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Source: *The Southwestern Naturalist*, Vol. 39, No. 1 (Mar., 1994), pp. 96-98

Published by: Southwestern Association of Naturalists

Stable URL: <http://www.jstor.org/stable/3672201>

Accessed: 24/02/2009 12:13

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## MOVEMENTS AND NESTING HABITAT OF LESSER PRAIRIE-CHICKEN HENS IN COLORADO

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Distribution and populations of lesser prairie-chickens (*Tympanuchus pallidicinctus*) have reportedly decreased >90% from historical levels in the 1800s (Crawford, 1980; Taylor and Guthery, 1980). This decline has been attributed to excessive grazing of rangelands by domestic livestock, brush control to increase cattle forage, and extensive conversion of native rangeland to cropland (Hamerstrom and Hamerstrom, 1961; F. F. Copelin, in litt.; Jackson and DeArment, 1963; Crawford and Bolen, 1976; Taylor and Guthery, 1980).

The amount of suitable nesting habitat appears to be a primary limiting factor for prairie-chickens (Kirsch, 1974). Previous studies of nesting lesser prairie-chickens have focused on Havard oak (*Quercus havardii*) rangeland of New Mexico (Suminski, 1977; C. A. Davis et al., in litt.; Merchant, 1982; Wilson, 1982; Riley et al., 1992), Oklahoma (Donaldson, 1969), and Texas (Sell, 1979; Haukos, 1988). Here I report on movements of lesser prairie-chicken hens from leks to nests from 1986 to 1990 in sand sagebrush (*Artemisia filifolia*) dominated rangelands in southeastern Colorado at the northern periphery of lesser prairie-chicken range and describe habitat characteristics at nest sites.

Lesser prairie-chicken hens from nine leks were studied on a 41.4-km<sup>2</sup> area on the Comanche National Grasslands (Pike-San Isabel National Forest) and adjacent private rangelands in Baca County, southeastern Colorado (37°3'N, 102°21'W). Average lek density from 1986 to 1990 was  $0.18 \pm 0.03$  SD leks/km<sup>2</sup> (range 0.14–0.22 leks/km<sup>2</sup>); the mean distance between a lek and its nearest neighbor was  $1.13 \pm 0.24$  km (range 0.80–1.70 km).

Rangeland vegetation was primarily sand sagebrush and mixed bunchgrasses dominated by sand dropseed (*Sporobolus cryptandrus*), red threeawn (*Aristida longisetata*), and sidecoats grama (*Bouteloua curtipendula*). Small soapweed (*Yucca glauca*) and broom snakeweed (*Gutierrezia sarothrae*) were common in some pastures. Domi-

nant forbs were western ragweed (*Ambrosia psilostachya*) and common Russianthistle (*Salsola kali*). Livestock grazing was the predominant land-use with cattle present from May through November each year. Plant nomenclature follows Scott and Wasser (1980).

Seventy-four hens were trapped on leks during April and May using funnel traps with chicken-wire leads (Toepfer et al., 1988). Solar- or battery-powered transmitters (13–26 g; <3.5% of a bird's mass) were attached by necklaces or ponchos (Amstrup, 1980) to 71 hens. Radio tracking was conducted on foot using a portable receiver and hand-held Yagi antenna to locate all hens weekly until completion of nesting or depredation. Hens were approached to within 50 m but not intentionally flushed during egg-laying and incubation. All locations were plotted on United States Geological Survey topographic maps (scale 1:24,000) and distances from lek-of-capture and nearest lek were measured to the nearest 100 m.

Canid and raptor predation resulted in mortality of 20 hens prior to incubation (nests were not located) and signals from another 20 hens were lost due to a variety of causes (additional sources of mortality, dispersal, radio loss or failure) prior to nesting. I measured vegetation at 29 nest sites after hatch or nest loss; four nests could not be relocated following nest depredation, and two re-nests were included. At each nest site I centered a 10-m north-south transect on the nest bowl and measured line-intercept (Canfield, 1941) of shrubs, forbs, grasses, and bare ground to the nearest centimeter. I recorded heights of the nearest shrub, forb, and grass, and height-density (Robel et al., 1970) at the nest bowl and every 2 m along transects. Sand sagebrush density was measured using 0.001-ha circular plots at the center (nest bowl) and each end of transects. Values presented are means  $\pm 1$  SD. Differences in movements between leks and nests and for microhabitat selection between nest bowls and their dependent 10-m nest transect were examined using *t*-tests (SAS Inc., 1988).

TABLE 1—Vegetative characteristics at 29 lesser prairie-chicken nest sites in Baca County, Colorado, 1986–1990. Asterisks signify statistical significance ( $P < 0.001$ , Student's  $t$ -test).

Characteristic	$n$	$\bar{X}$	$SD$	Range
Shrub height, cm	26 <sup>1</sup>			
Nest		47.6*	14.9	29–81
Transect		37.6*	9.7	22.7–57.2
Forb height, cm	26 <sup>1</sup>			
Nest		21.2*	11.0	5–54
Transect		15.7*	5.8	6.3–24.7
Grass height, cm	29			
Nest		36.1*	15.0	9–60
Transect		27.4*	12.5	9.3–59.0
Height-density, dm	29			
Nest		3.2*	1.5	1.0–6.5
Transect		2.0*	0.7	1.0–3.4
Sandsage density, plants/ha	29	3,471	3,439	0–12,667
Canopy cover, %	29			
Sandsage		7.2	9.4	0–36.1
Grasses		29.4	14.9	9.3–61.8
Forbs		1.4	1.5	0–6.5
Bare ground, %	29	69.5	14.3	38.2–87.7

<sup>1</sup> Shrubs and forbs were not present along 4 nest transects.

Mean distance from lek-of-capture to nest site ( $n = 31$ ) was  $1.80 \pm 1.04$  km (range 0.20–4.80 km) and was greater ( $P < 0.001$ ) than the mean distance between nests and the nearest lek ( $1.04 \pm 0.60$  km, range 0.20–2.50 km). Two renesting hens each moved 700 m from their initial nest to the site of the second nest; the lek closest to the nest was the lek-of-capture in both instances.

Mean distances moved by radio-marked hens from lek-of-capture to nest sites in Colorado was within the ranges reported elsewhere (1.2 km for 8 hens in Texas, Sell, 1979; 3.4 km for 37 hens in New Mexico, C. A. Davis et al., in litt.). Variation in lek-to-nest movements and size of hen home ranges has been attributed to both habitat characteristics and weather, with shorter movements and smaller home ranges in better quality habitats and during seasons of average or above average rainfall (Sell, 1979; Merchant, 1982). If females cluster nests around leks, or if leks are focal to female home ranges (Bradbury, 1981), then nesting areas could be identified, protected from disturbance, or enhanced through management without documenting specific nesting habitats for each population.

Most nests in Colorado ( $n = 20$ , 69.0%) were beneath shrubs, primarily sand sagebrush ( $n =$

12) and small soapweed ( $n = 6$ ), with the remainder in bunchgrasses, primarily sand dropseed ( $n = 5$ ). The tallest vegetation over nest bowls averaged  $50.7 \pm 14.7$  cm (range = 29–81 cm), with 69.0% of nests under vegetation  $\geq 40$  cm in height. Shrub, forb, and grass height, and height-density at nest bowls was greater ( $P < 0.001$ ) than along the paired dependent transects (Table 1).

Because livestock grazing is the primary use of the lesser prairie-chicken study area in southeastern Colorado, nest success may have been negatively impacted by excessive grazing. Lesser prairie-chickens typically select nesting habitats where height of residual cover is greatest (F. F. Copelin, in litt.; Haukos, 1988) or in ungrazed or lightly grazed rangeland (C. A. Davis et al., in litt.). Mean height of vegetation above nest bowls typically exceeds 50 cm (Donaldson, 1969; Suminski, 1977; Riley et al., 1992; this study) and is similar regardless of plant type (shrub or bunchgrass). In areas where livestock grazing is heavy, hens tend to nest under shrubs (Merchant, 1982; Sell, 1979; Riley et al., 1992) even though nests under shrubs are less successful than nests under bunchgrasses (Sell, 1979). Furthermore, regardless of habitat type, height and density of

vegetation at successful nests is greater than at unsuccessful nests and nesting success is inversely related to grazing pressure (C. A. Davis et al., in litt.).

Management of rangelands in southeastern Colorado should allow for sufficient residual cover of tall (>40 cm) bunchgrasses and sand sagebrush as secure nesting cover, especially within 1.8 km of lesser prairie-chicken leks. Since the average inter-lek distance in this study (1.13 km) was less than the distance from lek-of-capture to nest site (1.80 km), all rangeland occupied by lesser prairie-chickens in spring is potentially available for nesting. Livestock grazing on rangelands occupied by lesser prairie-chickens should be closely monitored because reduction in height of residual nesting cover may result in increased movements of hens and elevated nest predation.

This work was supported by the Colorado Division of Wildlife through Federal Aid in Wildlife Restoration projects W-152-R and W-167-R. The support of personnel of the Pike-San Isabel National Forest, Comanche National Grasslands is appreciated. C. E. Braun, T. D. I. Beck, T. Z. Riley, and W. D. Snyder provided critical review of this manuscript.

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