest, and plant height at nest.

Year	Site	Fate	Age	Cover species	OV at nest bowl	Plant height	OV at random point
2001	1	1	juvenile	little bluestem	2.6	48.0	2.5
2001	1	1	juvenile	little bluestem	4.9	55.0	1.8
2001	1	1	juvenile	little bluestem	4.4	88.0	1.1
2001	1	1	juvenile	little bluestem	4.5	78.0	1.9
2001	1	0	adult	little bluestem	2.3	77.0	1.6
2001	1	1	adult	little bluestem	3.8	43.0	4.1
2001	1	1	juvenile	little bluestem	5.5	31.0	4.8
2001	2	0	juvenile	little bluestem	2.3	32.0	1.9
2002	1	0	adult	little bluestem	2.9	53.0	2.9
2002	1	1	juvenile	little bluestem	2.5	44.0	2.0
2002	1	0	adult	little bluestem	3.9	43.0	1.8
2002	1	1	juvenile	little bluestem	3.4	36.0	0.5
2002	2	1	juvenile	little bluestem	2.5	40.0	0.5
2002	2	0	juvenile	little bluestem	2.0	38.0	0.8
2003	1	0	juvenile	little bluestem	4.9	42.0	1.1
2003	1	1	juvenile	little bluestem	4.6	68.0	2.4
2003	1	1	juvenile	little bluestem	4.4	34.0	2.3
2003	1	1	juvenile	little bluestem	3.6	43.0	2.3
2003	1	1	juvenile	little bluestem	2.6	87.0	1.3
2003	2	0	adult	little bluestem	3.1	60.0	3.3
2003	2	1	juvenile	little bluestem	3.4	44.0	2.4

$SE = 3.9$) nests, and there was no difference ($t = -0.45$, $P = 0.660$) in vegetation height at successful ($\bar{x} = 52.5$, $SE = 5.2$) and unsuccessful ($\bar{x} = 49.3$, $SE = 5.8$) nests. Overall chick survival to 54 days was 44%.

DISCUSSION

My results indicated differences between sand sagebrush and shinnery oak vegetation types were important for successful nests of lesser prairie chickens. Differences in nest success were related to differences in vegetation type, with higher nest success in the sand sagebrush vegetation type compared to the shinnery oak. This demonstrated the sand sagebrush vegetation type provided more of the requirements necessary for successful nests. Although cover (OV) was similar in both vegetation types, nest sites in the sand sagebrush vegetation type had more cover than did nest sites in the shinnery oak vegetation type. In similar habitat in Texas, Sell (1979) found lesser prairie chickens preferred sand sagebrush for nest concealment and recommended that nesting cover in the form of sand sagebrush and residual cover be provided.

Because all nests found during the study were in little bluestem clumps, and there was no difference in cover or height of vegetation at successful and unsuccessful nests, it appears there were sufficient little bluestem clumps for nesting hens in both vegetation types. However, because nests in sand sagebrush had more cover and were more successful than nests in shinnery oak, little bluestem clumps in the shinnery oak vegetation type may have provided insufficient cover from nest predators.

Nest success of lesser prairie chickens during this study was higher (67%) than estimates from studies on lesser prairie chickens in other states throughout their range

(Merchant 1982 [27%], Riley et al. 1992 [28%], Patten et al. 2005 [41%], Pitman et al. 2006, [26%]). Giesen and Hagen (2005) estimated nest success of lesser prairie chickens at 28% from 10 studies throughout their range, although they cautioned that results may be negatively influenced by observer disturbance. Observer disturbance was not considered a factor in my study as most birds were not flushed off their nests and nests were not visited a second time until nest fate was determined.

The fact that juvenile hens had greater nest success than adult hens was surprising as conventional wisdom would suggest that adult hens through experience should have greater nest success. However, Pittman (2003) working in Kansas found a similar trend with juvenile hens having greater success.

Although the mechanisms responsible for lesser prairie chicken decline are not understood, previous literature on other grouse species has shown nest success followed by chick success as the most significant factors influencing grouse population numbers (Bergerud and Gratson 1988, Peterson and Silvy 1996, Wisdom and Mills 1997). Adequate habitat for nesting is probably the mitigating factor in determining nest success of lesser prairie chickens, and improvements in habitat quality and quantity to provide sufficient cover and reduce predation are necessary for management of lesser prairie chickens in Texas (Kirsch 1974, Hagen et al. 2004). The success of lesser prairie chicken nests point to the importance of vegetative cover (Haukos and Smith 1989), and habitat management studies in the form of providing essential nesting cover are needed. These results suggest vegetation types affect nest success of lesser prairie chickens in Texas and further research is needed to determine which micro-habitat variables within

these vegetation types reflect these differences. To increase lesser prairie chickens in Texas, I recommend managers should focus on providing conditions that maximize successful nesting such as sand sagebrush and bunchgrasses for cover requirements.

CHAPTER IV

USE OF WILDFIRE AREAS BY LESSER PRAIRIE CHICKENS IN THE NORTHEASTERN TEXAS PANHANDLE

SYNOPSIS

During fall 2001, an uncontrolled burn (45 ha) occurred (caused by a passing train) within Lipscomb County and during fall 2002, a second fire (63 ha) occurred (caused by lighting) in Hemphill County south (9.6 km) of the original fire in Lipscomb County. This provided an unexpected opportunity to evaluate post-burn habitat and its use by lesser prairie chickens (*Tympanuchus pallidicinctus*). After spring rainfall stimulated re-growth of herbaceous plants, male lesser prairie chickens moved onto burned sites, feeding on emerging forbs throughout the summer. Female lesser prairie chickens also moved broods onto burned sites during both the first and second year post-burn. Percent ground cover of woody species, grass, litter, and visual obstruction readings decreased following the fires, however, percent ground cover of forbs and bare ground increased. Burned sites had more forbs than non-burned sites and probably had more insects available which are an important food source for chicks during their first 4–5 weeks of age. By the second year post-burn, males established a display ground on one of the sites.

INTRODUCTION

Prior to the 1800's, fires were common occurrences in the Rolling Plains region of the Texas Panhandle and served as major ecological disturbances to the prairie ecosystem (Litton et al. 1994). However, disturbance was considered positive due to the

regenerative aspects fire provides grassland-dominated systems. The extent to which fires create or maintain lesser prairie chicken habitat is not fully understood. However, controlled experiments have demonstrated the capacity of fire to alter and improve rangelands, particularly in the form of brush removal and plant succession (Synder 1977, Boyd 1999, Boyd and Bidwell 2001, Hagen et al. 2004). Due to expense and difficulties associated with prescribed burns in the Texas Panhandle, minimal information regarding its affects on lesser prairie chicken habitat exists for this region of Texas.

In spring 2001, Texas A&M University initiated a radio-telemetry study to evaluate habitat use and survival of lesser prairie chickens within the Rolling Plains portion of the Texas Panhandle (Gould 1962). During fall 2001, an uncontrolled burn (45 ha) occurred within Lipscomb County, a portion of my study area where we were conducting a radio-telemetry study to evaluate the use of sand sage by lesser prairie chicken. The fire occurred (caused by sparks along railway tracks from a passing train) during an exceptionally dry period, and the resulting fire was intense and burned over 95% of standing vegetation and litter materials. This provided a unique opportunity to evaluate post-burn habitat alterations and plant succession (1 year and 2 years after burning) as potential lesser prairie chicken habitat. During fall 2002, a second fire (63 ha) occurred (caused by lighting) in Hemphill County south (9.6 km) of the original fire in Lipscomb County. This provided an additional area to evaluate post-burn habitat (1-year post burning) and its use by lesser prairie chicken. Data were collected from summer 2002 (after spring rainfalls stimulated re-growth of herbaceous plants) through June 2003.

METHODS

Study Sites

Both the Lipscomb and Hemphill sites were actively managed for cow-calf production with grazing pressure being light to moderate. Approximately 22% of the land surface on the Lipscomb County site was dominated by woody species, and about 13% of the land surface on the Hemphill County site was dominated by woody species (Table 4.1). Sand-sage (*Artemisia filifolia*) was the dominant woody species, though significant stands of plum (*Prunus* spp.) and skunk-sumac (*Rhus trilobata*) occurred throughout each site. Grasses included buffalo grass (*Buchloe dactyloides*), curly mesquite (*Hilaria belangeri*), little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), and various gramma (*Bouteloua* spp.) species. Forbs, particularly western ragweed (*Ambrosia psilostachya*), snakeweed (*Gutierrezia sarothrae*), bluestem prickly poppy (*Argemone intermedia*), and common sunflower (*Helianthus annuus*) were common throughout the site.

A non-burned site adjoining each burned rangeland site was selected as a control site for comparative vegetative analysis for both burned sites. Each burned and non-burned control site were located within 1 pasture, therefore, grazing was assumed uniform prior to burning and not a factor in vegetative comparisons.

Procedures

For the 2 burned and 2 control sites, 50 randomly selected points were generated using an extension within ArcView™ to create a point theme for each site, resulting in a total of 200 randomly selected points. This theme was overlain onto a Digital Ortho

Quadrangle (DOQ) based on 1995 aerial photography. Each generated plot contained corresponding longitudinal and latitudinal coordinates. A hand-held Global Positioning Satellite unit (Garmin 12 XL, Garmin International Inc., Olathe, Kansas) was used to locate the plot locations in the field. Lesser prairie chicken were trapped using drop nets (Silvy et al. 1990) and fitted with radio collars in springs 2001–2003 and their locations were used to provide habitat selection data relative to the burned and non-burned areas.

Vegetative characteristics were measured during summers 2002 and 2003 on the Lipscomb County sites (burned and control) and during summer 2003 on the Hemphill County sites. Plant characteristics measured at each random point were obstruction of vision (Robel et al 1970), plant height, and litter depth, and percent woody, grasses, forbs, and bare ground were measured within a 0.10-m² frame (Daubenmire 1959) at all random points. Structural measurements of vegetation at burned points and non-burned points were compared using 2-sample *t*-tests (Ott 1993).

RESULTS

Radio Telemetry

From April 2001 through June 2003, 46 female and 27 males lesser prairie chickens were trapped in Lipscomb and Hemphill counties. Twenty females and 10 males were radio-tagged in 2001 with additional birds radio-tagged each year in an effort to maintain 20 females and 10 males with radio transmitters each year.

Use of Burn Areas

After the 2002 spring rainfalls stimulated re-growth of herbaceous plants on the Lipscomb County burned site, 3 male lesser prairie chickens moved to the site, feeding

on new-emerging forbs throughout the summer. In spring 2003, males established a display site on the burned site because of the shorter vegetation of the site. A female lesser prairie chicken with a brood also used the burned site during summer 2003.

At the Hemphill County burned site, 7 lesser prairie chicken males established a display site in spring 2003. Two female lesser prairie chickens with broods used the burned site during summer 2003 as brooding areas for their chicks. Burned sites had more forbs than non-burned sites (Table 4.1).

Table 4.1. Ground coverage (%) of woody species, forbs, grass, litter, and bare ground and visual obstruction (OV) readings in lesser prairie chicken habitat, 1 and 2 years post burn (2002 and 2003).

Study site	Visual obstruction											
	Woody		Forb		Grass		Litter		Bare		OV	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Site A(2002)												
Burned	12.6	2.5	30.6	2.2	26.5	2.1	10.2	0.9	41.4	2.8	1.9	0.1
Unburned	23.7	4.0	17.9	2.0	41.6	2.6	28.8	1.9	10.7	1.8	2.9	0.3
Site A(2003)												
Burned	12.7	2.6	28.6	3.1	34.7	3.8	16.8	2.2	23.7	3.0	3.0	0.2
Unburned	21.5	3.9	19.6	2.6	40.8	3.6	25.8	2.8	12.8	2.0	3.7	0.2
Site B(2003)												
Burned	9.3	2.8	44.9	5.1	33.6	4.9	6.8	1.0	42.3	4.8	3.0	0.2
Unburned	12.9	3.7	28.3	4.1	50.7	5.7	26.8	3.3	17.8	3.8	3.5	0.2

Vegetation Comparisons

Visual obstruction data from the Robel range pole indicated burned areas were more open than were control sites (Table 4.1). In addition, during summer 2002,

vegetation on the burned site in Lipscomb County was significantly (Paired t -test, $P < 0.05$) shorter than vegetation on the non-burned site. Non-burned sites had a mean plant height of 30.2 cm while burned sites had a mean height of 20.0 cm. The fire resulted in a less above ground biomass and screening variability largely due to the elimination of woody cover (Table 4.1). As a result, the burned area was considerably more open, due to the reduction of mature woody species (12.6% on burned and 23.7% on non-burned) and grass species (26.5% on burned and 41.6% on non-burned). However, forb cover was greater (Table 4.1) on the burned areas (30.6%) than non-burned areas (17.9%). This pattern remained through summer 2003 on the Lipscomb County sites and was similar on the Hemphill County sites for summer 2003 (Table 4.1).

Significant differences were observed regarding percent bare ground between the burned and non-burned sites for both Lipscomb and Hemphill counties. The non-burn sites contained 10.7–17.8% bare ground while the burned area contained 41.4–42.3% bare ground the first summer following the burn, however, by the second summer following the burn, the amount of bare ground on the Lipscomb County burned site had decreased to 23.7% (Table 4.1).

The amount of dead litter also differed between burned and non-burned sites for both Lipscomb and Hemphill counties. Litter on burned sites ranged from 6.8–16.8%, while litter on non-burned sites ranged from 25.8–28.8%, but did increase the second summer on the Lipscomb County site (Table 4.1).

DISCUSSION

Disturbance activities reduced woody canopy coverage and leaf litter and increased the amount of bare ground, thus exposing the underlying seed bank to potential initiation during rainfall events. Sufficient rainfall typically leads to an early response in forb production and sage seedling re-sprouting, followed by a later surge in grass species if moisture persists through the summer and grazing pressure is limited. Sufficient rainfall occurred during May and June 2002 to allow forb regeneration and establishment of sand sage seedlings. It is believed that open areas created by the fire allowed for relatively fast regeneration of forb production despite limited spring rainfall in 2002. Synder (1997) also noted that forbs tended to increase following burns, however, he noted visual obstruction and canopy cover of sagebrush in Colorado were reduced and had not recovered to pre-burned levels 7 years post-burn

Although there was less sand sagebrush cover on the burned plots than on non-burned plots, there was no difference in the number of sand sagebrush plants on the 2 areas. This was due to the reestablishment of sand sagebrush seedlings within the burned plots soon after there was sufficient rainfall in May and June 2002. Visually, however, the burned sites appeared drastically different from non-burn areas because the fire removed an estimated 95% of mature sand sagebrush within the burned area.

Following the fire during fall 2001, the burned site in Lipscomb County contained little vegetative matter excluding a few patches of plum. By the beginning of spring 2002, a dense covering of late season grasses were observed at the site, and on several occasions lesser prairie chicken's were observed feeding on the early season

greens located within the burned area. Male prairie chickens also made use of burn areas for display grounds and this also was noted by Cannon and Knopf (1979). Fire and other means of disturbance led to the setback of late succession grasses and woody species. Disturbance has proven a beneficial means of increasing forb and grass production within treated areas, particularly areas with high percentages of woody species. Rangelands with high brush densities tend to displace native grass species increasing grazing pressure on remaining grasses critical for lesser prairie chicken survival. Though no one type of range condition is optimal for prairie chicken habitat, strategic disturbance activities can lead to increased habitat dispersion and diversity of available habitat types. The immediate effect of fall burns was on nesting cover as cover was reduced, however, because the burns were small this probably had little effect on my study area. Boyd (1999) and Boyd and Bidwell (2001) noted this was particularly true when the fire happened in the spring.

Because in Texas, the majority of lesser prairie chickens are found on private lands, the future of lesser prairie chicken depends on the interest and commitment of private landowners. Establishing large blocks of lesser prairie chicken habitat may not be economically feasible; as a result, optimal management activities should focus more on quality versus quantity. Maximizing habitat diversity on small pastures will require further research and refinement. Disturbances such as fire, disking, spraying, or mechanical disturbances need further exploration in order to determine proper timing and management design. This assessment of post-burn conditions has provided an initial

and important opportunity to investigate rangeland responses in the Texas Panhandle to a once common form of ecological disturbance.

CHAPTER V

SUMMARY AND CONCLUSIONS

From April 2001 through August 2003, 115 lesser prairie chickens (*Tympanuchus pallidicinctus*) were trapped and radio-tagged on 2 areas (sand sagebrush [*Artemisia filifolia*] and shinnery oak [*Quercus harvardii*]) in the northeast Texas Panhandle. I compared breeding season and non-breeding season survival of both males and females on both study sites. I also compared nest success by hen age and study site. Two uncontrolled burns during fall 2001 and fall 2002 provided an unexpected opportunity to evaluate post-burn habitat and its use by lesser prairie chickens. During the study, I found that:

1. Breeding season survival was lower than non-breeding survival on both study sites.
2. Survival was similar between study areas despite differences in trends in abundance.
3. Nest success in the sand sagebrush vegetation type was higher than in the shinnery oak type.
4. Juvenile hens had higher nest success than did adult hens.
5. After re-growth of herbaceous plants, male lesser prairie chickens quickly moved onto burned sites, feeding on emerging forbs throughout the summer.
6. Female lesser prairie chickens moved broods onto burned sites during both the first and second year post-burn, probably due to increased insect abundance.
7. Percent ground cover of woody species, grass, litter, and visual obstruction readings decreased following the fires, however, percent ground cover of forbs and bare ground increased.

8. Burned sites had more forbs than non-burned sites.
9. By the second year post-burn, males established a display ground on one of the burn sites.

LITERATURE CITED

- Amman, G. A. 1944. Determining age of pinnated and sharp-tailed grouse. *Journal of Wildlife Management* 8:170–171.
- Bergerud, A. T., and M. W. Gratson. 1988. Adaptive strategies and population ecology of northern grouse, Vol. II: theory and synthesis. University of Minnesota Press, Minneapolis, Minnesota, USA.
- Boag, D. A., and M. A. Schroeder. 1992. Spruce grouse (*Falcapennis canadensis*). Account 005 in A. Poole, and F. Gill, editors. The birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D. C., USA.
- Boyd, C. S. 1999. The effects of burning season and frequency on the vegetative character and insect abundance of sand shiner oak range in western Oklahoma. Dissertation. Oklahoma State University, Stillwater, Oklahoma, USA.
- Boyd, C. S., and T. G. Bidwell. 2001. Influence of prescribed fire on lesser prairie-chicken habitat in shinnery oak communities in western Oklahoma. *Wildlife Society Bulletin* 29:938–947.
- Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodal inference: a practical information theoretic approach. 2nd Edition Springer, New York, New York, USA.
- Caizergues, A., and L. N. Ellison. 1997. Survival of black grouse *Tetrao tetrix* in the French Alps. *Wildlife Biology* 3:177–186.

- Cannon, R. W., and F. L. Knopf. 1979. Lesser prairie-chicken responses to range fires at the booming ground. *Wildlife Society Bulletin* 71:44–46.
- Connelly, J. W., M. W. Gratson, and K. P. Reese. 1998. Sharp-tailed grouse (*Tympanuchus phasianellus*). Account 354 in A. Poole and F. Gill, editors. The birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D. C., USA.
- Copelin, F. F. 1963. The lesser prairie-chicken in Oklahoma. Oklahoma Wildlife Conservation Department Technical Bulletin 6. Oklahoma City, Oklahoma, USA.
- Correll, D. S., and M. C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas, USA.
- Crawford, J. A. 1980. Status, problems, and research needs of the lesser prairie-chickens. Pages 1–7 in P. A. Vohs Jr., and F. L. Knopf, editors. Proceedings of the Prairie Grouse Symposium, Oklahoma State University, Stillwater, Oklahoma, USA.
- Crawford, J. A., and E. G. Bolen. 1976. Fall diet of lesser prairie chickens in west Texas. *Condor* 78:142–144.
- Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. *Northwest Science* 33:43–64.
- Federal Register. 1998: Endangered and threatened wildlife and plants; 12-month finding for a petition to list the lesser prairie-chicken as threatened and designate critical habitat. *Federal Register* 63: 31400–31406.

- Giesen, K. M. 1994. Movements and nesting habitat of lesser prairie chicken hens in Colorado. *Southwestern Naturalist* 39:95–98.
- Giesen, K. M., and C. A. Hagen. 2005. The lesser 260 prairie-chicken (*Tympanuchus pallidicinctus*), revised edition. Account 364 in A. Poole and F. Gill, editors, *The birds of North America*, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D. C., USA.
- Gould, F. W. 1962. Texas plants—a checklist and ecological summary. Texas Agricultural Experiment Station, Bulletin, MS-585, College Station, Texas, USA
- Hagen, C. A. 2003. A demographic analysis of lesser prairie-chicken populations in southwestern Kansas: survival, population viability, and habitat use. Dissertation, Kansas State University, Manhattan, Kansas, USA.
- Hagen, C. A., B. E. Jamison, K. E. Giesen, and T. Z. Riley. 2004. Guidelines for managing lesser prairie-chicken populations and their habitats. *Wildlife Society Bulletin* 31:69–82.
- Hagen, C. A., J. C. Pitman, B. K. Sandercock, R. J. Robel, and R. D. Applegate. 2005. Age specific variation in apparent survival rates of male lesser prairie-chickens. *Condor* 107:77–86.
- Hagen, C. A., J. C. Pitman, B. K. Sandercock, R. J. Robel, and R. D. Applegate. 2006. Radio telemetry survival estimates of lesser prairie-chickens in Kansas: are there transmitter biases? *Wildlife Society Bulletin* 34:1064–1069.

- Hagen, C. A., J. C. Pitman, B. K. Sandercock, R. J. Robel, and R. D. Applegate. 2007. Age specific survival and probable causes of mortality in female lesser prairie-chickens. *Journal of Wildlife Management* 71:518–525.
- Hamerstrom, F. N., Jr., O. E. Mattson, and F. Hamerstrom. 1957. A guide to prairie chicken management. Wisconsin Conservation Department, Technical Bulletin 15, Madison, Wisconsin, USA.
- Hannon, S. J., R. C. Gruys, J. O. Schieck. 2003. Differential seasonal mortality of the sexes in willow ptarmigan *Lagopus lagopus* in northern British Columbia, Canada. *Wildlife Biology* 9:317–326.
- Haukos, D. A. 1988. Reproductive ecology of lesser prairie-chickens in west Texas. Thesis, Texas Tech University, Lubbock, Texas, USA.
- Haukos, D. A., and L. M. Smith. 1989. Lesser prairie-chicken nest site selection and vegetation characteristics in tebuthiuron-treated and untreated sand shinnery oak in Texas. *Great Basin Naturalist* 49:624–626.
- Haukos, D. A., L. M. Smith, and G. S. Broda. 1990. Spring trapping of lesser prairie-chickens. *Journal Field Ornithology* 61:20-25.
- IUCN 2007. 2007 IUCN Red List of Threatened Species. www.iucnredlist.org. Accessed 15 November 2005.
- Jackson, A. S., and R. DeArment. 1963. The lesser prairie-chicken in the Texas Panhandle. *Journal of Wildlife Management* 27:733–737.

- Jamison, B. E. 2000. Lesser prairie-chicken chick survival, adult survival, and habitat selection and movements in fragmented rangelands of southwestern Kansas. Thesis, Kansas State University, Manhattan, Kansas, USA.
- Johnsgard, P. A. 1983. The grouse of the world. University of Nebraska Press, Lincoln, Nebraska, USA.
- Lehmann, V. W. 1941. Attwater's prairie chicken, its life history and management. U.S. Fish and Wildlife Service, North American Fauna Series 57, Washington, D.C. USA.
- Leupin, E. E. 2003. Status of the sharp-tailed grouse (*Tympanuchus phasianellus*) in British Columbia. Wildlife Bulletin No. B-104, British Columbia Ministry of Sustainable Resource Management, Conservation Data Centre, and British Columbia Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, British Columbia, Canada.
- Litton, G. W. 1978. The lesser prairie chicken and its management in Texas. Booklet 7000-025, Texas Parks and Wildlife Department, Austin, Texas, USA.
- Litton, G. W, R. L. West, D. F. Dvorak, and G. T. Miller. 1994. The lesser prairie chicken and its management in Texas. Booklet 7100-025, Texas Parks and Wildlife Department, Austin, Texas, USA.
- Marks, J. S., and V. S. Marks. 1988. Winter habitat use by Columbian sharp-tailed grouse in western Idaho. *Journal of Wildlife Management* 52:743–746.
- McCleery, R.A., R. R. Lopez, and N. J. Silvy. 2007. Transferring research to endangered species management. *Journal of Wildlife Management* 71:2134–2141.

- Merchant, S. S. 1982. Habitat-use, reproductive success, and survival of female lesser prairie-chickens in two years of contrasting weather. Thesis, New Mexico State University, Las Cruces, New Mexico, USA.
- [NOAA] National Oceanic and Atmospheric Administration. 2005. Nov 15. - NOAA home page. <http://www.noaa.gov/>. Accessed 15 November 2005.
- Norman, G. W., M. M. Conner, J. C. Pack, and G. C. White. 2004. Effects of fall hunting on survival of male wild turkeys in Virginia and West Virginia. *Journal of Wildlife Management* 68:393–404.
- Oberholser, H. C. 1974. The bird life of Texas. University of Texas, Austin, Texas, USA
- Olawsky, C. D., and L. M. Smith. 1991. Lesser prairie chicken densities on tebuthiuron treated and untreated sand shinnery oak rangelands. *Journal of Range Management* 44:364–368.
- Ott, R. L. 1993. An introduction to statistical methods and data analysis. Duxbury Press, Belmont, California, USA.
- Patten, M. A., D. H. Wolfe, E. Shochat, and S. K. Sherrod. 2005. Effects of microhabitat and microclimate on adult survivorship of the lesser prairie-chicken. *Journal Wildlife Management* 36:1270–1278.
- Peterson, M. J., and N. J. Silvy. 1996. Reproductive stages limiting productivity of the endangered Attwater's prairie-chicken. *Conservation Biology* 4:1264–1276.

- Pitman, J. C. 2003. Lesser prairie-chicken nest site selection and nest success, juvenile gender determination and growth, and juvenile survival and dispersal in southwestern Kansas. Thesis, Kansas State University, Manhattan, Kansas, USA.
- Pitman, J. C., C. A. Hagen, B. E. Jamison, R. J. Robel, T. M. Loughin, and R. D. Applegate. 2006. Survival of juvenile lesser prairie-chickens in Kansas. *Wildlife Society Bulletin* 34:675–981.
- Pollock, K. H., S. R. Winterstein, C. M. Bunck, and P. D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. *Journal of Wildlife Management* 53:7–15.
- Riley, T. Z., C. A. Davis, M. Ortiz, and M. J. Wisdom. 1992. Vegetative characteristics of successful and unsuccessful nests of lesser prairie chickens. *Journal of Wildlife Management* 56:383–387.
- Robel, R. J., J. N. Briggs, A. D. Dayton, and L. C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. *Journal of Range Management* 23:295–297.
- Schroeder, M. A., and R. K. Baydack. 2001. Predation and the management of prairie grouse. *Wildlife Society Bulletin* 29:24–32.
- Schroeder, M. A. and L. A. Robb. 1993. Greater prairie-chicken (*Tympanuchus cupido*). Account 036 in A. Poole and F. Gill, editors. *The birds of North America*, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D. C., USA.

- Seber, G. A. F. 1982. The estimation of animal abundance. Second Edition. Griffin, London, England, UK.
- Sell, D. L. 1979. Spring and summer movements and habitat use by lesser prairie-chicken females in Yoakum County, Texas. Thesis, Texas Tech University, Lubbock, Texas, USA.
- Silvy, N. J., M. E. Morrow, E. Shanley, Jr., and R. D. Slack. 1990. An improved drop net for capturing wildlife. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 44:374–378.
- Silvy, N. J., and C. A. Hagen. 2004. Introduction: management of imperiled prairie grouse species and their habitat. Wildlife Society Bulletin 32:2–5.
- Silvy, N. J., M. J. Peterson, and R. R. Lopez. 2004. The cause of the decline of pinnated grouse: the Texas example. Wildlife Society Bulletin 32:16–21.
- Storch, I. 2007: Conservation status of grouse worldwide: an update. Wildlife Biology 13(Suppl. 1):5–12.
- Sullivan, R. M., J. P. Hughes, and J. E. Lionberger. 2000. Review of the historical and present status of the lesser prairie-chicken (*Tympanuchus pallidicinctus*) in Texas. Prairie Naturalist 32:177–188.
- Synder, W. D. 1977. Sandsage-bluestem prairie renovation to benefit prairie grouse. Special Report No. 71. Colorado Division of Wildlife, Denver, Colorado, USA.

- Taylor, M. A., and F. S. Guthery. 1980. Status, ecology, and management of the lesser prairie chicken. Forest Service General Technical Report RM77. Rocky Mountain Forest and Range Experiment Station, United States Department of Agriculture, Fort Collins, Colorado, USA.
- Toole, B. E. 2005. Survival, seasonal movements, and cover use by lesser prairie chickens in the Texas Panhandle. Thesis, Texas A&M University, College Station, Texas, USA.
- United States Department of the Interior, Fish and Wildlife Service. 2007. Endangered and threatened wildlife and plants; review of species that are candidates or proposed for listing as endangered or threatened: the lesser prairie-chicken. Federal Register 72:69060.
- White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:120–139.
- White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, California, USA.
- Wiebe, K. L., and K. Martin. 1998. Costs and benefits of nest cover for ptarmigan: changes within and among years. Animal Behaviour 56:1137–1144.
- Wisdom, M. L., and L. S. Mills. 1997. Sensitivity analysis to guide population recovery: prairie chickens as an example. Journal of Wildlife Management 61:302–312.
- Wolfe, D. H., M. A. Patten, E. Shochat, C. L. Pruett, and S. K. Sherrod. 2007. Causes and patterns of mortality in lesser prairie-chickens *Tympanuchus pallidicinctus* and implications for management. Wildlife Biology 13(Suppl. 1): 95–104.

VITA

Name: Ryan Sterling Jones

Address: 2258 TAMU, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258

Email Address: ryan.jones@mdc.mo.gov

Education: B.S., Wildlife and Fisheries Sciences, Kansas State University, 2001

M.S., Wildlife and Fisheries Sciences, Texas A&M University, 2009

Employment: Wildlife Biologist, Missouri Department of Conservation