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VEGETATIVE CHARACTERISTICS OF SUCCESSFUL AND UNSUCCESSFUL NESTS OF LESSER PRAIRIE CHICKENS

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Abstract: Most descriptions of vegetation at lesser prairie chicken (*Tympanuchus pallidicinctus*) nests do not differentiate between those that are successful or unsuccessful. Consequently, we used radio telemetry and ground searching to analyze vegetative characteristics around 36 lesser prairie chicken nests in areas where vegetation was dominated by a mixture of shinnery oak (*Quercus havardii*) and grassland in eastern Chaves County, New Mexico. Female prairie chickens primarily used bluestem grasses as nesting cover. Basal composition of sand bluestem (*Andropogon hallii*) was greater ($P \leq 0.05$) around successful than unsuccessful nests. Plants at successful nests were taller ($\bar{x} = 66.6$ cm, $P < 0.02$) than those at unsuccessful nests ($\bar{x} = 34.9$ cm). Lesser prairie chicken nesting habitat could be improved in southeastern New Mexico by increasing the composition and height of sand bluestem within potential nesting habitats.

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Nesting cover is considered an important factor influencing nesting success of prairie grouse (Jones 1963, Artmann 1970, Kirsch 1974). Vegetation around nests provides concealment from predators and protects the nest from extremes in temperature, wind, and solar radiation. Loss of potential nest cover as a result of disturbances such as intensive livestock grazing or trampling presumably inhibits these functions and lowers nesting success (Jensen et al. 1990).

Because most descriptions of vegetation at lesser prairie chicken nests do not differentiate between successful and unsuccessful nests, a description of vegetation around successful nests would be of value in land management strategies. Consequently, we compared vegetative characteristics around successful and unsuccessful nests of lesser prairie chickens in southeastern New Mexico.

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STUDY AREA

The study area was approximately 15,500 ha of BLM lands in southeastern New Mexico. Topography is gently undulating to dunelike. Climate was semi-arid with distinct seasons, wide ranges of diurnal and annual temperatures, and moderately low rainfall. Nearly 75% of the annual precipitation ($\bar{x}$ = 380 mm/yr) falls during the growing season, May–October, mainly from brief but often intense thunderstorms (Maker et al. 1971).

The area was in the Southern Mixed Prairie Type, where the High Plains Bluestem Subtype graded westward into the Desert Prairie Subtype (Holechek et al. 1989:79). Most of the study area (89%) was on deep sandy soils where vegetation was dominated by various combinations of bluestem grasses and shinnery oak that characterize the High Plains Bluestem Subtype. The remaining 11% of the area was comprised of scattered inclusions of tighter soils where vegetation is dominated by short grasses, especially grama (*Bouteloua* spp.) and common buffalograss (*Buchloe dactyloides*), characteristic of the Desert Prairie Subtype. Broom snakeweed (*Xanthocephalum sarothrae*) and honey mesquite (*Prosopis glandulosa*) were conspicuous invaders of this subtype in some parts of the study area.

The High Plains Bluestem Subtype had 3 subdivisions in the study area resulting from domestic livestock grazing patterns, herein HPBS-1 (12% of study area), HPBS-2 (44%), and HPBS-3 (33%) (Riley 1978). Vegetation in HPBS-1 and 2 was dominated by grasses, especially bluestems, and secondarily by shinnery oak. Sand bluestem was the most abundant in HPBS-1 and little bluestem (*Andropogon scoparius*) in HPBS-2. HPBS-3 had grasses and shinnery oak in similar amounts, and three-awns (*Aristida* spp.) were more abundant than bluestems.

METHODS

We captured 48 female lesser prairie chickens on leks in spring 1976, 1977, and 1978 with cannon nets, rocket nets, and vertical mist nets (Davis et al. 1980). Forty-four females were radiotagged and relocated daily by use of a portable receiver and hand-held antenna. In 1976, we used a Brander harness (Brander 1968) to equip birds with battery-powered transmitters. In 1977 and 1978, solar-powered transmitters with rechargeable NiCad batteries were used with a modified Brander harness (Riley 1978). The transmitter's mass was about 20 g in 1976 and 18 g in 1977 and 1978. Nesting success (percent of nests hatching at least 1 young) was determined for 36 of 37 nests. Success for 1 nest (not associated with a radioed hen) could not be determined because we were unable to tell whether the nest had been abandoned, whether at least 1 egg had hatched, or if the nest had been destroyed by a predator.

At each nest site, we recorded the species and height of the plant providing the principal cover directly above or beside the nest. We also sampled vegetation within 3 m of each nest with line-point transects (Heady et al. 1959). These transects formed a cluster of 8 lines radiating out from the nest, with 1 line placed in each cardinal compass direction. Each line had 10 data points 0.3 m apart. The species of plant rooted nearest and ahead of each point was recorded to calculate plant composition (Levy and Madden 1933). Height of vegetation on or nearest every third data point also was measured.

We used a non-parametric test (randomization test, Snedecor and Cochran 1989:142) to compare mean composition and height of vegetation at successful versus unsuccessful nests. Chi-square tests were used to determine preference ratings (Snedecor and Cochran 1989:73). Differences were considered significant when $P < 0.05$.

RESULTS

Nest Sites

Prenesting females used HPBS-1 the most and the Desert Prairie Subtype the least (Table 1). All nests were in the High Plains Bluestem Subtype. We did not locate any nests or find any evidence of nesting activity in the Desert Prairie Subtype.

Nests were most abundant in HPBS-1, next in HPBS-2, and least in HPBS-3 (Table 1). Females used a variety of plants as nesting cover (Table 2). In HPBS-1 and 2, bluestem grasses usually provided the principal overhead cover for nests. In HPBS-3, where bluestem grasses were scarce, higher use of shrubs for overhead cover occurred.

Nesting Success

Success was determined for 36 of the 37 nests (Table 3). No attempt was made to compare

Table 1. Preference indices for relative use of High Plains Bluestem Subtype (HPBS) subdivisions and Desert Prairie Subtype (DPS) by radio-equipped prenesting and nesting female lesser prairie chickens, Chaves County, New Mexico, March–June, 1976–78.

Category	HPBS-1	HPBS-2	HPBS-3	DPS	Total
Prenesting females					
Preference index[a]	1.58	0.91	0.97	0.79	
% of observations					
Obs.	19.05	40.20	32.18	8.57	100.00
Exp.	12.04[b]	44.02	33.14	10.80	100.00
Chi-square data[c]	4.08	0.33	0.03	0.46	4.90[d]
P-value	<0.05	>0.50	>0.75	>0.25	>0.10
Nesting females					
Preference index[a]	1.80	1.17	0.50		
No. of nests					
Obs.	9.00	21.00	7.00		37.00
Exp.	5.00[b]	18.00	14.00		37.00
Chi-square data[c]	3.20	0.50	3.5		7.20[d]
P-value	<0.10	>0.25	<0.10		<0.05

[a] Observed/expected.
[b] Expected percent of observations/number of nests (prenesting/nesting females) corresponds to the percent of the study area occupied by the vegetation type or subdivision. For example, if no preference for type or subdivision occurred, only 12.04% of the observations/5 nests (13.5% of 37) should have occurred in HPBS-1 because that subdivision occupies 12.04%/13.5% of the study area/HPBS.
[c] (Obs. − Exp.)^2/Exp.
[d] For prenesting females ($\chi^2 = 4.90$, 3 df, $P > 0.10$); for nesting females ($\chi^2 = 7.20$, 2 df, $P < 0.05$). Probability of being incorrect in saying that the observed values are different from the expected values (Snedecor and Cochran 1989:73).

nest success among years because of small sample sizes within years (4 successful and 1 unsuccessful in 1976, 4 successful and 8 unsuccessful in 1977, and 2 successful and 17 unsuccessful in 1978). Most (17 of 26, 65.4%) of the unsuccessful nests were lost to predators, but a third of the unsuccessful nests were lost as a result of abandonment by the hen. Coyotes (*Canis latrans*), striped skunks (*Mephitis mephitis*), and snakes were the most commonly identified nest predators.

Nesting success was higher in HPBS-1, where 5 of 8 nests were successful, than in HPBS-2 (4 of 21), or 3 (1 of 7). Four of 6 nests in sand bluestem were successful. This is in contrast to lower success for nests in little bluestem (2 of 9), three-awn (1 of 7), sand sagebrush (*Artemisia filifolia*) (1 of 5), shinnery oak (0 of 4), and broom groundsel (*Senecio spartioides*) (0 of 2).

Table 2. Principal plant species sheltering lesser prairie chicken nests in each High Plains Bluestem Subtype (HPBS) subdivision, Chaves County, New Mexico, March–June, 1976–78.

Species	No. nests		
	HPBS-1	HPBS-2	HPBS-3
Grasses			
Andropogon hallii	4	2	0
Andropogon scoparius	3	7	0
Andropogon saccharoides	0	1	0
Aristida spp.	0	5	2
Total	7	15	2
Shrubs			
Artemisia filifolia	0	3	2
Quercus havardii	1	2	1
Yucca spp.	1	0	1
Total	2	5	4
Forbs (total)			
Senecio spartioides	0	1	1

Table 3. Number of successful and unsuccessful nests of lesser prairie chickens and causes of nest failure, Chaves County, New Mexico, March–June, 1976–78.

Fate	Nests		
	No.	% of total	% of unsuccessful
Successful	10	27.8	
Unsuccessful			
Abandoned	9	25.0	34.6
Female killed while off	1	2.8	3.9
Predation			
Coyote	3	8.3	11.5
Skunk	2	5.5	7.7
Unidentified mammal	1	2.8	3.9
Snake	6	16.6	23.0
Unknown	4	11.1	15.4
Total	26	72.2	100.0

Table 4. Mean basal composition (%) of vegetation within 3 m of successful (S) versus unsuccessful (U) lesser prairie chicken nests in High Plains Bluestem Subtype (HPBS) subdivisions, Chaves County, New Mexico, March–June, 1976–78.

Species	HPBS-1			HPBS-2			HPBS-3[a]	
	S $n = 5$	U $n = 3$	P[b]	S $n = 4$	U $n = 17$	P	S $n = 1$	U $n = 6$
Grasses								
Andropogon hallii	39.5	23.8	0.02	14.1	7.6	0.05		2.3
Andropogon scoparius	6.3	5.8	0.84	5.6	5.3	0.89		0.6
Sporobolus spp.	3.0	6.7	0.37	7.2	5.8	0.65	21.3	9.0
Aristida spp.	7.8	2.9	0.12	16.6	12.6	0.20	2.5	17.3
Others[c]	7.4	10.4		11.6	13.2			8.7
Total	64.0	49.6	0.11	55.1	44.5	0.03	23.8	37.9
Shrubs								
Quercus havardii	30.3	29.6	0.82	40.9	46.0	0.18	57.5	49.8
Others[c]	2.2	1.7		0.9	2.1		8.7	4.9
Total	32.5	31.3	0.86	41.8	48.1	0.20	66.2	54.7
Forbs (total)	3.5	19.1	0.07	3.1	7.4	0.60	10.0	7.4

[a] Statistical comparison of means not feasible due to sample size of 1 for successful nests.
[b] Probability of a larger difference occurring between sample means if true means are equal; determined by randomization test (Snedecor and Cochran 1989:142).
[c] Statistical comparison of means included in mean totals.

The 1 nest in silver bluestem (*Andropogon saccharoides*) was successful, as was 1 of 2 nests in yucca (*Yucca* spp.).

Nesting success also was related to tallgrass cover within 3 m around the nest. Sand bluestem was more abundant around successful nests than around unsuccessful nests in both HPBS-1 ($P < 0.02$) and 2 ($P < 0.05$) (Table 4). The 1 successful nest in HPBS-3 was surrounded by a heavy growth of dropseed (*Sporobolus* spp.).

Height of vegetation also affected nesting success. Plants at successful nests were taller than those at unsuccessful nests ($\bar{x} = 66.6$ cm vs. $\bar{x} = 34.9$ cm, $P < 0.02$) (Table 5). Also, vegetation within 3 m of successful nests ($\bar{x} = 30.2$ cm) was taller ($P < 0.05$) than that around unsuccessful nests ($\bar{x} = 21.8$ cm) (Table 5).

DISCUSSION

Nesting success probably was higher for lesser prairie chickens that selected sand bluestem for nest cover because it commonly formed tall, wide clumps with spreading stems that concealed nesting females from overhead and laterally. It is presumed that superior cover at and around nests provides for higher success by concealing the nests from predators. Such concealment also may contribute to a lower rate of nest abandonment by providing nesting females with a greater sense of security from predators, weather, and various disturbances. Other grasses and shrubs used as nest cover did not appear to offer as much overhead or lateral cover as sand bluestem. Areas high (>25%) in composition of tall sand bluestem also may provide relief from high temperatures, strong winds, low relative humidity, and intense solar radiation common during the nesting season in eastern New Mexico. Lack of adequate nesting habitat is a potential limiting factor for prairie chickens throughout their range (Kirsch 1974). High

Table 5. Mean height (cm) of vegetation surrounding successful (S) and unsuccessful (U) lesser prairie chicken nests in High Plains Bluestem Subtype (HPBS) subdivisions, Chaves County, New Mexico, March–June, 1976–78.

Subdivisions	No. of nests		Above nest			<3 m from nest		
	S	U	S	U	P[a]	S	U	P
HPBS-1	5	3	87.4	36.6	0.03	33.8	23.1	0.04
HPBS-2	4	17	55.9	39.5	0.05	24.5	21.4	0.34
HPBS-3	1	6	50.0	31.2	[b]	39.1	18.8	[b]
All	10	26	66.6	34.9	0.02	30.2	21.8	0.05

[a] Probability of a larger difference occurring between sample means if true means are equal; determined by randomization test (Snedecor and Cochran 1989:142).
[b] Statistical comparison not feasible due to sample size of 1 for successful nests.

quality nesting habitat for lesser prairie chickens in our study area had >25% sand bluestem.

MANAGEMENT IMPLICATIONS

Lesser prairie chickens exist in the shrub-dominated High Plains Bluestem Subtype in southeastern New Mexico by using mixed stands of tall grass and shinnery oak. To favor nesting success of this species in New Mexico, managers should increase sand bluestem cover and reduce shinnery oak. Quality nesting habitat can be maintained in semiarid grassland ranges, where brush encroachment is not a problem, by utilizing 25%–35% of the annual growth of key forage species (Holechek et al. 1989, Donart et al. 1978). Grazing utilization levels of <25% of the annual growth of key forage species (sand bluestem and little bluestem grasses on our study area) are necessary to improve nesting cover on these grasslands (J. L. Holechek, Prof. Range Science, N.M. State Univ., pers. commun.). Utilization >35% may lower nesting success by reducing composition of sand bluestem and the overall height of vegetation at nest sites (Pettit 1979). In areas where the basal composition of shinnery oak is >50%, it may be necessary to remove some of the oak before habitat improvement will occur (Haukos and Smith 1989). The average height of sand bluestem cover in areas managed for lesser prairie chicken nest habitat should be >50 cm.

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